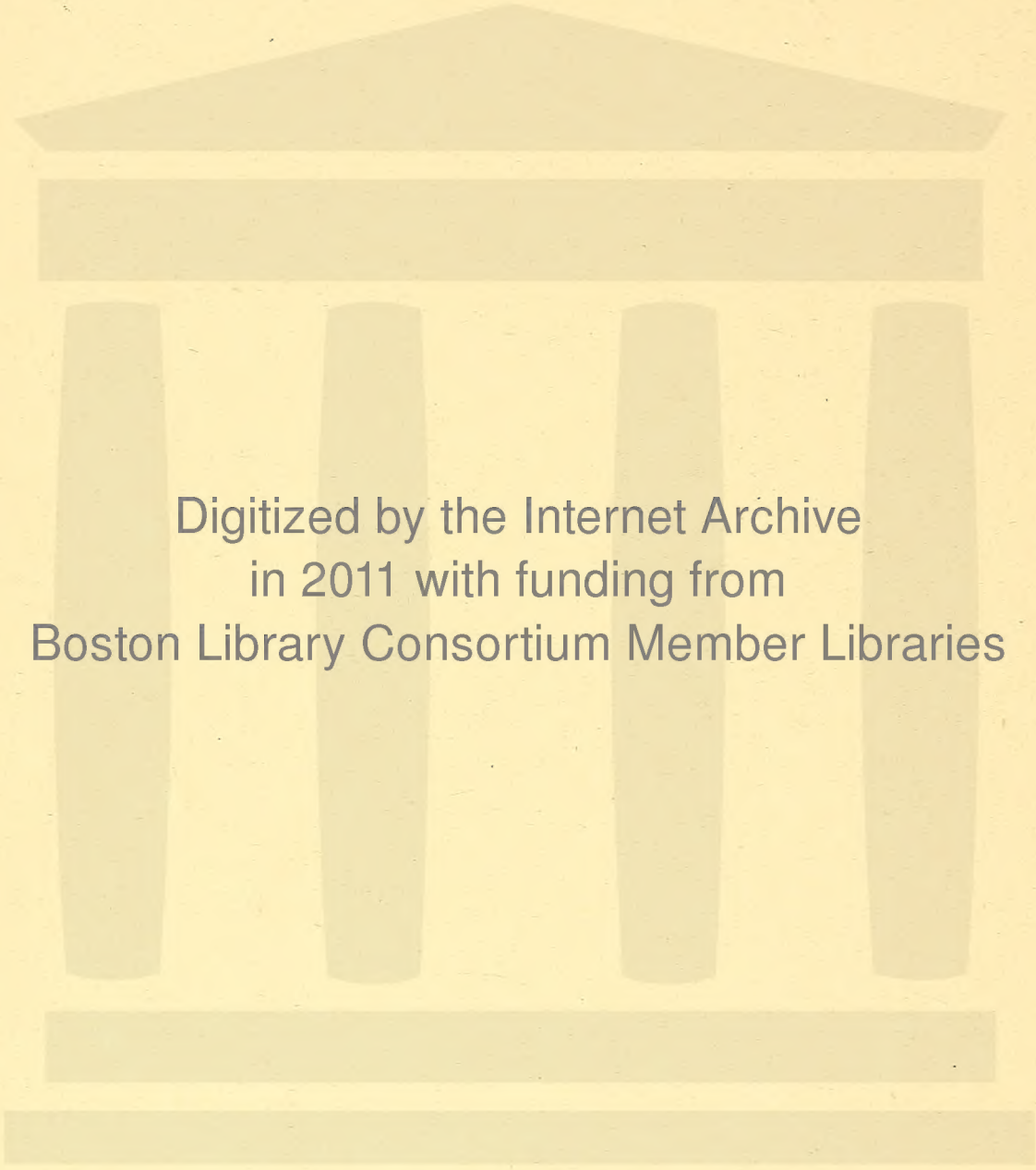
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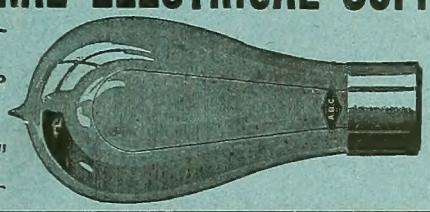

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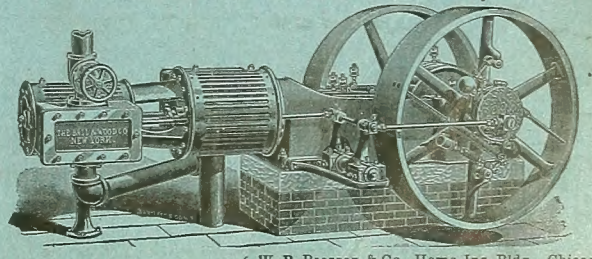

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Tapes, Insulating.
American Electrical Works.
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Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Electric Mfg. Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

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Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
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THE WESTON ELECTRICAL INSTRUMENT CO.

Are pleased to inform Electricians, Electrical Engineers and others engaged in the application of electricity to the arts, that they are now prepared to supply a really first-class, reliable and permanent Voltmeter for accurately measuring the difference of potential on *alternating current circuits.* The instrument, of which a cut is here shown, is designated

THE WESTON STANDARD

PORTABLE

Alternating and Direct Current

VOLTMETER.

It is adapted for use on *either alternating or direct current circuits* and its indications will be found perfectly accurate on either, to within one-fifth of one per cent.

It has received the most thoughtful study and every detail has been worked out with extreme care to insure great accuracy, sensibility and permanency; and no pains or expense has been spared in the effort to produce a really reliable and durable instrument for use as a standard in determining potential differences on alternating current circuits, with the widely varying rates of alternations met in practice. It has been subjected to a most exhaustive and long continued series of tests in the laboratory and has been put to practical use for a long time in order to discover any weak points, and to eliminate them before offering it for general and extensive use. We now offer it with perfect confidence and feel assured that when its good qualities become known, it will be gladly accepted as THE Standard Portable Instrument for alternating current work.

It is not made upon the "cheap and nasty plan," nor is its beautiful exterior finish and pleasing design a cloak for beastly mechanical work inside. On the contrary, all its working parts are made to gauge by the aid of special expensive tools and machines designed to produce the most accurate and uniform quality of work. The moving parts are supported on the very best sapphire jewels, highly polished, and the pivots are made of hardened steel, accurately ground to gauge and highly polished. Each instrument is carefully standardized at 20 different points on the scale and the divisions correctly marked, and each instrument after having its scale marked is again checked by comparison with an absolute standard and certified to before being sent out.

It requires only from .02 to .056 of an ampere (according to range) to cause the index to move entirely across the scale. The size of the scale is the same as that used on the well known Weston Portable Direct Current Voltmeter, and readings can be made almost as quickly as with the latter named instrument. It is practically free from errors of self induction, so much so that the eye cannot detect any difference between its readings on a direct current circuit and an alternating current, having the same potential difference, but with much higher rates of alternation than is ever met with in practical work. It is therefore correct for all the rates of alternation met with in practical work. We make a large variety of ranges to meet the requirements of all kinds of work.

WESTON ELECTRICAL INSTRUMENT CO.,

Office and Factory: 114 to 120 William Street, NEWARK, N. J.

WHAT'S THE USE OF BUYING SWITCHES?

WE ARE GIVING THEM AWAY.

READ THIS.

We will for 30 days from the date of this notice, give away ten, five ampere, or nine, ten ampere Paiste switches to any one sending us an order for one hundred dollars worth of goods, accompanied by this blank filled in and signed.

CENTRAL ELECTRIC COMPANY,

November 23, 1891. CHICAGO.

Central Electric Company,
CHICAGO.

Please send with accompanying order .....ampere Paiste switches, for which you agree to make no charge.

Signed.....

.....1891.

A DEPARTURE IN CARBONS.

We are selling MOULDED Carbons, Chicago delivery at factory prices for FORCED Carbons.

THIS IS A DEPARTURE IN THE SUPPLY BUSINESS.

EVERY CARBON GUARANTEED

For straightness, brilliancy and life. A full stock of 7-16 and ½ inch plain or coated Carbons will hereafter be kept in our Warerooms and prompt shipment assured. Save time and money by buying in Chicago instead of at the factories.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison
General
Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

For Particulars, address nearest District Office.

DISTRICT OFFICES:

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CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
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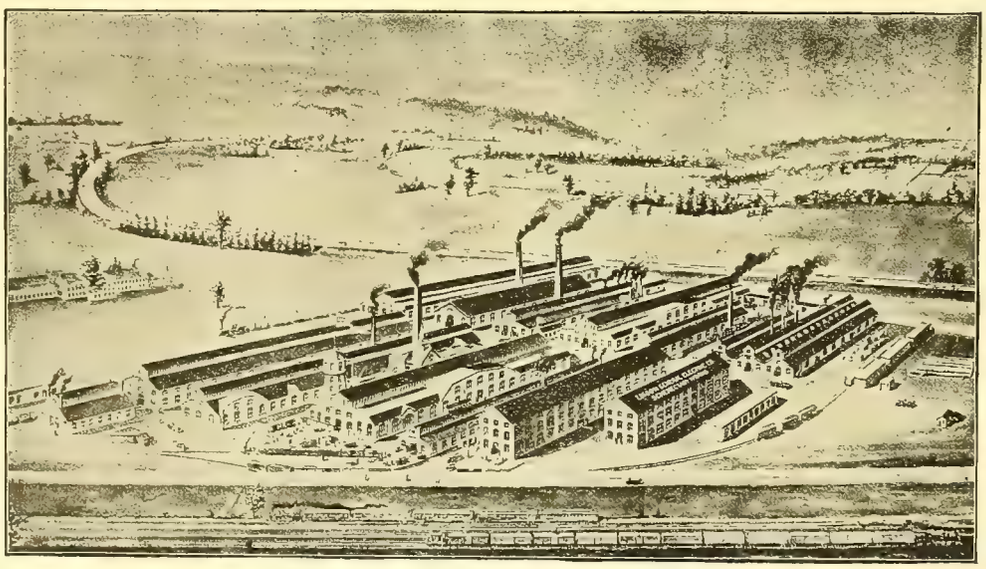
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

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Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

THE

WASHINGTON CARBON COMPANY'S

WEEKLY BULLETIN TO ITS FRIENDS.

Last week we stated that the ***Carbon Trust*** proposed to drive us out of the business by monopolizing the supply of raw material. ***To this end IT is bending all ITS energies.***

MORE ABOUT TRUST METHODS:

A representative of the ***Trust*** visited people who supply us with raw material and proposed the following:

"The Trust will buy raw material from YOU, if you will agree to charge outsiders twenty-five per cent. more than you charge the Trust."

This little scheme would have enabled the ***Trust*** to ***Advance the price of Carbons***

$2.00 PER THOUSAND,

but ***it failed.*** By ***"Outsiders" it*** meant ***The Washington Carbon Company. It is part of its creed that no one but the Trust has any right in the business.***

We are glad to be "outsiders." We propose to keep on being outsiders, for it pays, as our order books show.

We are very busy, but have time enough to keep an eye out for the ***Trust*** and have gathered much interesting matter, which we propose to deal out in weekly installments.

As we have arranged for an abundant supply of raw material, we are prepared to make contracts for carbons at fair prices for a term of years.

THE WASHINGTON CARBON COMPANY,

LOOK OUT FOR NEXT WEEK! Washington, Pennsylvania.

NOTICE.

In view of the decisions in the cases of Western Electric Mfg. Co. vs. Chicago Electric Mfg. Co., reported in 14 Federal Reporter, 691, and Western Electric Co. vs. Electrical Construction Co., et al, reported in the WESTERN ELECTRICIAN of November 21, 1891, and a large number of cases in which injunctions have been granted on the Gray Patent No. 172,993, February 1, 1876, we claim as owners of said Gray patent the exclusive right to make, use and sell, or to license others to make, use and sell, apparatus covered by the claim of said patent, which is as follows:

"The combination of a movable elevator car, the annunciator attached thereto and moving therewith, circuit closing and breaking signal keys on different floors, and mechanism whereby an electric current is maintained between the signal keys and annunciator without interruption by the movement of the car."

We have agents in all the principal cities who will install apparatus licensed by us and will guarantee the satisfactory operation of same.

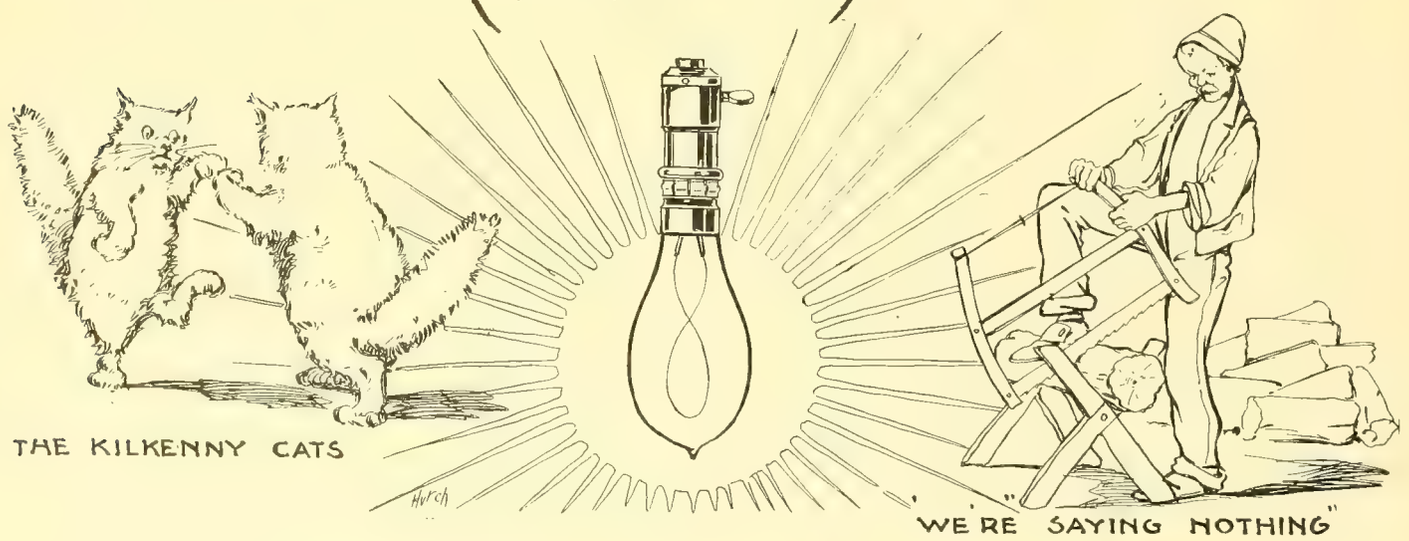
All persons are warned against making, using or selling electric elevator annunciator apparatus not licensed by us.

WESTERN ELECTRIC COMPANY,

CHICAGO and NEW YORK.

E. E. & S. Co.

(That's us)



While our worthy competitors are tearing each other to pieces — we will we are selling Packard Lamps.

THE ELECTRICAL ENGINEERING & SUPPLY Co.

931 Rookery - Chicago

ST. PAUL
DULUTH

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K. K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

SPRAGUE, DUNCAN & HUTCHINSON,
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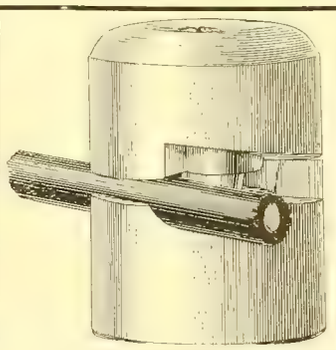
CONSULTING ELECTRICAL ENGINEERS.

15 WALL STREET, NEW YORK.



The Latest Thing in Insulators.

MANUFACTURED BY THE

Security Insulator Co.

An Insulator that is easily and quickly adjusted, and will securely clamp the wire without injury to the Insulation, thus doing away entirely with tie wires, and effecting a large saving of time and labor in wiring. Wire from $\frac{1}{8}$ to $\frac{3}{4}$ of an inch may be used, thus allowing of a variation of $\frac{1}{4}$ of an inch in size of wire. Made of the best Vitrified and Non-Absorbent Porcelain.

Write for Price and Full Particulars.

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136 Liberty St., - NEW YORK.

SUNBEAM INC. LAMP CO. SUNBEAM INCANDESCENT LAMP CHICAGO ILLINOIS U.S.A.

An Old Fact for the New Year.

The **"SUNBEAM"** consumes *less* current in proportion to the *amount of light RETURNED* than any competitive lamp in the market. Be the candle power what it may—of the lamp bought of us—we never fail to *deliver* the *light contracted* for.

THE SUNBEAM INCANDESCENT LAMP COMPANY,

805 Chamber of Commerce Building, CHICAGO, Ill.

THE RIES REGULATING SOCKET

FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

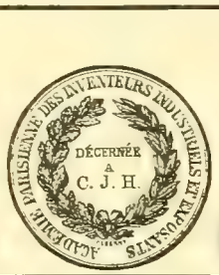
SOMETHING ENTIRELY NEW. Saves the Current, Regulates the Light. An Innovation in Electric Lighting. **SIMPLE, EFFICIENT, ECONOMICAL.**
INDORSED BY THE ELECTRICAL PRESS and prominent Electrical Engineers and Electricians.

NO RESISTANCE, OR ANY OTHER CURRENT-CONSUMING DEVICES USED.

The Price of our No. 1 Ries Regulating Socket (for lamps 16 to 25 C. P. 50 volts) is

$1.27½ { $3.00 EACH LESS 57 1-2 PER CENT. DISCOUNT. MAKING THE NET PRICE $1.27 1-2 EACH, When Ordered in Quantities. } **$1.27½**

For particulars write to
THE RIES ELECTRIC SPECIALTY COMPANY, **SOLE PATENTEES AND MANUFACTURERS,**
BALTIMORE AND EUTAW STS., BALTIMORE, MD.



HIRLIMANN BATTERIES

Are Standard. Only One that is Guaranteed.

Manufactured by **C. J. HIRLIMANN,**
117 Macdougall St., NEW YORK.

Gleason & Bailey Mfg. Co.,
(LIMITED.)

Manufacturers of, and Dealers in, a line of General

ELECTRICAL MERCHANDISE.

ALSO ELECTRIC AND COMBINATION FIXTURES AND GLASSWARE.

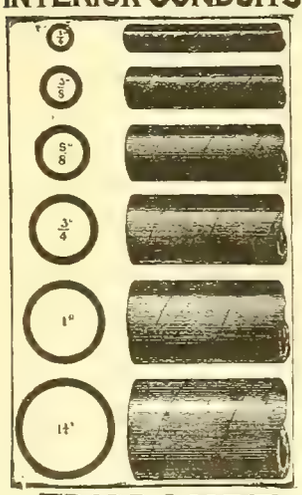
Rubber Covered Weather-Proof Wires and Lamp Cords.

233 Lake Street, CHICAGO, ILL.

It will pay you to get our prices and new catalogue.

BRANCHES: { 164 Summer St., Boston, Mass ; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa ; 60 W. Monroe St. Chicago. } **St. Louis, Mo.**

INTERIOR CONDUITS



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The Solution of the Problem of Safe Guarding
ELECTRIC CONDUCTORS
Wherever and for whatsoever purpose employed, is to be found in the
CONDUIT SYSTEM.
INTERIOR AND UNDERGROUND
CONDUITS
MANUFACTURED BY
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WORKS: { 527 to 531 W. 34th St., 526 to 528 W. 35th St.,
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CARBON
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Unsurpassed in Strength and Durability.

LIBERAL DISCOUNT TO THE TRADE.
Write for Quotations.

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45 BROADWAY. NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

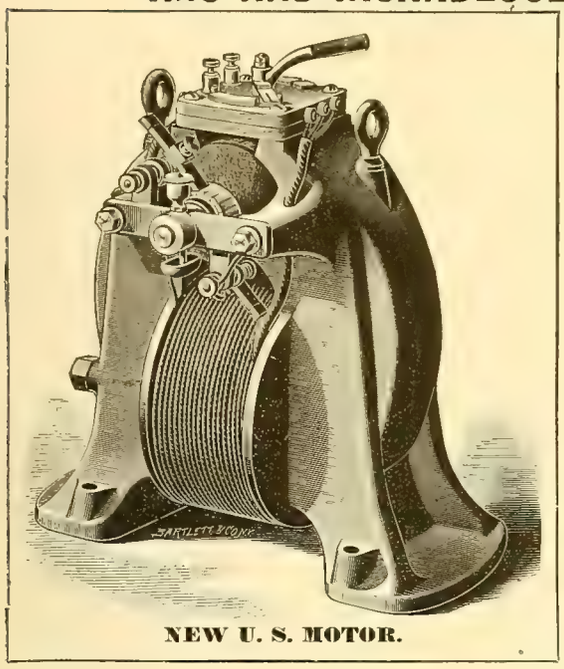
LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This System Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.)

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



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Automatic Dynamos.—Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

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Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

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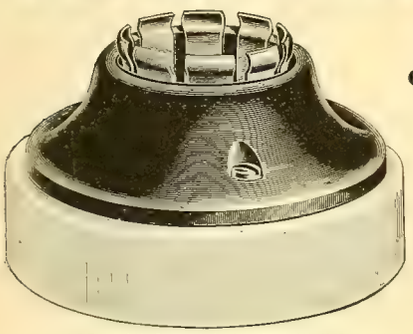

No. 135. All Porcelain Keyless Wall Socket.

BOSTON, 620 Atlantic Avenue.

NEW YORK, 510-534 West 23d Street.

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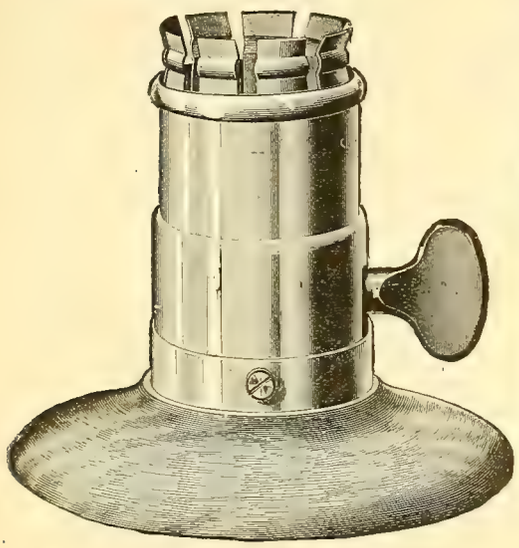
INCANDESCENT LAMPS.

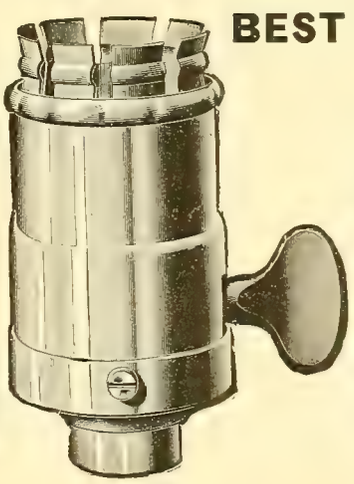
Orders Executed Correctly and Promptly.

SOCKETS.

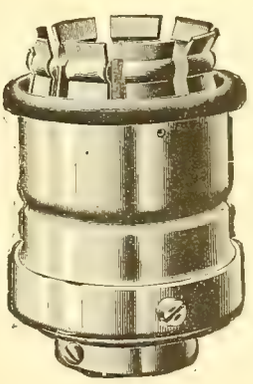
BEST AND CHEAPEST.



No. 125. Key Wall Socket—Porcelain or Wood Base.



No. 110. Key Socket.



No. 120 Keyless ⅜ inch Socket.

ALSO—

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STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

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JAS. SCHAWEL & CO., 29 JOHN ST., NEW YORK.

Importers and Melters. Sheet and Wire in any Gauge. Scrap Purchased.

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See our full page advertisement in issue Sept. 12, for illustrations, prices, etc.

MICA.

For all Electric Insulating Purposes East India Mica is the best on the market.

I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

$40 FREE.

How many words can you make, using only the letters in the words "**HAT IDENTIFIER**." 1st prize—Twenty-five dollars; 2d prize—Ten dollars; 3d prize—Five dollars; 4th prize—One dozen "Identifiers."

Send a dime for rules governing contest and sample "Identifier" to

ILLINOIS METAL CO.,

Royal Insurance Bldg., Chicago, Ill.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

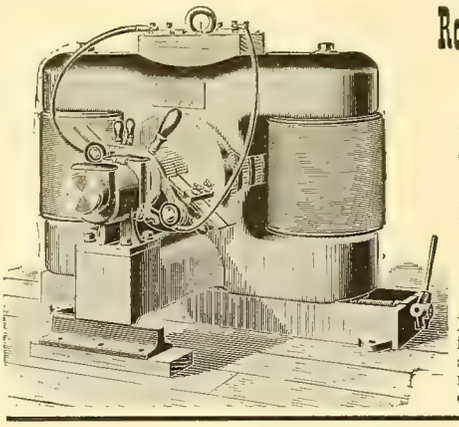
MANUFACTURED BY

MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.



Rockford Electric Mfg. Co.,

ROCKFORD, ILL.,

Manufacturers of

MOTORS,

(Stationary and Railway).

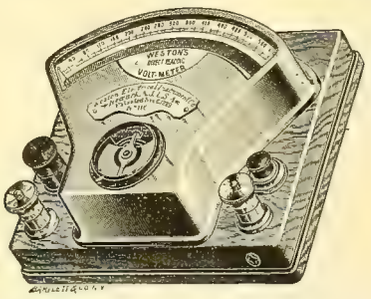
Incandescent Dynamos and Generators

(MAYO SYSTEM).

Specially adapted to Isolated Plants. Absolutely self-regulating and reliable. The Motors are the most efficient now in the market. Agents wanted in unoccupied territory.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

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THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.

SOLID BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

SAMSON CORDAGE WORKS,

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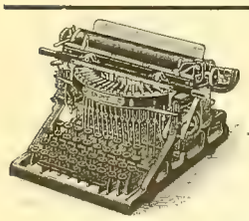

The "DENSMORE,"

The World's Greatest Typewriter,

Should be examined before purchasing any other.

MANY IMPROVEMENTS. HIGHEST STANDARD.

Invented, owned and controlled by men having had fifteen years' experience on type-bar machines.

Simplicity, Strength, Durability, High Speed, Easy Action, Permanent Alignment. Most convenient. Two interchangeable carriages. Steel throughout.

STANDARD KEY-BOARD, with shift carriage for capitals. Call or send for catalogue.

"A perfect machine. Am delighted with it. A pleasure to run it."—CHAS. D. KELLY, Stenographer West Shore R. R., New York.

We will appoint a reliable dealer in all cities as soon as possible, and in the meantime will ship machines on approval to parties having a good commercial rating.

DENSMORE TYPEWRITER CO., 202 Broadway, New York.

THE SHORT DYNAMO.

Efficiency, 92 Per Cent.

From 75 to 500 Horse Power.

Flat Ring Armature.

Multiple Brushes.

Large Commutator. Independent Coils.

Perfect Ventilation.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, OHIO.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

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"WINTER SPECIALTIES."

BRAND'S STEEL WIRE TRACK BROOMS,
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BURTON ELECTRIC HEATERS

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ELECTRIC RAILWAY SUPPLIES

OF EVERY SORT—
FOR ANY SYSTEM.

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Western Electrician.

EVERY SATURDAY.

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Electricity in Gold Mining.

"Placer mining must be conducted in a much more economical manner in the future, and the work must be more thoroughly performed," said E. S. Bennett of Denver recently. "As the work is done at present, by far the greater proportion of precious metal escapes, and a vast amount of water is of necessity wasted. The time is not far distant when deposits that can be worked profitably by the sluice process will be few and far between."

These remarks were made by Mr. Bennett in support of the statement that a necessity existed for a machine which would successfully operate in deposits that could not be profitably worked by the sluice methods. The true method, he believes, is a process by which the metal is saved by amalgamation. The machine which he has designed to accomplish the work is shown in Fig. 1.

FIG. 1. ELECTRICITY IN GOLD MINING.

The amalgator is located at Arvada, seven miles from Denver. It is working in a gravel bed which Mr. Bennett styles the "potato patch." The designation is not inappropriate, as the deposit in which operations have been proceeding adjoins a farm. It is the last place in the world where one would look for a mining machine. To visit the plant one leaves a country road, and passing through a farm gate follows a shaded lane which leads to the power house. On all sides of him the visitor sees evidences of prosperous farming, but the power station is hidden by the trees until he is within a few hundred feet of it. The situation of the ground is shown in Fig. 2.

The location of the amalgamator at this point was easily explained by Mr. Bennett. He desired to operate at a point readily accessible from Denver, so that those interested in mining could without inconvenience see the machine actually at work. He also wished to demonstrate that the amalgamator could be successfully operated in a bed from which the sluice miner could obtain very little return for his labor. The gravel bed where the amalgamator is located was years ago worked by miners, but they soon abandoned the place as decidedly unprofitable. By locating his machine at this point, Mr. Bennett saw that there was an opportunity to demonstrate its thoroughness in operation; if in this abandoned bed a yield of any proportions could be gained, he thought the success of the amalgamator was assured. The result, it is asserted, has fully justified Mr. Bennett's claim for his machine. The most careful miner had never taken from the gravel more than ten cents' worth of gold per cubic yard. Mr. Bennett says his machine has secured double and sometimes more than treble this amount. The explanation is simple. Nine-tenths of the free gold found in leads the world over exists in particles too fine to be seen by the unaided eye, according to the statements of mining engineers. The current in a sluice carries not only these fine particles but a considerable proportion of the visible portions to the dump. All these microscopic particles are saved, it is claimed, by instant amalgamation in the Bennett machine, and what therefore may be valueless deposit to the sluice miner may prove profitable ground to the operator of the amalgamator. In support of these statements Mr. Bennett says, in the operations at Arvada, that 75 per cent. of the entire result has been in gold so light and fine that it is held for a considerable time in suspension in otherwise clear, still water.

The Bennett amalgamator, as it appears at work at Arvada, is shown in Fig. 1. This is the first machine built by the inventor, and although he may make some modifications in future amalgamators the change will be in details entirely. In general design and in the whole scheme of operation no change will be made. That the present machine is actually in successful operation is almost incredible to him, Mr. Bennett says. He found it necessary to have the various parts made in forty different shops located all over the country. Builders made mistakes and caused delays; parts were found to be imperfect and unsuitable; but when finally assembled the machine was put at work, and that it has accomplished something is shown by the dumps of tailings shown in Fig. 2. The machine is at work to-day, and that it collects gold was demonstrated when the writer visited the plant. Mr. Bennett was then engaged in the interesting work of scraping the amalgam containing the precious metal from the plate.

All the power for the amalgamator, with its manifold operation, is provided by electric motors, which are located on the body of the machine. It is contemplated here to give not a detailed description of the mechanical construction of the rather complex apparatus, but merely a general idea of the mode of operation. The operator's house in the front of the amalgamator contains the switches and resistances for controlling the motors. The house is provided with windows on all sides, as Fig. 1 shows. When the machine is in position for work, as shown in the same view, the "dipper," which holds a cubic yard, digs its way into the bank, and is lifted. The two operations are performed with power furnished by two 15 horse power motors. The operator's house is then caused by a third motor to revolve about the central mast and the dipper is carried to a hopper opposite the large cylinder at the left

of the machine, where it is tripped. The contents descend by gravity into the cylinder, which is simply a huge sifter. The cylinder is rapidly revolved so that the fine sand in which the gold is distributed falls to a compartment directly beneath. The stones or "tailings" are thrown out by a carrier shown at the right.

In the chamber into which the fine sand falls is a series of jets through which water enters under a pressure of forty pounds. Covering the surface of this chamber are amalgamated plates. The pressure of the water keeps the contents in continual agitation, and the conditions for the instant amalgamation of each particle of the precious metal are favorable. After it has been thrown against the plates till the metal has been captured, the combination of water and sand is allowed to escape at the back of the machine.

After the machine has been in operation a given length of time the amalgam is scraped from the plates and the gold is reduced by ordinary methods. The entire machine, as Fig. 1 shows, is mounted on wheels so that it may be run on rails to any desired point. Power for moving it is provided by the 25 horse power motor that revolves the cylinder sifter and the carrier. Under ordinary circumstances the dipper deposits a cubic yard of gravel in the hopper every minute. It has been worked much more rapidly than this. It is stated that it has handled 125 yards in sixty minutes.

A general view of the location, with the power house at the left and the amalgamator at the right, is given in Fig. 2. The heaps of tailings show the amount of work performed by the machine. In the station the 80,000 watt generator is driven by a Rice automatic engine. The generator and the four motors on the amalgamator are of the Edison type. It has been found that on an average the motors absorb about 46 horse power.

As the illustration shows, the wires are carried from the station on poles. The wires terminate a short distance from the amalgamator in heavy waterproof cables, which are shown plainly in Fig. 1. All the electrical machinery has given great satisfaction. Mr. Bennett said in relation to it: "Electricity has been a good friend of mine. The perfection of electrical apparatus has made possible the operation of a machine like mine, and the longer I use it the better pleased I am with it."

The question naturally arises as to the financial success of the plant. In considering this subject it must be remembered that up to the present time the machine has been considered experimental. The ground on which it is working is so poor that by ordinary methods nothing to speak of can be extracted from it. In spite of these facts the machine is now earning enough to pay for its operation, Mr. Bennett says, which is a wonderful achievement if time proves it to be absolutely true. The machine is owned and operated by the Bennett Amalgamator company of Denver.

The citizens are agitating the subject of establishing an electric light plant at Quakertown, Pa. The question is to be decided at an election.

FIG. 2. ELECTRICITY IN GOLD MINING

American Institute of Electrical Engineers and the World's Electrical Congress.

The resolution given below, adopted by the international congress committee and the council of the American Institute of Electrical Engineers, is the outcome of the recent visit to New Yorkcity of Dr. Elisha Gray of Chicago, chairman of the electrical committee of the World's Congress Auxiliary.

Dr. Gray, after several informal interviews with officers and members of the Institute, was invited to attend a meeting of the congress committee on December 16th, when a mutual exchange of views upon the subject was had, and the result is said to be entirely satisfactory to all persons interested. Following is the resolution:

Resolved, That the American Institute of Electrical Engineers, having already taken action, during the past three years, by correspondence and otherwise, toward the holding of an international electrical congress in connection with the Columbian World's Fair, hereby expresses its desire and intention to co-operate by all means in its power with the World's Congress Auxiliary of the World's Columbian Exposition, through its electrical congress committee, in furthering the gathering of such a congress at Chicago in 1893, and in making it a successful and worthy representation of the best electrical science and practice in all parts of the world.

In connection with the above the following letter from Prof. Gray will be read with interest:

To the Editor of the WESTERN ELECTRICIAN.

Allow me through your columns to say to the local committee and the electrical fraternity in general, that during my recent visit to New York and the East I found everywhere, among electricians of every grade, a lively interest in, and a hearty co-operation with, the world's congress movement under the auspices of the World's Congress Auxiliary.

The work of appointing an advistory council and of formulating a programme is now going on. A meeting of the local committee will be called at an early day.

ELISHA GRAY,
Chairman World's Electrical Congress Committee.
Highland Park, Ill., Dec. 26, 1891.

Electricity at the World's Fair.

Inasmuch as a very important portion of the electrical exhibits at the World's Fair—the actual generating plant—will be shown in machinery hall, the special rules of the machinery department will be of interest to prospective electrical exhibitors. They are as follows:

A limited quantity of steam and water power will be furnished for the purpose of exhibiting machinery in operation, the quantity of each to be definitely settled at the time of allotment of space. Any excess will be charged for at a fixed price. Demands for such excess must also be settled at the time of allotment of space.

Exhibitors must be manufacturers of machinery and not dealers only.

Exhibitors must provide show-cases, shelving, counters, fittings, countershafts, pulleys, beltings, etc., at their own expense.

Exhibitors are required to furnish the following information, and a drawing to the scale of one-fourth inch to a foot of the plans and distribution of the objects they wish to exhibit: If machinery, actual horse power required; cubic feet of steam used an hour, at a pressure of 150 pounds; diameter of steam and water pipes; diameter of discharge or drain pipes (the main shafts will make 120 and 240 revolutions a minute); dimensions of space required must be given in feet and inches, without including any allowance for passage ways; what per cent. of labor performed by females in the production of articles exhibited; whether the applicant is a producer or manufacturer.

By special arrangements the installation of heavy articles requiring foundation should begin while the building is under construction.

The floor of machinery hall will support 250 pounds per square foot. The heaviest single piece received must not weigh more than 30,000 pounds, as facilities will not be provided for handling heavier weights.

The steam pressure supplied will be 150 pounds to the square inch. Those wishing to secure lower pressure may do so by using a reducing valve. Water pressure will be that due to a head of 225 feet, or a pressure of 98 pounds to the square inch, and a head of 40 feet, or a pressure of 175 pounds to the square inch. The line shafting will be 16 feet from the center of the shaft to the floor. Driving pulleys are limited to 36 inches in diameter.

Exhibitors of steam and other machinery who desire to offer their exhibits for use by the Exposition company should send their applications as soon as possible Such exhibitors may select their own men to operate this machinery. Their wages will be fixed and paid by the Exposition company. The Exposition company will defray the necessary expenses of exhibitors, loaning them machines, tools, etc., for use beyond that which they would have incurred as exhibitors simply, wear and tear excepted. Fire engines entered for exhibit offered and accepted for use will be properly cared for and furnished with fuel free of expense.

All exhibits of machinery in motion must be inclosed by a railing 2 feet 6 inches in height, to come inside the space. No signs will be allowed to extend over the passage way and no signs will be allowed made of muslin, linen, canvas or paper. No fire will be allowed in machinery hall except by special permission. Not more than a day's supply of oils or other inflammable substances will be permitted in machinery hall, but a suitable place for the storage of these materials will be provided.

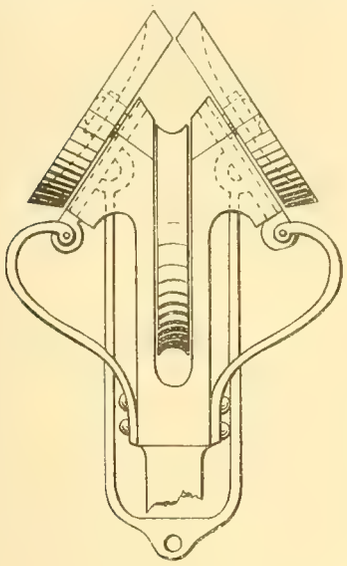
Exhibitors not desiring to employ attendants or watchmen may leave their exhibits in the care of the department, which will assume the responsibility of their cleanliness

One of the distinctive features of the electrical display will be that made in the main basin which runs from the lake westward toward the administration building, a distance of 1,500 feet. Special attention will be given to the illumination of this basin and it will be encircled by incandescent lamps two feet apart and three feet above the surface of the water of the basin.

The gas people still continue to attack the management of the World's Fair, one journal alleging that the electric interests have been "coddled" and gas given the cold shoulder. It is now asserted that the authorities of the exposition cannot get along without gas, and that "the commissioners may have to beg later on for that which they so vain-gloriously rejected at the outset." If this is the case, the gas interests should be in a position to dictate terms to the World's Fair for the use of this indispensable product and would have no need to whine. The gas people are only injuring their own cause by their present course, if they are correctly represented by the journals devoted to their interest.

Another Trolley.

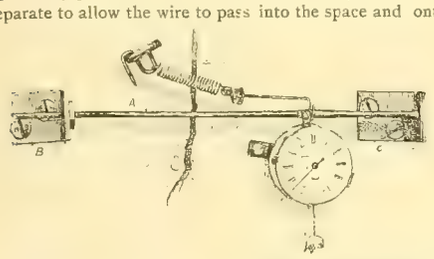
The jumping of the trolley wheel from the overhead conductor is one of the small difficulties for which inventors of electric railway fixtures are endeavoring to furnish a remedy. One of the latest attempts to provide a mechanism for securing the wheel on the wire, so that it will not of itself become detached and yet be readily removable, has been made by C. S. Foster of Whitesborough, N. Y. The cut shows the construction of the device. There are, above the trolley wheel proper, a pair of retaining-wheels mounted on sliding pieces, which are adapted to move up or down in slots in the trolley head. The retaining wheels are projected to their upper position and close the space, by means of springs secured as indicated to the trolley-head at their lower ends and to the movable slide at their upper ends. The springs are strained to throw the wheels into the position represented in the illustration.



ANOTHER TROLLEY.

It will be observed that the wheels come together only at their lower edges, leaving a V-shaped opening on the outside of the wheels and above the trolley when the wheels are in a closed position.

The operation of this trolley will be readily understood. The movement to the side of the inclined wheels, as the device travels along the conductor, allows any fixture, such as the hanger of an insulator, to pass between the wheels which close again after the passage. When the device is brought into contact with the conductor the wire engages in the V space formed by the edges of these upper retaining-wheels, and as the trolley is moved upward by pressure from below, the wheels automatically separate to allow the wire to pass into the space and onto the trolley wheel proper. When it is desired to remove the trolley from the wire, the releaser or yoke, shown in the cut with an eye in its lower end, is operated to draw the retaining-wheels downward and apart, so that the trolley is free to move away from the conductor.



DETECTING MOVEMENTS IN MASONRY BY ELECTRICITY.

Detecting Movements in Masonry by Electricity.

E. P. Abbott, chief engineer of the Minneapolis & St. Louis railroad, recently devised an ingenious indicator by which he was enabled to detect movements in a bridge abutment.

After building the south abutment for the Second street bridge in Minneapolis, a crack appeared in the masonry which threatened to be serious. The abutment is very heavy, being 83 feet long and 10 feet thick at the base. The necessity of determining whether the crack was gradually widening or was remaining stationary led to the construction of the indicating mechanism, which was placed on the abutment as shown in the cut.

On one side of the crack the works of a Waterbury watch were firmly secured, and a short lever was attached to the hour-hand post and connected to the rod *A*. As will readily be seen, the least widening of the crack would be multiplied through the train, and indicated on the dial. A 1/16 inch opening, it may be explained, would cause over oner evolution of the pointer. The spiral spring took up all the slack in the joint between the lever and the long rod, and the weight *W*, attached to a piece of silk running around the pointer spindle, took up all the slack in the train.

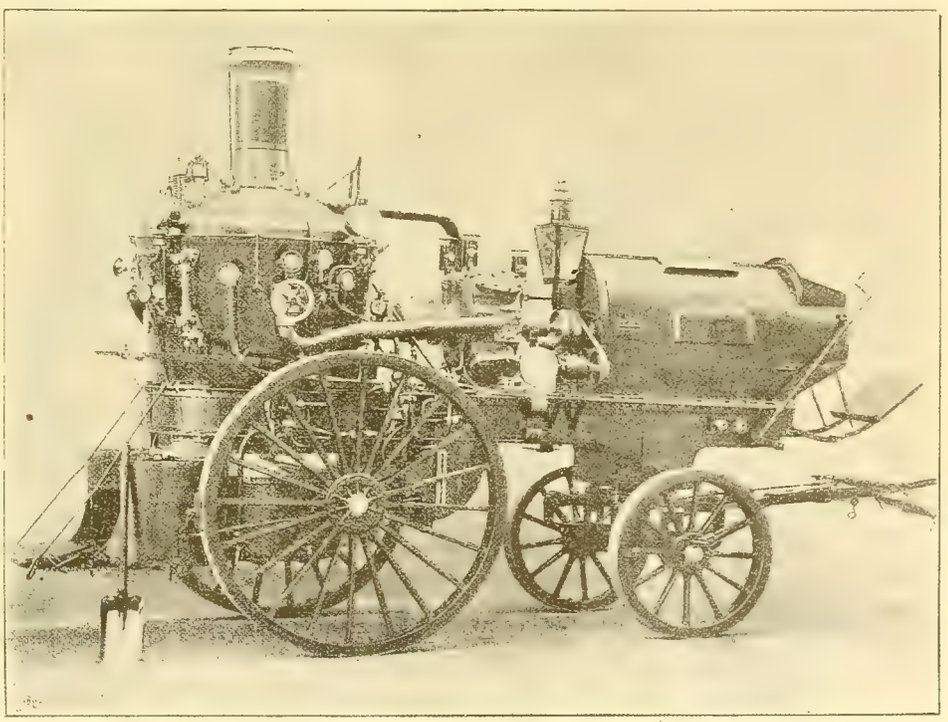
By means of the nut on the inside of the stop *B*, the end of the rod was brought just to contact with the stop *C*, and an ordinary battery was connected to form an electrical circuit through this contact. In this manner if there was any movement it would be detected by the aid of the electricity as well as by the indicator proper, thus securing a double test.

The entire cost of the whole outfit was about $6, and from all accounts it accomplished its purpose very satisfactorily, demonstrating absolutely that the masonry remained stationary for three weeks after the device was put on. The cut is from *Engineering News*.

Schuckert & Co.'s Military Electric Lighting Wagon.

An English contemporary, *Industries*, is responsible for the statement that much of the electric lighting equipment used by the English army comes from the German firm of Schuckert & Co. One would think that England, with its reputation for good electrical work, could produce apparatus which would meet all the requirements of the most exacting specification; and, besides, were this not the case, it would be only natural to suppose that the Britishers' pride might prevent importations in this line and for such use. It is to be presumed, though, that in so far as the manufacture of electrical specialties and philosophical apparatus is concerned, our cousins admit that Germany maintains the lead.

A good illustration of what the Germans can do in the line of special electrical machinery is presented in the accompanying cut, which shows a very complete electric lighting wagon for military service. This car contains everything that can possibly be wanted for lighting any such military engineering operations as bridge-building, throwing up earthworks at night, etc. The total weight of the complete equipment is 3½ tons, so that it can be easily drawn by horses. The engine is one of the small four cylinder "Abraham" type. It drives a flat ring dynamo directly through a flexible leather coupling. The car carries twelve arc lamps, with lanterns and poles complete, and a search light. The cables, coal, carbons, and all spare stores are carried in a separate wagon or tender.

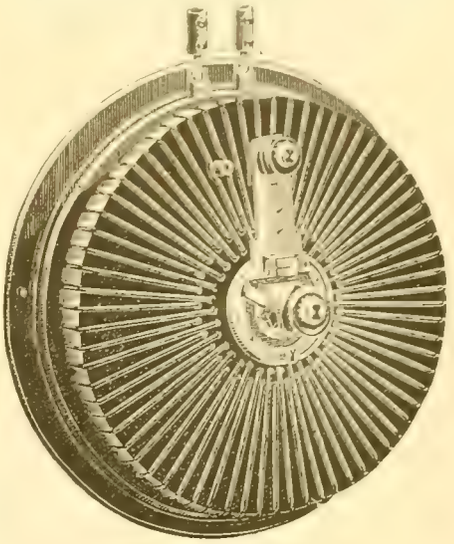


SCHUCKERT & CO.'S MILITARY ELECTRIC LIGHTING WAGON.

A new electric line has been opened at Defiance, O. It is owned by the Defiance Light & Power company, which also furnishes the town electric and gas lights. The officers are: President, W. B. McKinley; vice-president, E. O. Harris; secretary, treasurer and manager, C. L. Nelson.

A Simple Rheostat.

The engraving represents a [illegible] devised by Carl Lange of Berlin, Germany. It is designed for use on arc light circuits. This rheostat consists of a disk on which are laid [illegible] in a manner similar to that employed in the Ganz converters. The whole is mounted on an iron frame. The arrangement has the advantage of possessing a large cooling surface and of allowing a regulation down to one-half volt. The particular regulator herewith illustrated is provided with an additional switch which permits the breaking of the current at two points.



A SIMPLE RHEOSTAT.

Chicago Electrical Association.

At the regular meeting of the Chicago Electrical association on December 22d A. H. Adams read a paper on "Chimneys and Chimney Draughts," followed by L. G. Bassett, who spoke of the "Speed of Electricity." The following named officers were elected for the six months' term beginning January 12th. President, E. G. Hovey, vice-president, J. F. Connor; secretary, F. R. McBerty; treasurer, Albert Scheible. This association meets on the second and fourth Tuesday evenings of each month at 169 Washington street.

A new electric tram car has been tested at Croydon, in England. The car, when empty, weighs 5½ tons, is driven by two motors of 14 nominal horse power, and can attain a maximum speed of 16 miles an hour. A trial trip was first made to Thornton Heath, after which the whole of the circuit to North End, Croydon, was completed without a hitch, and the inspectors expressed themselves as being thoroughly satisfied with the experiment.

West Side Electric Railway at Kansas City, Kan.

"A neat little road, built and run for dividends," is an expression which might be applied to characterize the line which is the subject of the present article. The West Side electric railway was projected with the idea of providing the northern section of Kansas City, Kan., with rapid transit, and by the present arrangement between the two companies one 5-cent fare takes a passenger over both electric and cable systems to all points on the cable line in Kansas City, Mo. There is in all about four miles of double tracked road, with two spurs, and at present six motor cars are in service. The railway system of the Detroit Electrical Works is employed on the West Side road, and it is hardly necessary to add that the speed and regularity with which the cars make their trips is enabling the Kansas citizen to understand the meaning of rapid transit in reality as well as in name.

Passing over the bridge from Kansas City proper into Kansas City, Kan., on a cable car of the Metropolitan street railway, the first glimple of the West Side line is obtained at the corner of Third street and Minnesota avenue. At this point the the transfer from the cable to the electric system is made. A short ride over the line from this corner due north on Third street brings the visitor to the

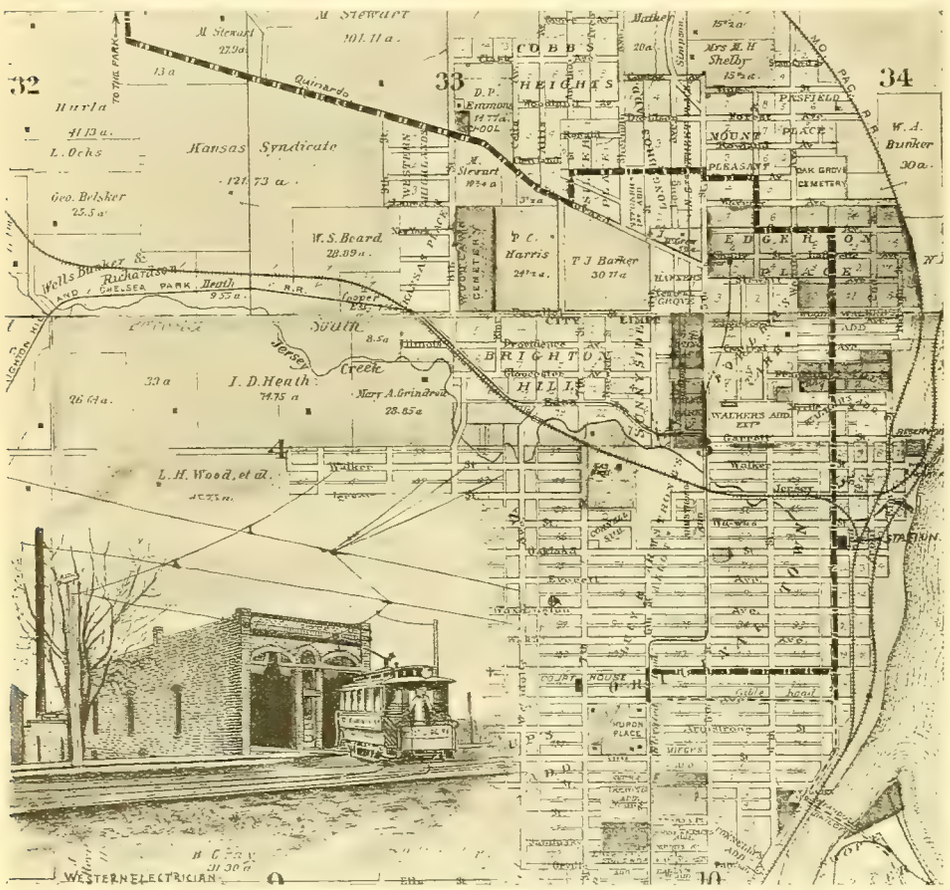


FIG. 1 WEST SIDE ELECTRIC RAILWAY AT KANSAS CITY, KAN.

power house. Thence the road extends on, as indicated by the map, Fig. 1, through the northwestern section of the city to Nineteenth street and Quindaro boulevard, with a branch to Brown Park and a spur from Third street and State to Fifth and Minnesota.

Before entering into a description of the details of equipment and line construction, it will not be amiss to give a little history.

The original projectors of the scheme to construct the West Side railway were James D. Husted, Luther H. Wood and Charles F. Hutchings, all of Kansas City, Kan. The company was organized and charter granted July 31, 1888, and the first meeting of the incorporators under the charter was held August, 1888, at which Charles F. Hutchings, James D. Husted, Luther H. Wood, William L. Wood, E. J. Camp, Thomas H. Rowland and Oliver R. Burnham were elected and qualified as directors. The ordinance granting a franchise and the right of way over the streets of the city was passed August 16, 1888. The construction of the road was commenced February 9, 1891, and the system was completed and the first car run over the road April 28, 1891. The present directors are W. N. Coler, Jr., New York; Leonard H. Hole and James W. Campbell, Chicago; Charles F. Hutchings, H. A. Yonge, Martin Stewart, Kansas City, Kan., and W. S. Nelson, Kansas City, Mo.

The officers are W. N. Coler, Jr., president; W. S. Nelson, vice-president; Charles F. Hutchings, secretary; Charles F. Hutchings, attorney; C. S. Clark, superintendent and manager.

Relative to the equipment of the West Side line it may be said that the Detroit Electrical Works, although furnishing only their standard machinery, made an effort to establish an installation that might be referred to as one of their model roads. The cuts show how well this end has been attained.

The two-story brick power-house covers a lot 29x150 feet, and as will be seen from the accompanying interior views of the station, the cars are run into the barn at the second story. The "barn," or perhaps more properly, the car-house, is about eighty feet deep, and has a capacity of six cars. The little station is arranged according to modern ideas. There is a transfer table and pit, Fig. 2, by which the shifting of the cars from track to track, and ordinary running repairs, are greatly facilitated. In the basement, below the car-room, is the workshop and storeroom, Fig. 3. Just behind the shop, on the ground floor, is the generator room, Fig. 4. It may be mentioned here that it is the intention of the company, as the station's capacity is increased, to take away the wall between the dynamo room and the shop, and make the two apartments into one large generator room. Behind, and opening into the last named apartment, is the boiler room. That portion of the station containing the generating plant is of one story, but the ceiling of the room is high and the light is good. In addition to the station proper the West Side company has office quarters on the lower floor of a building on the opposite side of the street from the plant.

In the power plant proper there are two 70 horse power tubular boilers, which furnish steam at 120 pounds' pressure. The boilers were made by Brownell & Co., Dayton, O., and each is fitted with Tupper double-ribbed grates, upon which Cherokee slack is burnt. A stack 32 inches in diameter and 70 feet high makes an excellent draught. Missouri river water is supplied to the boilers from a National feed water heater by two Smithvail steam, pumps. In connection with the feed water system there is employed a very efficient little apparatus by the aid of which coal oil is introduced to the boilers to prevent scale. This device, is an invention of Louis Wolf, the West Side company's dynamo tender.

The electrical power apparatus is, as was before stated, of the most approved patterns built by the Detroit Electrical Works, Detroit, Mich. A 150 horse power Williams single compound non-condensing engine, built by the Williams Engine works, Beloit, Wis., drives the 80,000 watt dynamo supplying the system. This generator is wound for 500 volts, and is over-compounded to the extent of 15 per cent. A length of German silver tape resistance is connected in shunt to the series coils of the machine, so as to permit of an adjustment as to electromotive force after the generator has been put to work. A Cleveland

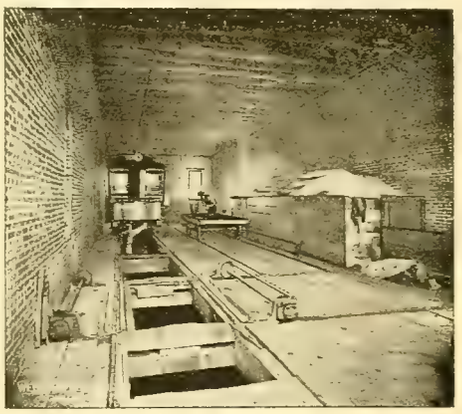


FIG. 2. WEST SIDE ELECTRIC RAILWAY AT KANSAS CITY, KAN.

automatic switch cut into the main conductor at the switch-board, Fig. 5, operates, most efficiently, it is stated, to break the overhead circuit when there is a call upon the generator for an output of over 90,000 watts. In addition there is a Detroit ampere meter, a Weston voltmeter, Detroit switches, not to forget a lightning arrester of a type recently introduced by the Electric Merchandise company, Chicago.

The overhead conductor is of "single 0" hard drawn copper wire. The line poles are of unpainted cedar, set about, 120 feet apart, and extending from 18 to 23 feet above ground. On the road there is about 4,000 feet of center pole construction. The center poles are set 120 feet apart, and the brackets are of steel. The only insulator is at the wire. For the return circuit the rails are bonded with No. 4 iron wire. A glimpse of the heaviest grade and the center pole construction is given in Fig. 6.

Fifty pound Providence girder rails are used through the system. The rails are set on concrete piers, and are braced with oak pieces and $\frac{5}{8}$-inch tie rods. The braces are set along the line about 7½ feet apart. Contractor E. M. Lampkin built the road.

The roadbed of the West Side line is considered to be first class. The maximum grade is one of 8¼ per cent. for 760 feet. Figuring from the profile of the road each car is lifted, so to speak, 465 feet in making the round trip over the main line, a distance of 7.24 miles. Over the Park branch the run is only 8 miles and a car is lifted 97 feet. An average speed of 8 miles per hour is made, including all stops. The cars on the line were built by the St. Louis Car company. They are 16 foot cars finished in bronze and each is fitted with a 30 horse power Detroit Electrical Works motor. The trucks are the Three Rivers pattern

FIG. 3 WEST SIDE ELECTRIC RAILWAY AT KANSAS CITY, KAN.

built by the Sheffield Velocipede Car company, Three Rivers, Mich. At night each car is illuminated by seven 105 volt incandescent lamps, five of which are burnt at a time.

To describe such a system as that of the West Side Railway company and not give any credit for intelligent

superintendence of details, so essential where economical operation is attained, would be an injustice to the management of the road. To show, then, what results may be secured by an intelligent handling of this apparatus, a few expense accounts for the month of September, 1891, are given below. Perhaps it is hardly necessary to say that

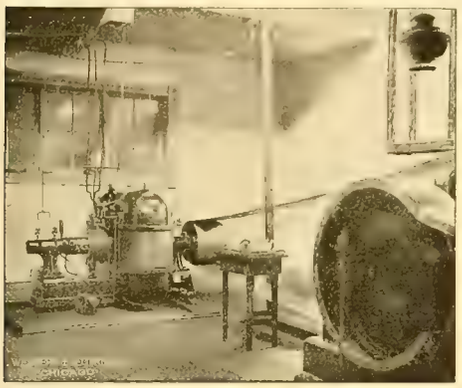


FIG. 4. WEST SIDE ELECTRIC RAILWAY AT KANSAS CITY, KAN.

the September accounts were not chosen from the fact that they presented a better condition of affairs than was the average. Enough figures are given to enable railway managers to judge for themselves whether or not General Manager Clark has reason to be proud of the performance of his equipment.

EXPENSES.

Car Expense	$ 764.12
Car Expense, Repairs and Renewals	259.51
Motive Power Expense	260.00
Motive Power, Repairs and Renewals	258 39
Maintenance of Way (once every four months)	138.61
Maintenance of Buildings	
Maintenance of Park	$5.57
Loss and Damage	
General Expense	1,197.74
Total Expense	$ 2,963.97

CAR EXPENSES.

Motormen and Conductors	$ 734.12
Transfermen and Flagman	30.00
Total	$ 764.12

CAR EXPENSES, REPAIRS

Pay Roll	$ 100.00
Car Wheel	
Brake Shoes	
Gears and Pinions	28.45
Trolley Wheels	0.08
Trolley Parts	7.61
Glass	3.00
Electric Lights	20 00
Chimneys for Lamps	7.15
Carbon Brushes	
Fuel, Heating Cars	
Transfer Checks	
Register Expense	40.00
Wire	
Car License	
Secret Service	7.30
Miscellaneous	36.02
Total	$ 259.51

MOTIVE POWER EXPENSE.

Two Engineers and two Firemen	$ 230.00
Other Labor, Motor Wiper	30.00
Total	$ 260.00

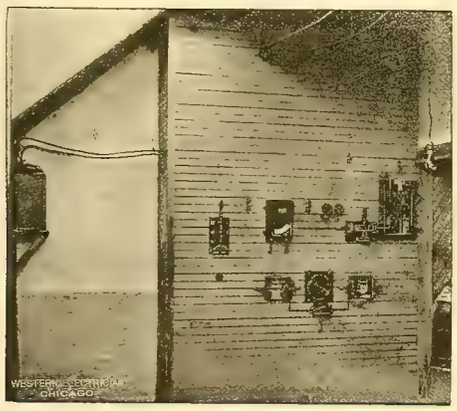


FIG. 5. WEST SIDE ELECTRIC RAILWAY AT KANSAS CITY, KAN.

MOTIVE EXPENSES AND REPAIRS.

Fuel	$ 170.86
Water	34 04
Lubricants	34.50
Waste	9 04
Boiler Repairs	8 59
Engine "	
Dynamo "	1.21
Switch-board Repairs	
Sundry	
Miscellaneous Expenses	.15
Total	$ 258.39

MAINTENANCE OF PARK.

Laborers' Pay Roll	$
Policemen	
Water	12.86
Ice	
Incandescent Lamps put up	64.31
Advertising	8.40
Total	$85.57

MAINTENANCE OF WAY.

Pay Roll	$ 11, [illegible]
Rails	
Ties	
Spikes	
Bolts	
Fish Plates	
Ballast	2.89
Pavement	
Wire	5.00
Poles	
Hangers	6.76
Miscellaneous	7.99
Total	$ 158.74

GENERAL EXPENSE.

Manager's Salary, Office Rent, Office Employes, Insurance, Interest (Mo. Pro.) on Bonds, Water and Ice, Stationary and Printing, Telephone Rent, Miscellaneous	$ 744 07

NOTES.

Pounds Cherokee slack per car mile	11.98
" Coal per 1 horse power hour	5.6
Total Car Miles	20,373
Passengers Carried	61,284
Motive Power Expenses per car mile	2.545 cts.
Car Expense per car mile	5.024 "
Total Op. rating Expense per car mile	9.943 "
Total Expense per car mile	12.87 "

It should be explained that in the above statement 'total operating expense per car mile" includes "car expenses" "motive power expense,""maintenance of way" and "general expense."

Electric Traction for Chicago.

To the Editor of the WESTERN ELECTRICIAN:

Your editorial mention in a recent issue of the fact that improved transit facilities for Chicago are demanded on every side, and the added comment that the present agitation of the subject has the good effect of attracting public attention to electric railways as the probable solution of the problem, leads me to give expression to views held by certain friends of electric traction.

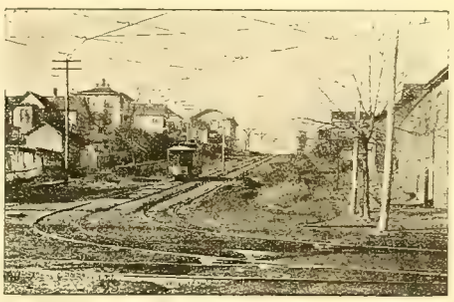


FIG. 6. WEST SIDE ELECTRIC RAILWAY AT KANSAS CITY, KAN.

Thus far no advocacy of electric traction as a possible correction of present evils has appeared in Chicago daily publications. Many detailed plans for necessary changes have appeared, considering cable, subway and elevated, but not electric, lines. Plausible and helpful theories have been offered the daily papers, but since they savored of electricity as a means of propulsion space has not been given them. At the Farwell Hall citizens' meeting of December 5th, the proposals of two speakers that aid might come from a judicious employment of electric lines met with emphatic disapprobation. Doubtless ignorance of the system is an ever present cause for the existing sentiment.

Local electrical publications can perform a valuable service to Chicago's inhabitants by making an attempt to educate the daily journals to a just estimation of electric traction. The latter then could, and presumably would, give the subject intelligent consideration for the edification of their readers. It need not be proposed to change the cable to electric lines; rather perfect them along their present routes. There are, however, many miles of antiquated horse car lines which are sadly deficient in "get there" qualities. Indeed, twenty-five per cent. of the people who patronize the cable lines do so because the trains make better time than the horse cars, which run nearer to, or even by, their homes. Make electric lines out of the horse car routes which extend parallel to the cable roads, and the principal cause for overloading the varlous cables will be removed. Thereby the total traffic to and from the business center of the city will be beneficially distributed both for the companies and their patrons. It would seem a reasonable act if steps were taken, and that immediately, in view of the crowded condition of our city during the months of the World's Fair, to arouse an intelligent interest in electric railways for Chicago. Certainly the experiences of other large cities can furnish no arguments for the non-employment of the trolley system here.

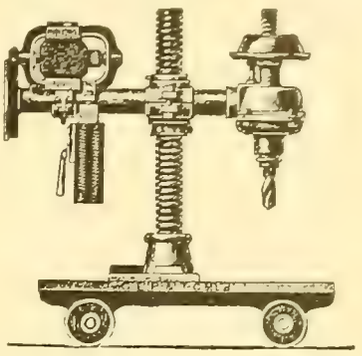
Chicago, December 22, 1891. W. R. MASON.

Telegraphers' Strike.

A press dispatch dated December 26th, and sent out from San Francisco says: Acting Chief Ramsay of the Order of Railway Telegraphers of the United States has had a conference with representatives of railway employes' unions and states that he will confer with Southern Pacific officials next week, when he expects the trouble between the striking telegraphers and the railroad will be satisfactorily settled.

An English Electrical Drilling Machine.

Last week there was presented in these columns a description of the Edco electric drill which is in use in a number of well-known American machine shops. The cuts shown herewith represents two forms of another type of electric drill which is being introduced in England by the General

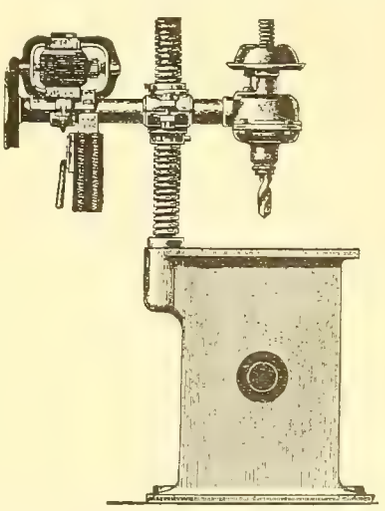


ENGLISH ELECTRICAL DRILLING MACHINE.

Electric Power & Traction company of London. The two drills here shown are alike in general form, the difference being that one is arranged to be portable, while the other is for stationary work. These machines are fitted with half horse power Immisch motors and they are capable of drilling holes up to 1¼ inch in diameter in either iron or steel.

Franklin and the Royal Society.

An interesting reference to Benjamin Franklin is made in a recently published sketch of the Royal Society of England. It seems that in 1756 Franklin was elected a fellow of the society, to the proceedings of which he contributed several important papers. But his electrical discoveries, if they attracted great public attention, also led, indirectly, to the most ridiculous, but by no means the least bitter, of the quarrels from which the records of the Royal Society are no more free than are those of most other human institutions. In 1769 a committee of the society was appointed to advise the dean and chapter of St. Paul's upon the best manner of protecting the cathedral from lightning, and under the directions of the committee, arrangements, as efficient as the knowledge of the time enabled them to be, were made for the purpose. In 1772 a similar committee was appointed to report on the best means of protecting the Purfleet powder magazines. In their report, the committeemen very properly recommended pointed conductors, but one member of the committee dissented from this proposal and delared that all lightning conductors should be fitted with knobs on their ends. His reason for taking this stand was not a purely scientific one. The discoverer of the pointed conductors was Franklin, who, the dispute with the American colonies then being at its height, was emphatically a *persona non grata* just then in England. The dissenting committeeman, Mr. Wilson, was a person of influence, and he managed to get his views indorsed by the board of ordnance; the fact that the Purfleet magazines were actually struck by lightning at this time scoring another point in his favor. The question became a popular one. As in Lilliput, the people became big-endians or little-endians, and for as valid a reason. George III. himself took a side, ordered the points to be taken off the royal conductors, and bade Sir John Pringle, then the president of the society, support



ENGLISH ELECTRICAL DRILLING MACHINE.

Mr. Wilson. Sir John is credited with the dignified response, "Sir, I cannot reverse the laws and operations of nature," to which the king, naturally incensed that so incompetent a person should hold so important an office, responded, "Then, Sir John, perhaps you had better resign," which Sir John did.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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IT is always a pleasure to announce a new and practical application of electricity; and the use of electric power in placer mining seems to furnish such an opportunity. The apparatus, as illustrated on another page, appears to give promise of extended usefulness,

THE electrical exhibitors at the World's Fair will have much to do with the machinery department—that is, all who expect to show dynamos under load will have. It behooves them, therefore, to be acquainted with the rules that will govern the exhibits in machinery hall. These are given in another place, and are worthy an attentive perusal.

A CORRESPONDENT writes to suggest the desirability of the transformation of the horse car lines in Chicago into electric railways. No one will deny that such a change would be highly satisfactory. Indeed, we think that our correspondent might go farther than he seems inclined to do and advocate electric roads in place of cable lines. We are inclined to think that the cable, even when operated under most favorable conditions, is destined to be superseded by electricity.

THE indications are that the New Year will be indeed a happy one to the electrical fraternity. On all sides expressions of cheerfulness are heard. "Business brisk," "Better than this time last year," "Factory running overtime," etc., tell their own story. The outlook is good, and the year promises to be a successful one in electrical annals.

THE WESTERN ELECTRICIAN heartily congratulates the Hon. A. C. Durborow, Jr., on his appointment as chairman of the important select committee of the House of Representatives on the World's Columbian Exposition. The compliment thus paid to a new and youthful member is very marked, but we are confident that time will prove that the speaker's confidence has not been misplaced.

ST. LOUIS is added to the list of cities where the electric light people have trouble with the municipal authorities. The Municipal Electric Light company claims that it is losing money on the lights furnished the city, and threatens to forfeit its contract. The rate mentioned is certainly low, and the city seems to have much the best of the bargain. One thing about the situation in this city is refreshing, however. The mayor is not in favor of a electric light plant operated by the city.

NEW YORK is not the only city in which an underground electric road is proposed to afford rapid transit. Some measure of relief is needed in Boston, and President Whitney of the West End company has come out in favor of a tunnel under the Common, to take care of a portion of the congested down-town traffic. On the other hand, St. John V. Day, in a paper recently read before the Chicago Electric club, points out what he considers the defects of the tunnel system for electric traction, and says that very serious inconvenience, if not absolute danger, would result from the breaking down of the generating plant, thus imprisoning the passengers in the tunnel. He is in favor of an elevated electric system. There is much to be said on both sides of this question, and it is probable that the literature of the subject will be enriched by many more contributions before electrical railway men come to a common understanding of it.

FROM all accounts the trolley system is about to score another victory, and this time in a neighborhood in dangerous proximity to New York. From present appearances Brooklyn will soon be able to judge for itself whether the much maligned overhead wire is as unsatisfactory or as dangerous as the cable. The metropolis expects great things of its new cable road, and it will soon be in a position to learn something. Here is a fine chance for comparison. Chicagoans have a fund of information as to the workings of the cable, and the knowledge was obtained by observation of, and personal experience with, two distinct systems. A comparison of the two Chicago lines reveals the fact that not only does a well-managed cable road have its disadvantages, but, further, that unless the system is kept in a state of veritable perfection it becomes but little better than a nuisance. But it is not our intention to malign the cable system. We merely wish to point out the excellence of the opportunity which, in all probability, will soon be presented to the conservative New Yorkers, who are only just awakening to a realization of the fact that Boston, with all its old fogy ideas, had a method in the madness leading to the adoption of the overhead wire.

SO much space in these columns has already been given to the question of municipal lighting that it seems almost like an imposition to again broach the subject. But in view of the fact that city councils, in their attempts to be very knowing, continue to ventilate their ignorance, it will not be amiss to call attention to a few points to which, as a rule, the all-wise city father pays little or no attention. Every now and then we hear that the city of So and So has begun an investigation into the cost of electric lighting with the view of establishing and running its own plant. "Alderman Blank has been collecting figures," and these "show that we are paying too much for our lights," or expressions of a like tenor, are now of common occurrence in the papers. But the "investigation" which is the most seductive to the verdant political economist is that contained in the report which embodies the "Table Showing the Comparative Cost of Lights in Other Cities." It is this simple and apparently incontrovertible statement which catches the aldermanic eye, and makes a world of trouble for the electric light manager.

In almost every city where the question is agitated the cost per light for a given period of time is brought into comparison with figures procured from other municipalities, and the comparison, as a rule, is made with no consideration whatever as to whether the conditions under which the systems are operated are the same. That each city has its "personal equation," in so far as a lighting service is concerned, never seems to enter the aldermanic mind, until, perhaps the central station manager, frequently after days of hard work, succeeds in making clear the reasons why one city may pay one price for a light and another $10 more, and yet both plants be run with about the same profit—or loss—per lamp.

There seems to be a lack of understanding as to how many details should be considered before it is possible to make an intelligent comparison. It may not seem of much importance to the learned councilman whether the circuits are one mile in length or eighteen, or whether the lamps are located far apart or close together. "So many lamps costing so much," is about as far as he gets. But, unfortunately, the central station manager must figure upon these points and many more.

All central stations having city lighting contracts are not necessarily aiming to secure more than a proper share of the city funds. There are a few which would be satisfied with profits sufficient to insure the payment of a 6 per cent. dividend. For this reason a municipality might do worse than to institute an investigation by experts rather than to trust to the judgment of laymen many of whom, sad to relate, often find it dificult to write accounts of their observations in correct and intelligible English.

ABOUT a year ago attention was called in these columns to the growing tendency among English manufacturers toward the building of the directly connected electric lighting equipment. In this country it is the exception rather than the rule to see a dynamo driven by the engine without the intervention of a belt or other sort of gearing. Our foreign brethren, though, seem fully aware of the many advantages of the more compact plant, and in this respect, as in not a few others, we would do well to become imitators. To be sure, we have compact combinations of engine and dynamo for ship lighting, but as yet it seems that our manufacturers have failed to appreciate the existence of a demand for an outfit which leaves room for something besides itself in the apartment where it may be located. In Chicago especially there exists what might be termed a latent demand for a plant that has the advantage of requiring a minimum of floor space. American engine manufacturers, owing, of course, to a lack of competition in this particular line, offer their engines, and dynamo builders still offer efficient lighting machinery, but for some reason or other no one has come to the front with the combination outfit. There is bound to be an awakening, though, and perhaps it will be just after the World's Fair when the people from the other side see that we and not they are behind the times.

GRATIFYING news comes from the American Institute of Electrical Engineers regarding the relations of that body and the World's Fair Electrical Congress to be held in Chicago in 1893. As the result of Prof. Elisha Gray's visit to New York, the International Congress committee and the council of the Institute have adopted a resolution pledging the organization to co-operate with the World's Congress Auxiliary, under whose auspices the distinguished gathering will be held, in furthering the arrangements for the projected congress, and in making it "a successful and worthy representation of the best electrical science and practice in all parts of the world." This is as it should be, and we are sure that all friends of electrical development, east and west, will join with us in rejoicing at the harmonious outlook for the greatest assemblage of electricians the world has ever seen.

In retreating gracefully from an untenable position the Institute does great credit to its good sense. It has proven strong and sagacious enough to admit a mistake, and has thereby enhanced the respect and good opinion of its well wishers, among whom the WESTERN ELECTRICIAN desires to be counted. When we, as a nation, extend an invitation to the electrically distinguished men of all lands to meet with us, we should have no disagreements at home. It is a pleasure to record the fact that this has been recognized by the American Institute in the abandonment of a claim that could never be sustained, and which, if persisted in, would inevitably cause discord and confusion.

Credit for the happy result is largely due Prof. Elisha Gray, chairman of the committee on the World's Electrical Congress, who was able to remove many erroneous impressions from the minds of the members of the Institute. Prof. Gray is peculiarly well fitted for the position he holds, and under his leadership the Institute, and, indeed, all similar organizations, will be made heartily welcome in the work of preparing for the congress.

Hon. Allan C. Durborow, Jr.

Chicago has been highly honored by Speaker Crisp of the House of Representatives in the selection of Congressman Durborow as chairman of the committee on the World's Columbian Exposition. The appointment also possesses a peculiar interest and gratification to the management and friends of the WESTERN ELECTRICIAN, owing to Mr. Durborow's long connection with this paper in the capacity of business manager. It is very seldom indeed that a new and youthful member, not widely known in national politics, is distinguished by being placed at the head of an important committee, and this fact renders the honor all the more conspicuous. The compliment to Mr. Durborow is very flattering.

A glance at the excellent portrait that is presented on this page reveals the fact that the West Side congressman is a young man, and of pleasing personal appearance. In fact he has just completed his thirty-fourth year, having first seen the light in Philadelphia, November 10, 1857. When he was five years old his parents moved to Williamsport, Ind. William Durborow, an uncle of the congressman, had been a pioneer of the town, settling there in 1834. After acquiring an elementary English education in the public schools of his adopted town, Mr. Durborow, in 1872, entered the preparatory department of Wabash college, at Crawfordsville, Ind. Later he enrolled himself as a student at the Indiana University at Bloomington, graduating in 1877. For two years after leaving college he was with a wholesale book house in Indianapolis. When he came to Chicago, in 1879, he entered the wholesale department of Field, Leiter & Co., and later was employed in the retail store Then, after being with that firm nearly three years, he worked for Crerar, Adams & Co. for six years.

But it was by his connection with the WESTERN ELECTRICIAN that the congressman's commercial career was principally distinguished. Within a few months after the date of the initial appearance of this journal Mr. Durborow was appointed business manager, and this position he held for three years, only resigning it last February to enter upon his duties as a member of Congress, to which office he had been elected the preceding autumn by a majority of over 3 000. The *Chicago News*, in a sketch of Mr. Durborow, states that the paper "was a remarkable financial success," and it may be added that Mr. Durborow bore his share in the achievement of this result. He was alert, enterprising and resourceful, and these qualities told in his business relations. Frank and cordial in manner, the young business manager was popular with his acquaintances, and he has a large circle of friends among the electrical fraternity in Chicago, and, indeed, throughout the country. He is in a position to know what the electrical paternity will want at the World's Fair, and although he is not a man to allow his friendly preferences to interfere with his duties as a sworn officer of the government, it will reassure the electrical people to recognize the fact that the chairman of the committee, from several years' experience gained on a representative electrical journal, will have the knowledge to deal justly with them, should any question be brought before the committee in which electrical interests are involved.

In view of his position it is hardly necessary to say that Mr. Durborow is a Democrat in political belief. He is accounted a shrewd and successful politician of the clean-handed type. He is unmarried.

The new chairman modestly tells how he was appointed in the following language: "When I was summoned to his (the speaker's) room and he asked me if I had a choice of committees I said, with some hesitancy, that it would please me very much to be on the Columbian Exposition committee. 'How would you like to be a chairman?' he asked. Honestly it took my breath. But I did not weaken. I thanked him and said it would suit me first-rate. That is the whole story. Why he did it is more than I can tell."

The Los Angeles, Cal, Electric company has increased its capital stock from $150,000 to $300,000.

The trustees of the town of Chico, Cal., have been considering the idea of erecting an electric light plant. The committee appointed to examine into the feasibility of the project has made a report, in which it is stated that the committee found a place on Chico creek where, at a small cost, an electric plant could be put in which would furnish the town with plenty of light. By damming the creek and piping the water a fall of 300 feet can be secured, enough to develop power for 60 arc lights and 1,500 incandescent lights.

Municipal Lighting Plants.

The city of Milwaukee has just had an interesting controversy over municipal lighting. The movement for establishing a municipal plant had many enthusiastic advocates, who made great claims for the proposed plan. In opposition to this project Edward C. Wall, president of the Badger Illuminating company, caused an investigation to be made, the result of which he presented in the form of an address to the members of the city council. Much valuable data was obtained in the course of President Wall's investigation which will be of general interest. The investigation was conducted by correspondence with city clerks, mayors and superintendents, and in all cases the information submitted was official.

Mr. Wall calls attention to the fact that local conditions affecting the cost of furnishing light should be taken into consideration, wherever the subject is discussed. "In Milwaukee," he says, 'after the first of January, new electric conductors to lamps must be placed in underground conduits, which are very expensive. Our superintendent estimates that it will cost not less than six thousand dollars a mile, perhaps considerable more."

Continuing in the same line, he says:

The Badger Illuminating company now has about 41 miles of pole-line. The ordinance requires that this 41 miles of line shall all be placed underground within five years, a certain percentage each year, so that in addition to the large expense that we will incur in building new lines, to supply lamps that will be ordered in the future, we will be obliged to expend within the next five years about $250,000 in changing the system at present in use. By this change we will lose the money heretofore paid for overhead conductors, and when that is taken into account, any profit that may have been made will be more than wiped out by the loss thereby incurred.

As to the cost of the construction of conduits, I have letters from the secretary of the Wisconsin Telephone company, showing that the work that company did in Milwaukee in 1890 cost about $6,784.80 per mile; from Mr. Goslett, the engineer of the Edison General Illuminating company, showing the cost of over twenty miles laid by that company to be over $11,000 per mile, and by the Milwaukee Street Railway company, over $10,800 per mile.

Referring to the experience of other cities in operating lighting plants, Mr. Wall presents some equally valuable information. He says:

I have reports from the mayors and city clerks, and superintendents of plants owned by cities, where the lines are all on poles, no conduits being used, in 18 cities, in 12 states, showing the cost of producing their own lights, which I will present to your committee. (See table below.)

It is interesting, in studying this schedule, to see how misleading mere reports are of the cost, without knowing the conditions. Take, for instance, the city of Urbana, Ill. It reports that it costs that city $38.33 per year; apparently a very low price, but the answers to questions that were asked throw light on the subject that changes matters. The lights in that city burn on what is termed the moonlight schedule—until 12 o'clock at night—being, in a year, 1,460 hours, making the cost 2 62-100 cents per hour.

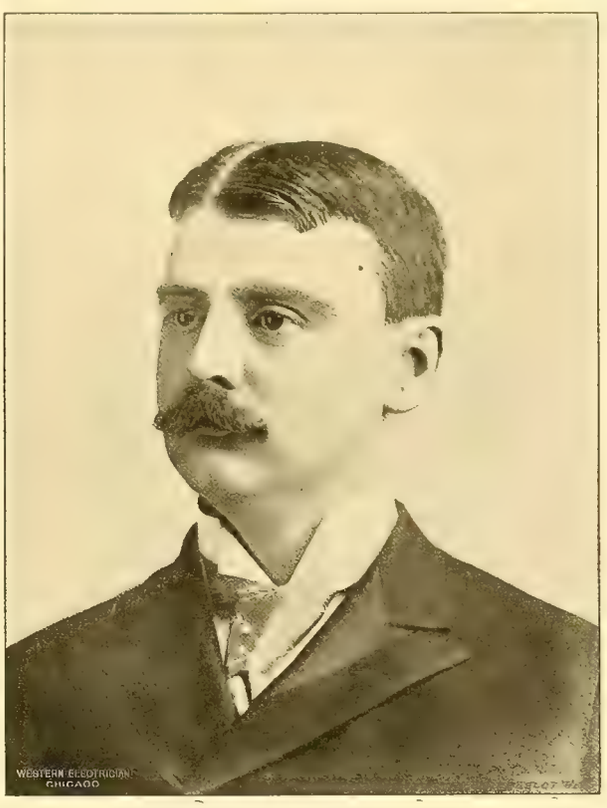
The Badger Illuminating company's city lights burn 3,910 hours in a year. At the same rate per hour the cost would be $102 64. The report also shows that there is no allowance made for depreciation except for partial repairs, and nothing charged for interest on the investment. The city has 35 lights, which are run in connection with the waterworks. How much of the electric light expenses are charged to this other department is not stated.

The city of Martinsville, Ind., reports 30 lights on streets, costing $40 per year; they are lighted at sun down and extinguished at midnight. No charge for depreciation or interest on the investment. At the same rate per hour, if run the same number of hours that the Badger Illuminating company's lights are, the cost would be $106.74 with no allowance for interest or depreciation.

Ypsilanti, Mich., reports 87 lights at a cost of $37 per year. The lights run on the one o'clock moonlight schedule; no allowance for depreciation or interest on the investment; at the same rate per hour, if run the number of hours that the Badger Illuminating company's lights are, would cost $81.32. with no allowance for interest or depreciation; and the power used is water, which every one knows is much less expensive than steam, where coal is the fuel.

Herkimer, N Y.. reports 50 lights at $50 per year. No allowance for depreciation or interest on the investment; run on the moonlight, midnight schedule. Figured the same as above, it would cost $106.75, with no allowance for interest or depreciation.

Aurora, Ill., about which we have heard so much, reports 118 lights at $67.99, lighted on dark and cloudy nights; no allowance for depreciation or interest. Would cost, if figured as



HON. ALLAN C. DURBOROW, JR.

REPORTS FROM MAYORS, CITY CLERKS AND SUPERINTENDENTS, WHERE THE ELECTRIC LIGHT PLANTS ARE OWNED BY CITIES, ALL ON POLES AND OVERHEAD WIRES. NONE USING UNDERGROUND CONDUITS.

NOTE.—Lamps on all night moon schedule burn 2,168 hours; to 12:00 P. M. moon schedule, burn 1,460 hours; to 12:00 P. M. every night, burn 1,875 hours. Badger company lamps burn all of each and every night, or 3,910 hours.

State.	City.	Number of Lamps.	Power and Fuel.	Schedule Lamps Burn On.	Price per Year.	If Burned Same No. of Hours as Milwaukee, Would Cost Per Year.	Remarks.
Arkansas	Little Rock	136	Steam, Coal	All Night, Moon	$ 81.00	$ 145.85	Depreciation and interest not figured
California	Alameda	93	" "	To 1:15 a. m. Moon	125.00	293 30	" " "
Illinois	Urbana	25	" Slack Coal Run in Connection with Water Works.	" 12:00 p. m. "	38 33	102.64	" " "
Illinois	Aurora	118	Steam, Coal $1.90	2,622 hours	67.99	101.25	" " "
Iowa	Lyons	37	" Pine Strips	To 3:00 a. m. Moon	68 00	148.58	Plant for sale; furnish commercial lights; profit is deducted from cost of city light. Depreciation and interest not figured.
Indiana	Madison	85	" Pittsburgh and Slack $1.44	All Night, Moon	63.35	114.17	Depreciation and interest not figured.
Indiana	Martinsville	30	Steam, Coal	To 12:00 p. m. Moon	40 00	106.74	" " "
Indiana	Goshen	32	" Fuel Oil	2 828 hours	70.72	97.75	" " "
Kansas	Topeka	184	" Coal	All Night, Moon	84 00	148.50	" " "
Kansas	Stockton						Plant discontinued, and for sale.
Missouri	St. Joe	161	Steam, Pea Coal, $1 65	All Night, Moon	58.00	104.40	Depreciation and interest not figured.
New York	Herkimer	50	" Coal	To 1:00 a. m. Moon	50.00	106.75	" " "
Ohio	Miamisburgh	41	" "	All Night, "	65.00	117 69	5 per cent. on $12,000 interest, no depreciation.
Ohio	Jackson	27	" Slack 35 cents Pea 60 cents	" "	80.00	144.27	Depreciation and interest not figured.
Ohio	Marietta	204	Steam, Nut Coal $1.25	To 12:00 p. m. every night	40.00-45.00	113 69	" " is allowed.
Pennsylvania	Chambersburg	67	" Bituminous and Screenings, $2.55	To 12:00 p. m. Moon	52.00	135.67	" " "
Texas	Fort Worth	51	Steam, Coal	All Night, "	60.28	124.73	" " not figured.
Michigan	Ypsilanti	87	Water	To 1:00 a. m. "	35 00	81.32	Lamps are 1,200 candle power. Depreciation and interest not figured.

others above, $101.25, with no allowance for interest or depreciation. Coal costs them $1.90 per ton.

Topeka, Kan., reports 184 lights, at $84, on the moonlight, all night schedule, no allowance for depreciation or interest; at same rate, if run as long as ours are, would make the cost $148.50, with no allowance for interest or depreciation.

Lyons, Ia., reports 37 lights, costing $68, run on the moonlight, 3:00 A. M. schedule; figured as above would cost $148.58. The city clerk says that the plant is for sale; further, that the city furnishes private lights, and deducts the profit from the same, which amounts to $144 per month, from the cost to the city.

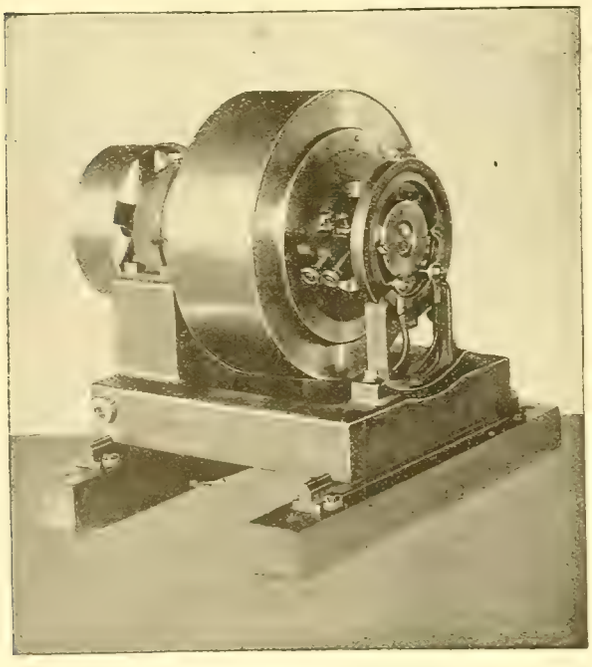
Jackson, O., reports 27 lights, costing $80 per year, run on the moonlight schedule; no allowance for depreciation or interest; if run the same number of hours that we do, would be $144.27 per year. The fuel used there is slack coal, costing 35 cents per ton delivered, and pea coal costing 60 cents per ton delivered.

The city clerk of Stockton, Kan., replies: "Our plant has been discontinued, and is for sale; can you send us a buyer?" Here is a chance for the distinguished electricians who have lately made such wonderful statements of the cheapness at which they can furnish lights, to go into business.

These reports are from cities that have small plants, and it is not fair to compare the cost therein with the cost of a large city, where the circuits are long and expenses necessarily greater. Every one of these cities has overhead service, which is the cheapest kind of construction, and this ought not to be lost sight of, for the cost, as I have said so often, between the construction and maintenance of an overhead and underground system, is of the very greatest importance in arriving at the value of the service. When it is shown, as is here shown, that the cost per lamp hour is greater in cities owning their own plants, after making the property allowances for different conditions, it seems to me that every one should be convinced that the claim that we have always made that we are furnishing the best and cheapest light in the United States, is proved beyond question.

Mr. Bevan, a gentleman connected with the Milwaukee College, has figured the average paid per light per state, in 527 cities, thirty-five different states, using 2 000 nominal candle power arc lights, burning every night and all night, at $145.58. This shows that the prices average considerably higher than those paid in Milwaukee, and with the exception of New York city and perhaps one or two other places, the conductors are through overhead service. The price paid in New York city is $164 25 per year for conduit service. The following is the list of states:

Alabama and	$141.80	New York	$121.44
Arkansas		Ohio.....	148.75
Connecticut	115 25	Rhode Island	182 50
Illinois.....	127 50	Texas	139.20
Maine.....	150.00	Wisconsin	138.00
Minnesota....	125.75	Colorado	163.50
Mississippi	125.75	Georgia	117 25
New Jersey and	151.70	Kansas and.....	125.20
New Hampshire		Iowa	103.78
Dakota	240.00	Michigan.....	185 66
Pennsylvania	110 40	Montana and	
Tennessee...	100.50	Nebraska	100.00
West Virginia	94.50	North Carolina.....	144.38
California	181.50	Oregon	250.00
Florida	133.00	South Dakota	153.00
Indiana	78.76	Washington	237.00
Massachusetts	155.72	Wyoming...	
Missouri	137.72		



THE WADDELL-ENTZ THREE HORSE POWER MOTOR.

The special committee that visited Chicago to ascertain the cost to that city of constructing and maintaining an electric light service for the same obtained the following information, the result of the city electrician's experience in Chicago: That a 1,000 arc light plant, with the lamps placed 150 feet apart, could be built at the rate of $499.12 per lamp, or a trifle less than $500,000; that it costs the city of Chicago $83 per year to maintain the lamps, with no allowance for interest or depreciation, and that the services of many persons connected with the same were charged wholly, or in part, to the fire alarm telegraph and other services, thereby lessening the apparent cost of the electric light department; that in the outskirts of the city the corporation had and was making contracts with private companies to do the lighting for $170 per year.

I want to call special attention to the fact that in estimating the cost at $499.12 per light, the lights were to be placed only 150 feet apart. At that rate it would cost $17,529 per mile, at which rate it would cost to reproduce the present system of the Badger Illuminating company in this city, about $825,000; it should be borne in mind also that to construct and maintain a system where the lamps are only 150 feet apart is less expensive than to construct and maintain that of this city, where the lamps average over 400 feet apart.

All the facts with reference to the conditions in Chicago must be considered to determine accurately the actual expense of construction there. The service owned and operated by the city of Chicago is in the thickly settled portions, where the street under the sidewalk is excavated and used for storage and other purposes by the stores abutting thereon.

In the report of the fire marshal for December 31, 1889, on page 100, will be found the following relating to electric light construction in that city:

"The feeders throughout are two-inch iron and steel pipe, laid under the sidewalks, inside the curb wall, or in the street, wherever it is considered the best and most economical to lay them."

It will therefore be seen that in laying the conduits for the electric light service in Chicago, very little excavating has to be done; that simply an iron or steel pipe is run through the areas, and the cables pulled through the same.

The Waddell-Entz Three Horse Power Motor.

The cut illustrates the three horse power motor built by the Waddell-Entz Electric company of Bridgeport, Conn. The motor is of the ring type with internal poles and runs at eleven hundred revolutions per minute. The variation in speed between no load and full load is claimed to be less than two per cent. It is a plain shunt machine without any series winding on the field. There is no sparking at the brushes under changes in load, and little heat in the armature and magnet coils when running at its full load. The armature is entirely inclosed in a brass case as shown, no wires being visible. The case serves to protect the armature from injury, and makes a handsome finish to the machine.

The form of the magnetic circuit cannot be readily seen from the cut, but is that of a single core wound with the magnet coil, and pole pieces are brought from each end of the core around the head and top of the coil and presented to the inside armature surface. This gives a short magnetic circuit and is said to be economica both as regards weight of metal and the exciting current required. The magnetic circuit is composed of two parts of cast steel, or malleable iron, with a bushing through the center of the magnet core for the shaft be aring. This construction gives one long bearing with the armature at one end, and the pulley at the other. The magnet is built in a very simple manner. All boring and turning is done on one center necessitating only one setting and centering in the machine. There is no planed work on the motor excepting the rails. The magnet coil is wound separately on an iron spool and then slipped on the core which is cast to the proper diameter and requires no turning down.

The Waddell-Entz machines are self oiling by means of a reservoir and chain at each end of the shaft. The oil wells communicate with each other by a hole at the bottom of the core and are filled from the back end of the machine, where the drain pipe is also situated. The bed plate has a saddle at the back end bored out to fit the magnet which is bolted to it as shown. The seat for the brush holder frame is bored out at the same centering.

The weight of the machine complete is three hundred and sixteen pounds, and the over-all dimensions are, height, eighteen inches; length with pulley, eighteen and three-sixteenths inches; width over rails, nineteen inches

The commercial efficiency of this machine is claimed to be 86 per cent. It may be stated that the larger machines of this type are of the multipolar type, but they are built with a single core and exciting coil, as in the three horse power machine.

Incandescent Lamp Hood.

The new form of hood for incandescent lamps shown in the illustration is one likely to become very popular. The construction is such that it can be used in many places instead of a "moisture-proof" globe. As will be seen it is a combination of metal and glass intended to completely inclose the lamp. The lower half, of glass, is securely

INCANDESCENT LAMP HOOD.

held in place by spring clips, but can be quickly removed when necessary to clean or to replace a lamp. The metal top, which is also used as a reflector, overlaps the globe in such manner as to protect it from "drip" and effectually prevent the entrance of water. In shipping, the parts "nest" one in the other, so as to occupy very little room in the package. This fixture was designed by Chas. Wirt and is being manufactured by the Electrical Supply company, Chicago.

Rapid Transit in Great Cities.[1]

By Sr. John V. Day.

It would be idle at this time of day, and more especially in any of the great cities of the United States, to dilate upon the importance of rapid transit facilities by some kind of railway for every thickly populated and active community. The public mind has by many phases of experience, some of them not of the most comfortable or reassuring character, become well educated up to a certain point in the development or unfolding of the rapid transit problem as one of the most conspicuous factors of enchanced civilizing tendency to every city within which there is congregated thoughout the day in its business center a vast array of men and women engaged, some as leaders and innumerably many more in the ranks of commerce, in the trades as well as the professions. These, and incessant activity in the pursuit of these, have caused such central areas to be so vigorously occupied for all purposes of business, that the entire population is, in respect to dwelling places, for housing and carrying on the domestic or family life, pushed from such centers outward and forced to plant homes in the surrounding less closely occupied districts.

How best to provide quite adequate transit facilities, that shall either constitute a system complete in itself, or form part of a system which, while providing rapid transit shall at the same time insure a full and satisfactory wayside railway accommodations for passengers, that is to say, with stoppages at short distance stations, such as every two, three, four or five blocks, throughout all hours of the day and much of the night, is beyond a doubt one of the most important, if not actually the most important, public question pressing for solution to-day in all the leading capitals and cities in the world. On its proper solution, as F. H. Monk, general manager of the West End street railway of Boston, truly remarks, "Hang vital considerations of public health, comfort and happiness, as well as the possibilities respecting the future increase in growth of population, in growth of wealth and the general well-being of the community; hence it is a matter of the greatest interest to all classes of people. To the capitalist because its proper solution ought to afford him opportunities for making profitable investiments in lands in suburban districts, of building houses and stores which will meet with a ready sale and renting in those districts, and of turning the present country roads and lanes into well arranged streets bordered by the quiet and retired homes of the cities' toilers. To the laboring man the proper solution of this matter presses because, under the exigencies of civic life, such solution alone affords him the opportunity to gain for himself a modest and comfortable home where his children may live and grow up to manhood and womanhood in wholesome surroundings of every kind, and to which for a small fare he may be transported daily at a high speed so as not to involve loss of time, and that with safety and comfort."

That there have been interminable difficulties surrounding the solution of this rapid transit problem is patent to every one, for in connection with it, as in all other human affairs, there have been evolutions of many kinds, and it is certain that by the operation of the great law of progressive development, we are in the very thick of the accomplishment of many more such, both in the respect of the laying out and construction of the lines of railway, and the vehicle, as well as the motive power for propelling the vehicles, in regard to which latter I must not omit to say, in addressing so eminently practical a body of gentlemen

1. Read before the Chicago Electric club December, 21, 1891.

as those who constitute the Electric club of Chicago, that it is certain, until some more advantageous form of physical energy is discovered, electrical energy will for long hold its own as the motive agent principally, if not in a very short time solely, employed for such rapid transit traffic. But a very great deal has yet to be done, to increase our knowledge of the internal and external waste of the electric motor of large dimensions, before such an universal application of electricity will be made, while another direction in which this problem holds out much promise to the practical electrician, is that which includes the secondary or storage battery, whose weight and bulk must yet be reduced and its tendency to short circuiting and spilling of the liquid got rid of, to render it in every way availiable for motor cars. I am glad to testify, and that very emphatically, that it does seem to me that a member of this club has gone a very long way further than others in this branch of electrical evolution. I need scarcely say that I allude to Mr. Pumpelly and the storage battery which bears his name.

It is safe to say, because it is unequivocally the fact, that almost all energetic committees are wide awake to the significance of rapid transit to themselves, and have grown to be thoroughly in earnest in their demands for it. But there has been an exception to this in our own city. Irrespective of whatever difficuities stand in the way, and which experience has proven to be not inconsiderable, the public mind has everywhere resolutely set its activities at work to remove them.

Judging from the appointment of a "Rapid Transit Commission" to deal with and report upon this question for New York city, and the movement in this matter in the city of Philadelphia, and of what we who are residing in or about the city of Chicago daily experience as to the pressing necessity in our very midst, while not referring to other less populous cities in the United States, and for the present, too, passing over the condition of this question in Europe, and in the United Kingdom in particular, it is certain that public clamor is forcing surely, although it be somewhat slowly, the evolution of a system of rapid transit between cities and suburban districts whose successful carrying out will be one of the chief engineering achievements of the closing years of the Nineteenth century.

Perhaps the most astounding fact in this connection is that our own city of Chicago, with the extraordinary vim and foresight of its citizens, and with more extraordinary necessity for rapid transit than is to be found in any other city of the world, should have delayed until within the last three or four weeks to get thoroughly awake in this matter, while only now it has become so from the civic chair, the city council, throughout the entire community, principally because of certain recent revelations in the coroner's court proving the toleration of legal malpractices because of the utter inadequacy of the present means of transit, which go to demonstate that by the existing absence of facilities there is on the part of the owners of some of the cable roads almost a regardless preference to kill outright some of the patrons whilst oftentimes leaving hundreds, nay thousands, of other to suffer for hours in the cold and wet, after having pocketed their fares by a batallion of rude and ruthless conductors, many of whom, to say the least, are so ill-mannered as to be unfit for the association assigned to them, rather than make any effort to increase those means of transit.

The development of a thoroughly adequate rapid transit system offers to the immediate prospect of the public an immense unfolding of benefits which have been long latent, while to the civil, the mechanical, no less than the electrical engineer, its carrying out is pregnant with the very fullest promise. As an industrial project there is none that I know of which opens up a vaster field for every branch of the iron, steel and woodworking industries, whence it follows that for the artisan it is replete with assurance of abundant employment. To the manufacturer of dynamo electric machinery and to the producer of copper, it presents the largest, and therefore most important field by far, as yet opened up

Although in the foregoing general considerations capital has been passed over, it is not left, to be mentioned here, in the last place, because it is least, but because it has seemed to me expedient to direct attention in the first place to the assurances which the preceding points imply; and for the reason that such assurances always help the movement of capital toward any particular line of investment, while it is almost unnecessary to remark that without such assurance it is in the nature of things impossible for sufficient capital to be moved, and that courageously enough for insuring progress to be made in any measure adequate to the ceaseless flow of human development in great cities.

The public voice will do more at first than other any force which can be brought to bear to influence the flow of capital, but certain experiences show that this is almost powerless to achieve much until several other interests, both municipal as well as private, have been consulted and fairly dealt with. Statistics have proven in regard to urban travel that facilities not only create traffic, but that the surest way of increasing the patronage of existing lines is to encourage the construction of additional facilities, and to provide increased velocity of transition.

This has been abundantly illustrated by the elevated railways in New York, the Metropolitan railway of London, the Brooklyn bridge and other instances.

The statistical fact I have just mentioned shows that instead of the municipal authority hampering and hindering the construction of urban lines, as in the past, by delays in granting franchises and by imposing heavy financial loads which it is notorious several such enterprises have had to encounter, they should be encouraged. The end to be attained in all such cases is of that degree of importance that no tendency ought to exist which should cause capital to be timidly held back at the inception of an enterprise by fear of municipal or state interference.

That this view of the matter is being taken by those who have given close consideration to the subject is clear from the attempt recently made by Senator Crawford, in the legislature of the State of Illinois to provide increased facilities for the acquiring of franchises for the carrying out of such railway enterprises; nor is it less encouraging a fact that the present mayor of Chicago has recently expressed himself in favor of cutting down the difficulties which bestrew the path of the promoters of street railways.

It is hardly possible for a well-devised scheme of rapid transit between the business center of a city and its residential quarters to be proposed which will leave any doubt as to the probabilities of its net earnings available for dividends, for the simple reason, which has been proved unvariable, that a line so laid out increases the population of the district it leads to and induces people to ride more frequently and for shorter distances. This foreknowledge is of immense importance in going to show how much capital per unit distance, say per mile, may be safely invested and therefore largely determines the character of the system which should be adopted. But while favoring on the one hand, as I do, much increased municipal and state facilities, and having pointed out that such railways are so safe an attraction for capital, I wish to add that it should not be possible, on the other hand, for capital to receive inordinate or extravagant returns, and the local authorities ought to guard a franchise against this. All cash capital actually invested in the enterprise should be reasonably sure of receiving a just and adequate reward for the risk undertaken, but in fairness to the public, who are its patrons, no more.

A company having been freely granted all reasonable and necessary rights and privileges, to enable it in good faith to carry out its plans in respect of the proper construction and working of its railway system, should as a sufficient set-off against the easier acquisition of such rights be held to the strictest accountability in the carrying out of its duties and obligations to the public instead of having such opportunities for escape therefrom as seems to be the condition of existence of the North Side cable railways of Chicago, which elicited such well-merited censure from the coroner and jury in the recent investigation of the causes of the collision in the La Salle street tunnel.

The public is indeed entitled to receive this much protection in return for the privilege to enter upon possession of a right of way to construct and operate any system of such railways.

With the indications, which the preceding general remarks point to, we are led to inquire what means or system is best adapted to carry out all the requirements of such a class of passenger traffic in the most perfect manner. This question has already received many solutions, some of which have been practically carried out, while others remain as yet untried, although not one of them is without the aegis of powerful advocates.

Of the several solutions which have been practically tested, the conclusion cannot be escaped that no one of them completely fulfills the requirements of any community, nor is any one of them free from some one or more of several inherent defects and dangers to life, which although it is a good deal to say, yet is not more than ought to be now said, viz.: that with the science combined with the practical experience in constructing and operating railways that the engineer of to-day possesses, such defects and dangers certainly can and ought to be avoided, and the public has the right to demand that they shall be avoided. No railway system can be considered as even approaching the condition of adequacy, unless in its inception it is so laid out as to have its carrying capacity developed with that ratio of growth which statistics prove to be a general law for every suburban district wherein a railway may be laid out leading from the business center of the city. Prof. Lewis M. Haupt has pointed out that the patronage of municipal lines increases as the square of the velocity of travel—from which the deduction is self-evident that the development of a city is dependent on rapidity of transit, and the further conclusion that on such means of transit much of the future general superiority of every great city is dependent. For all great cities the time has come when the science of municipal economy will have to be substituted for temporary makeshifts. Beyond a doubt every system of street railway, whether operated by horse traction, cable traction, steam locomotive or by the electric motor as at present developed, and whether used as surface roads, elevated roads or in tunnels, irrespective of the fact that so many of these have been constructed at enormous costs, are all of them nothing more than temporary makeshifts.

So far as I am aware there has been no attempt made anywhere to deal largely enough with this question, so as to lay out a system of such railways at the inceptive stage with a large and grandly true view of any great city's still greater future; hence the constant need in every class of municipal railway practice, up to to day, of having to destroy many costly works, which were designed without sufficient regard to the city's development, only to make room for still more costly works, which have not been laid out with any more inceptive foresight of such needs removed but a little farther off. The time has gone by for such extravagance and neglect, and there is not a city anywhere but which is in too large a way of business and the comfort and health of whose inhabitants is too largely at stake to admit of its property and prospects being longer trifled with. Such waste will bring want in every city as surely as in the homes of the negligent or careless.

Rapid transit is wanted everywhere upon the basis of the science of municipal economy, which includes common honesty, not upon the basis of boodle but straightforward business

In most cases lines of communication requisite to meet the pressure of this kind of traffic must, of necessity, be carried through some of the principal streets, and as these are frequently crowded with pedestrian, equestrian and vehicular traffic, a surface railway is in most cases out of the question, and this for two reasons.

First—Because it is impossible to obtain rapid transit on the same level with an interfering [illegible] several different directions.

Second—Because of the danger to human life which every system of railway on the surface of the street involves.

From these considerations it follows that a safe and adequate system of rapid transit can only be carried out by being entirely separated from the street traffic, which means that the tracks must either be raised above, or height above the street level or carried beneath that level.

These conditions have developed on the one hand the tunnel system, which is in operation in London and known as the Metropolitan railway, worked with a peculiar construction of steam locomotive, and the more recently constructed City & South London railway, wherein an iron and cement lined tunnel on what it has become the fashion to call, although erroneously so, Mr. Greathead's plan, with electrically operated trains, has been adopted. On the other hand the evolution has resulted in the elevated railway.

Before, however, either the tunnel or elevated railway was resorted to for this class of traffic, surface railways of different kinds were tried, and naturally so, as the immediate outcome of current experience in regard to traninsular or transcontinental railway traffic.

It is interesting to note that the first practical attempt at this was made in this country more than half a century ago, namely in 1834, when in the city of New York two lines of horse railways were first operated in some of the principal thoroughfares.

These lines developed an extraordinary statistical fact, namely, that the traffic immediately available for such railways is many times in excess of the population.

During the first year of their operation the New York horse railways carried 6,835,548 passengers, while the population then was 515.547 persons, showing the number of passengers to be about thirteen times the population. A few more statistics in this connection are available for our present purpose. In 1836, or two years later, the number of horse lines in New York was doubled, and the traffic increased to thirty-one times the population. In 1860 six lines of surface roads were in operation in New York city, when the ratio of passengers to population rose to forty-seven. In 1865 the number of lines had doubled, or reached the number of twelve, when the traffic amounted to 82,000,000, or eighty-three times the population. A decade later, or in 1875, the number of street railways had risen to nineteen, when, with a doubled population, the ratio of passengers carried reached a hundred and sixty times. Before this, however, through the growth of the suburbs, the necessity of rapid transit had begun to press itself upon crowded business communities in other countries, particularly in London.

Up to the year 1862 passenger traffic of the kind we are considering had been carried on in London by horse omnibuses, but even before then my friend, the late eminent engineer and shipbuilder, J. Scott Russell, F. R. S., had attempted the solution of this problem in the city of Glasgow by a steam omnibus, which ran for some time between that city and the suburban manufacturing town of Paisley. This, however, through frequent breakdowns, frightening of horses, and ending in a boiler explosion, was abandoned after about twelve months' use. The General Omnibus company of London in 1862 was carrying 41,068,000 passengers, and when the Metropolitan railway was opened it was expected by the promoters of that line that a great portion of the traffic which that railway was constructed to compete for would be taken away from the Omnibus company. Such, however, was not the case, for the facility which the Metropolitan railway developed for reaching the suburbs immediately produced a rapid growth in the number of passengers for being moved to and from those districts. In 1870 the Metropolitan District railway, as well as some of the surface tramways, was open to traffic, and although in direct competition with each other, the passengers carried rapidly increased in number until in 1884 the total number of passengers reached 308,821,000, of which 75,113,000 were carried by the Omnibus company, 75,926,000 by the Metropolitan, 38,521,000 by the District railway, and 119,261,000 by the tramways.

In the twenty years from 1864 to 1884 the population of London increased thirty-six per cent., while the passenger traffic increased 470 per cent. At the middle of this period, when many of the defects and dangers of operating passenger trains by steam locomotives in the long tunnels of the Metropolitan railway had become well recognized, a new movement took place in the city of New York, culminating in the Manhattan Elevated railway, which was opened for traffic in 1878. The traffic returns for that city after the elevated railway was built, although designedly constructed to compete with the pre-existing horse lines, showed that the ratio of passengers to population had reached 175. In 1885 twenty-three lines were in operation in the city of New York, when this ratio had risen to 213, while in 1890 it had reached 405.590,159 passengers. Of this immense number 191,611,382 were carried by the elevated railway; that is to say, an increase of more than 76,500,000 of passengers in five years. The balance, namely, 213,978,931, were carried by the horse railway, which shows an increase of over 4,000,000 in the same five years, or about one-twentieth of the increase in the elevated railway traffic.

These figures prove beyond question the extraordinary attractiveness for passengers which even a most imperfect, noisy and by no means clean system of elevated railway possesses in comparison with any surface railway, when the transit is quicker, and suggests how much greater the attraction of an elevated railway would be with a noiseless, and therefore smooth and clean, traffic, in comparison with a surface railway, or still more, any possible tunnel railway.

A remarkable proof of the manner in which traffic by means of a judiciously planned and well equipped railway between the heart of a city and its outer districts will create

its own traffic is shown in the case of the Brooklyn bridge, which, in 1884–85, carried 9,000,000 passengers, and in 1889–90, with the same two tracks, 35,000,000, and yet the ferries across the river are as crowded as they were before the bridge railway was opened.

In regard to how best to meet the necessities of such traffic, I have for some time given all the questions involved very careful study, and have been, for many solid reasons, led to decide against the possibility of any tunnel system being carried out at a cost which can be commensurate with proper dealing with a city's future. During these studies I reached the conclusion that a four track elevated railway, having two tracks for express trains and two tracks for wayside service, could alone meet all the requirements of the case. In this I have the support of Mr. Monk, general manager of the West End street railway of Boston, who, in a recent communication to the New York Electric club, said:

"I am constrained to believe that a four-track elevated road, allowing two tracks for express trains and two tracks for way service, built through the congested parts of the city to the suburbs, and connecting them with surface lines radiating from the termini of the elevated roads in such manner that the entire trip on both the elevated and surface lines may be made for one fare, will prove for many years to come a measure of great popular satisfaction, and solve, in many large cities at least, the present riddle of How shall we get to and from our homes and places of business cheaply and safely?"

Underground conveyance of many kinds is being urgently pressed forward at the present time, and especially one having, like the elevated system I have suggested, four tracks, two for express trains and two for wayside traffic, each track being placed in an independent tunnel, therefore requiring four tunnels.

Even if I omitted to notice the natural dislike which most persons have to descend out of daylight and fresh air into tunnels, however well these may be illuminated and ventilated, however luxuriously equipped for the passenger train service, there is an inherent dread of being the subject of some one or other of the many catastrophes which railway records are but too full of, as having happened in tunnels. These are, however, overlooked by the promoters of tunnel schemes. Especially have they been misrepresented by Mr. Sterne, the New York agent of the Greathead railway system, in an article published in the *Forum* of August last, wherein, too, the same gentleman does not hesitate to hazard some unblushing misstatements in regard to elevated railways. Let us give Mr. Sterne a little of our attention. In regard to the cost of the works for the four-tunnel Greathead road proposed for the New York city line, Mr. Sterne, when before the Rapid Transit commission, estimated the cost of a single-track tunnel, cut in the rock upon which it is assumed New York city stands continuously, at about one million dollars per mile of single track. Four of these tunnels, two for rapid taansit, the other two for wayside traffic, would therefore cost four million dollars per mile, including, as I understand, the extra excavations for underground stations and the elevator shafts for connecting these with the surface.

With all the advantages which we possess to-day in the practical uses of electricity, not only for operating trains, but for lighting them also, as well as tunnels, and for working elevators, it is open to serious doubt whether, when, to the foregoing four million dollars per mile, is added, the further cost of generating stations, motor cars, passenger cars, and the copper for the conductors, such a system could be constructed and operated so as to make a satisfactory return on the investment, at a fare which the traveling public would be willing to pay.

It is certain, indeed, that when, as is the fact in the United States at least, the public has for so many years been accustomed to be carried to the farthest limits of every important city for a five cent fare, upon the comparatively cheap construction of street railways hitherto used for this sort of traffic, it would be very unwilling from that point of view to encourage the adoption of so costly a scheme as the four-tunnel electrically operated one, since its adoption would imply resort to higher charges for travel.

Instead of raising the fares, the tendency is to lower them, and in some of the municipal legislatures—for instance, in that of Chicago—proposals have been made to cut the fare down to three cents. Upon an ordinary surface steam railway in the United States, it is found that a fare of one cent per passenger mile is the least that can be made to pay. For municipal railways the passenger mile condition has not, in this country thus far, come into operation, but a uniform fare for variable distance, which introduces the certainty that with such a very costly system of railway construction for municipal traffic, long distance passengers cannot pay.

In deciding upon any system of municipal railway communication, the fare which the public is willing to pay must not be lost sight of. It is one of the leading factors in determining the amount of capital which can be properly invested in such undertakings, and because of that this factor principally governs the engineering character of the works; that is to say, the engineering design must be such that while fully adapted for the prospective traffic, it must not cost more than a predetermined limit per unit, say per passenger mile or per mile length of structure. When, then, we add to the foregoing four million dollars per mile the cost of the electric plant sufficient to operate the intended traffic, we reach figures which are startling. It has been recently estimated by Theodore Cooper that to equip a double track railway with an electric plant sufficient to handle the traffic of the existing elevated railways of New York city would require an expenditure for real estate, engines, boilers, dynamos, conductors and motors at least equal to five hundred thousand dollars per mile of double track, but this is possibly somewhat in excess.

This would have to be doubled for equipping a four-track tunnel, thus bringing up the first cost of the four-track tunnel scheme to at least five million dollars per mile without including in the estimate numerous essentials which do not enter into the list of requisites for any above ground railway, whether elevated or surface. For example, there is not included in this estimate the cost of the elevators nor the electric plant for continuous lighting of the tunnels, stations and trains.

There is still another very serious point which arises in considering any system of underground railway operated electrically by continuous conductor, which, so far as I know, has not previously had public attention directed to it, namely, what is to happen in a tunnel with numerous trains in it, when a breakdown or other occurrence causing a stoppage of the electrical plant takes place? No electrical railway plant has as yet been devised which does not sometimes, and always very unexpectedly, stop, through the burning out of an armature, and from several other causes.

Such occurrences either produce a temporary stoppage of the entire traffic by the trains becoming congested together or otherwise interfered with when happening on above-ground railways. But, as with these there is always abundance of free space and light, each train is easily dealt with, and the passengers can at once alight, so that the inconveniences caused by such breakdowns on above-ground roads are reduced to a minimum.

Not so, however, in the Greathead circular tunnel, wherein the carriages are designed to have as little free space as possible between them and the tunnel walls or lining.

It would be impossible for passengers to alight from carriages in these tunnels excepting at the stations.

Not only a single train but many trains at the same instant will be in the same tunnel, with their loads of live humanity, powerless, helpless to escape, so that it is difficult to foresee how, in view of such casualties, which may be looked upon as among the certainties of any electrically operated tunnel system, the imprisoned passengers are to be extricated in any comparatively short time, even in the wayside tunnels, where it is proposed the stations shall be at short distances apart—say of two, three or four blocks. This pre-supposes the case of a failure of the train propelling part of the electrical plant only, but then the illuminating part of that plant is liable to break down also. This would add darkness to the horrors of the imprisoned passengers. Such break-downs occurring in the way traffic tunnels would be terrible indeed; in the express or rapid transit tunnels they would be appalling.

[*To be concluded next week.*]

The Lighting Situation in St. Louis.

Interesting developments in the lighting situation in St. Louis have been brought about by the election of R. T. McDonald as president of the big Municipal Electric Light & Power company. This company lights the city, having a contract by which it is said to be losing money. It agreed to furnish light to the city at $74.95 each lamp per year, relying on commercial business to give it a profit. The company is under bond for $50,000 to carry out its contract faithfully. The new president says quite plainly that an effort will be made to induce the city to pay more money for the lights. In an interview he is represented as saying:

"The stockholders of the Municipal company have got tired of carrying a bonded indebtedness of $1,000,000 and seeing the concern lose money every day. They demand a change. When this contract was made it was thought that the private business would be so large that the company would be justified in carrying the cheap city contract, but that theory was a mistake. It is impossible to keep up a lamp for less than $125 or $130 a year, and we find ourselves now with 2,400 city lamps at $74.95 and only 1,200 private lamps at $150. That's a losing business. See what these other cities are paying—almost double the St. Louis rate—and then tell me if we are not justified in raising the price."

"How will you do it?"

"Forfeit our contract, pay the $50,000 and start again. We will light the city for $130 a lamp. That is cheaper than other cities are paying, and it will be enough to give us a fair profit. We will introduce a bill amendatory of the contract we now have, and if it does not pass we will take up our plant and put it to use elsewhere or will sell the plant to the city and pay the $50,000 forfeit. The original cost was $2,000,000, and it has cost us since $600,000 to repair and improve it. We will sell it for the original cost. Our bill will go in pretty soon, and until we know what is to be done we will keep up the city lighting just as it is now."

Mayor Noonan said: "I am not in favor of the city's owning its lighting plant, and therefore I should not approve of a proposition to buy the machinery of the Municipal company. I do not care to say what I should do if the Assembly passed a bill making a new contract with the company. I do not want to anticipate any action of the Assembly. We will hold the company to the letter of its contract, and if they forfeit it we will take their $50,000 and then see what we shall do further. The forfeit should have been larger in the first place. It was a mistake to make it so small. Whatever we do, though, the city will not return to gas. That is now antiquated. We've got to have electricity. Aside from the inconvenience, it is too great an aid to the police for us to attempt to do without it."

Rapid Transit in Boston.

Boston, like New York and Chicago, is confronting the rapid transit problem, but the New England metropolis has the advantage in that it already enjoys the benefits of perhaps the greatest electric railway system in the world. But the down town traffic on surface lines is proving too much for the narrow, winding streets, thronged with pedestrians and vehicles, and the electric cars are forced to go so slowly that relief is sought. A rapid transit commission has been appointed, and President Whitney of the West End company lately appeared before this body with a plan for relief. Mr. Whitney gave statistics of the street car traffic of the past and estimates for the future, and then suggested a tunnel under the Common. He said:

We propose to connect Tremont street, Shawmut avenue, Washington street and Broadway to South Boston, with the northern part of the city by a tunnel commencing at the junction of Tremont and Warrenton streets and emerging at Adams square. This preserves substantially the line of travel as it at present exists, and we have provided, when public necessity and convenience shall require the development of an elevated railroad, that it shall enter and leave at precisely the same point. Now, that has not only the advantage of being the cheapest system which can possibly be devised, but it has the advantage of giving to the people throughout this district the greatest possible advantage in the use of it. It places cars from all over this district, from South Boston and from Dorchester, Roxbury, Brookline and Cambridge on one side, and East Boston and Middlesex county on the other—it places them side by side, whether they come by an elevated or a surface system, and gives to everybody the common advantage of each. The depot is so arranged that any man coming upon the lines of the West End road from any point in the district can at this central station take any other line, and go whithersoever he pleases. I believe that is the simplest, and, indeed, the only feasible solution of this question.

I believe that, if in the judgment of this commission they should see fit to empower the West End Street Railway company to do this work, and the necessary legislation can be obtained under which it can be done, this system of street transportation which has done so much to keep the moral condition of this community pure, and has done so much for the building up of Boston as a trade center, can be continued; but the West End Street Railway company cannot undertake this work unless you are willing to strengthen its hands, and the state is willing to strengthen its hands, by removing from them the danger of hostile legislation.

I have no desire to waste my days and nights in anxious thought as to how the West End shall be preserved from this hostile legislation; and, even if it were different, it would be impossible for the West End company to undertake to raise this money under the existing condition of things; and I cannot bring this too plainly before the commission, if they desire to have this work done.

I believe this is the only way that it can be done. I believe that whosoever undertakes this work, whether it be the West End company or not, the public necessity and convenience are so united in having this run as one system that sooner or later a practical consolidation of the two things will be brought about, even if they were to start separately. If the city desires to undertake this work, so far as the West End company is concerned, it has no objection. But it seems to me that the carrying out of this plan, the further extension of this transportation system into the eight-mile limit, and then, as time goes on, into the 12-mile limit, can be done ultimately by the West End company, if the state and the city will strengthen its hands in the manner I have indicated.

Chicago Electric Club.

On Monday evening last there was another jollification at the rooms of the Chicago Electric club, and for the third time this season the members threw aside all dignity, and united in the common purpose of having a good time. The paper of the evening was read by Prof. F. B. Badt. "Is it True What Electricity Is?" was the question which the professor answered most satisfactorily both negatively and affirmatively. F. E. Degenhardt presided over the meeting in his usual graceful manner, while Messrs. Buckley, Gregory, De Land, Fowler and others caused much laughter by their responses to the somewhat unexpected demands from the chair. After the momentous question of the evening had been decided, E. C. Loveland and W. M. Chase favored the club with two delightful selections on the piano and cornet. The formal meeting was adjourned after the announcement that on Monday evening, January 4th, Chief J. P. Barrett of the department of electricity of the World's Fair would read a paper on "Electrical Exhibitions During the World's Columbian Exposition."

The city council of Dayton, Tenn., has decided to use electricity for street lighting. The city agrees to take twelve or more lights at the rate of $120 per month for ten years. A plant is to be in running order within 90 days.

CORRESPONDENCE.

New York Notes.

NEW YORK, Dec. 26.—With the cheerfulness of the Christmas season upon us Cyrus W. Field's misfortunes seem sadder than ever before. It is almost with a feeling of relief that one hears that his son has been officially pronounced insane. The formal inquiry into the mental condition of Edward M. Field was brought to a close at White Plains on Saturday last. Judge Dykman officially confirmed the finding of Commissioner Robertson's jury, and on application of Cyrus W. Field, Jr., appointed Clara Lindley Field, the insane man's wife, a conservator to take charge of Field's person and property. She will be required to give security in the sum of $10,000. It is probable that Mrs. Field will furnish bonds Monday or Tuesday and then institute proceedings in the Supreme Court for the release of Field from Ludlow street jail. Cyrus W. Field is reported to be steadily improving. Whether the younger Field be insane or not, it can but be hoped that the finding may tend somewhat to soften the effect on the father of this heaviest and perhaps last blow.

While speaking of the Fields mention must be made that Frank J. Sprague's two indictments charging Edward M. Field with larceny in the first degree have been handed in. The extent to which Mr. Sprague is interested in the failure of Field, Lindley, Wiechers & Co. was explained in a previous letter.

The Gothamites can fight against the trolley system as hard as they wish; they can build their cable roads and try to block out electricity, but after all the more modern method seems to be creeping upon the great metropolis. The enemies of electric traction have worked hard and succeeded, in so far, at least, as New York city proper is concerned, but the beginning of the end is at hand, for the wedge has been entered in Brooklyn. For some weeks a strong fight against the trolley system has been made by some of the people on the other side of the bridge, and at one time it looked blue for electricity. Now, however, we witness the "survival of the fittest" for the trolley deal went through the Brooklyn board of aldermen on Monday with flying colors. All the main lines of surface railroads were authorized to substitute the overhead wires with electricity as a motive power, to succeed the horses now in use. The hitch that prevented this result from being reached a week ago was smoothed out on Monday, and the five members of the railroad committee—Coffey, McGarry, McGrath, Wafer and Thomas—were fully convinced that the trolley was what was wanted. A lot of long resolutions were drawn up in which were granted the petitions of the Brooklyn City, the Brooklyn City and Newtown, the Atlantic Avenue, and the Coney Island and Brooklyn Railroad companies for permission to substitute the trolley for horses. The resolutions specify that the poles for the support of the wires shall be of iron or steel, to be erected along the street curb, and shall not be more than twenty feet in height. The companies are authorized to use the elevated railroad structures for hanging their wires, and the rate of speed is limited to ten miles an hour. Each company is required to give a bond in $150,000 to indemnify the city for damages caused by any work done under this franchise. There is no section, however, requiring the companies to pay into the city treasury one cent for the privileges granted. These resolutions encountered a lively opposition to their adoption in Aldermen Beard, Heaney and Mackellar. But these opponents had no weight. Aldermen Coffey and Thomas said that they had talked with prominent people who wanted the trolley, and then a vote was taken on a motion to refer back to the committee. This attempt at delay was beaten by 14 to 3, Beard, Heaney and Mackellar alone supporting it. Then the trolley resolutions were adopted by a vote of 13 to 4.

The Long Island City Illuminating company has been awarded the contract to light the principal streets and avenues of Long Island City for a term of five years at $160 a lamp per year. There is no restrictions in the contract as to the number of lamps to be erected, and some unkind persons say that the contract was rushed through the board in great haste. Mayor Gleason is the principal owner of the stock of this company, which is simply an offshoot of his electric car line.

Electrical inventors might do worse than think twice when they hear of the organization known as the Parisian Inventor's Academy. The 'Academy" in its anxiety to secure the support of American inventors, to say nothing of the small sum of $10 incidentally mentioned, has been sending notices to certain people, which stated they had been elected honorary members of the "Academy," and by forwarding $10 would receive a medal and diploma. Postmaster Van Cott sent to Paris to find out about it. He received a reply that there was nothing known against the Academy, but that it was a private organization.

There is some talk that efforts will be made to prevent the renewal of contracts for private wires from the Produce Exchange which expire March 1st. These wires are leased by big operators, as a rule, and some of the smaller fry object to the system. The cost of a private wire to Chicago is $18,000 a year.

The list of casualties for the week might be longer. There was one fire and two deaths accredited to electricity. The fire was on Thursday night in the west end of the waiting-room sheds of the new Pennsylvania railroad station in Jersey City. Crossed electric light wires were the alleged cause. Employes discovered the flames, and soon extinguished them.

Speaking of the honors showered upon electricity by those at a loss for reasons why and how deaths and fires occur, calls to mind that John George Roth, the crank, who attempted to shoot the Rev. Dr. John Hall November 29th, was on Thursday found not guilty, the jury deciding that Roth was insane at the time of the shooting. Roth is what might be termed a new type of the peculiar species referred to above. He stated on the stand that it was in 1879 when he first learned of a conspiracy against him. Those who conspired against him, he said, wore an electric apparatus around their necks which generated electricity by pulling a string. This electricity they threw into him, producing an itching and burning sensation. An "itching" and "burning" to the extent of about 350 volts applied at intervals by the "pulling of a string" might possibly keep before John's mind the fact that ministers are not necessarily conspirators. W. F. O.

Milwaukee, Wis.

MILWAUKEE, Dec. 29.—The dispute of months has been settled by the city renewing the electric light contract with the Badger Illuminating company for four years at $110 per lamp per year. Such was the result reached at the last meeting of the common council. The special committee reported that from figures furnished by the Milwaukee Power & Lighting company the cost of maintaining a plant of 500 arc lights would be $29,406.50, or $53.83 per lamp, not allowing any interest, the cost of the plant being $150,000. The Badger company, the committee reported, already had a capacity of 1,000 arc lights, while the capacity of the Milwaukee Power and Lighting company was 210. The latter plant was for sale at $150 000. The committee reported that from City Electrician Barrett of Chicago, it had learned that the cost of a new plant of 1,000 arc lights would be $500,000, and that the cost of maintaining the plant, with the wires laid underground, would be $80 per lamp per year. The committee thought that it would be advisable for the city to secure a plant of its own, as soon as it was financially able to do so, but agreed with Mr. Barrett that it would be cheaper to wait until the close of the World's Fair. Right upon the heels of the special committee's report came a proposition from the Milwaukee Power & Lighting company to sell its plant to the city, after increasing its capacity to 500 lights and fully equipping it it with apparatus of the Western Electric company of Chicago, upon the following terms: The sum of $37,500 to be paid down on or before February 15th next; February 15, 1893, $52,000, with 6 per cent. interest, and the same sum and interest on February 15, 1894, and February 15, 1895, making a total principal of $193,500, and amounting, with interest, to $212,180 The company offered to give the city a lien upon the last two payments, amounting to $104,000, for the faithful performance of the proposed contract, and to run the plant at its own expense for $62.50 per year, for one or two years. Under the terms of the Badger company's offer the city would pay $55,000 a year for 500 electric lights and have nothing at the end of the four years, while under the Milwaukee Light & Power company's offer it would own its plant at the end of four years. To some of the aldermen the Milwaukee company's offer was very seductive, and it was certainly unexpected to all. A motion to refer the matter was lost and so were motions to make a contract with the Badger company for a year, to make a three years' contract, to fix the price at $100, to pay $100 for underground construction and $90 for the overhead system, all with the Badger company. The report recommending the award of the contract to the Badger Illuminating company, at $110 per lamp per year for four years, was finally adopted by a vote of 25 to 8. The discussion that preceded the settlement was something remarkable, even in the common council. During the discussion President Hare left the chair to state that the members of the Milwaukee Light & Power company had tried to induce him to take stock in the corporation It was not an attempted bribe, however he explained.

On December 19th, after everybody had been led to believe that the electric light fight had been settled for four years by the decision of the Common Council to award the contract to the Badger Illuminating company at $110 per lamp per year, the Milwaukee Light & Power company levied an injunction restraining the city officials from signing the contract with the Badger company. The Milwaukee Light & Power company claims that the common council's proceedings in the matter were illegal. It is averred that the contract should have been awarded to the lowest bidder by the Board of Public Works, after proposals had been advertised for and received, instead of which the Common Council passed a resolution directing the board to make a contract with the Badger company to furnish 500 lights for four years at $110 per light per year. The price is exorbitant, the Milwaukee Light & Power company claims; and it is willing to furnish lights at a much lower figure. The course pursued by the common council, it is further averred, is a mere subterfuge to make it appear that the city is contracting for the use of a patented process, although the Milwaukee Light & Power company is willing to furnish the same light by another process for a much smaller price, if given an opportunity to bid. The Badger company's rival has secured a writ of certiorari returnable next March. The city attorney, however, will at once attempt to dissolve the proceedings, so that the city may sign the contract with the Badger company. The latter concern will meanwhile furnish lights to the city without a contract, relying upon the municipal authorities to reimburse it in the end. It may be some time before the troublesome matter is settled.

The decision of the Common Council in favor of a long-term contract with the Badger Illuminating company created some feeling among the advocates of a municipal lighting system. The Federated Trades Council adopted strong resolutions scoring the aldermen for "surrendering to a monopoly." An indignation meeting was to have been held in a Walnut street saloon last Saturday evening, but the indignant citizens were not in it, and resolutions expressing confidence in the aldermen were adopted with but three dissenting votes.

The Western Union Telegraph company has succeeded in securing the common council's permission to introduce the aerial cable system as a compromise between the overhead and underground wire systems. The ordinance was ordered to a third reading at the last meeting, the majority report recommending its passage being adopted by a vote of 21 to 12.

Henry C. Payne has submitted to the common council the ordinance regarding street railway extensions, the document having first been approved by Henry Villard. The extensions included in the ordinance have already been outlined by your correspondent. They extend in every direction, reaching to the new city parks and tapping suburban residence districts. They are several miles in length, and Mr. Payne estimates that it will cost in the neighborhood of $550,000 to build them. The ordinance provides that work shall be commenced on or before June 1, 1892, and completed before December 1, 1893, provided that no tracks need be constructed upon any street until the grade of such street is finally established. Mr. Payne asks that where open or excursion cars are mounted upon the trucks of the regular cars, a license fee of only $7.50 shall be required for running them from May 1st to November 1st. The regular annual license fee for street cars is $15. The company will not use open cars, he declares, if an additional fee of $15 is required for them, but if the fee is made $22.50 for each motor, $15 for the regular cars and $7.50 for open cars, the company will use open cars, and the city will receive an additional income of $2,000. The ordinance is in the hands of the council railroad committee.

J. E. Cummings, who has had charge of the construction of the Edison company's underground system here, has been ordered to San Francisco, where he will establish a station. He will leave early in January. Mr. Cummings has made an excellent record in Milwaukee. He is a practical, successful electrician, has worked himself up from the ranks, and looks well after the interests of his employers. Some weeks ago there was trouble about cables laid under the river. Mr. Cummings had them examined, and it was reported that they were all right, but he felt certain that something was wrong, so he put on the diver's suit himself, examined the cables, remaining under water quite a long time, and thus finding out the nature of the trouble.

The dates and subjects for the university extension lectures on electricity which Dr. H. B. Loomis of the State University, will deliver under the auspices of the Wisconsin Electric club are as follows: January 8th, "Electrostatic

Induction;" January 15th, "The Electric Current;" January 22d, "The Electro-Magnet;" January 29th, "Electro-Magnetic Induction;" February 5th, "The Dynamo and Motor;" February 12th, "Electric Discharge in a Vacuum." All the lectures will be given on Fridays and they are to be delivered at the high school.

About 2,000 people attended the ball given by the street car employes at the West Side Turner Hall last Saturday evening. The floor was so crowded that dancing was impossible until a late hour, when many of the people had gone away. The attendance included the managers and superintendents, as well as the conductors, drivers and motor men. All enjoyed the fun. The ball netted a handsome sum for the relief fund.

On the Farwell avenue line electric cars have begun running from the Kirby House, which before had been the down-town terminus, to the Union depot, making the full length of the line. The new line to the depot crosses Michigan street bridge instead of Huron street bridge, as the old one did, and it passes within half a block of the Bijou and Davidson theaters, so that it will prove a very great accommodation to East Side people.

The Milwaukee Street Railway company and Con Dean, the saloon keeper who some time ago temporarily prevented the operation of the northerly part of the Farwell avenue electric line by means of an injunction, have clashed again. The North avenue and Farwell avenue lines cross each other at a point where Dean owns a corner, which is occupied by his saloon, and the company found that it would be very convenient to put up a pole at this corner. Dean objected, but the construction gang unloaded the pole in front of his place and started to put it in position. This was last Saturday morning. Dean grabbed his coat and rushed down town. The foreman knew by experience that Dean had gone to secure an injunction, and so he engaged extra men, and the work was soon being done with might and main. On the other hand, Dean knew how to get an injunction about as expeditiously as anybody could, and he and a deputy sheriff, the latter with the necessary papers, arrived on the scene just as the men were raising the pole in order to put it into position. The job was not finished. The injunction did not interfere in any way with the operation of the Farwell avenue line.

In Milwaukee, as the case cited proves, injunctions count, but up in Superior the orders of the courts seem to be treated like so much waste paper. At that place a fierce fight has been on between the street railway people on one side and the Northern Pacific and Great Northern railway companies on the other. The street railway people, in extending to a populous suburb, where the steel plant is located, found it necessary to cross 3,000 feet of right of way belonging to the Northern Pacific, South Shore and Great Northern railway companies. The South Shore people capitulated without making any trouble, but the other roads, especially the Great Northern, did some tall fighting. On Friday last, while General Manager Mellen of the Northern Pacific and some of his associates, were conferring with President Norvell of the street railway company, Superintendent Merrill, of the Great Northern, proceeded to the disputed crossing and put a force of men at work pulling up pavement for another track. The city officials were with the street railway people, and Superintendent Merrill and his men were arrested. Then Norvell had the Great Northern enjoined, and the Great Northern had Norvell enjoined. The steam railroad companies kept fifty men on the ground and engines running over the tracks. The street railway company had men on the ground too, and all that night the opposing forces camped around bonfires. About 2 o'clock Saturday afternoon some twenty policemen took the places of the street railway men, and the latter made a rush and drove their opponents, whom they outnumbered, off the contested ground, the police making no attempt to interfere. The street railway laborers at once began to tear up the rails crossing the street, and to lay their own iron. The Great Northern officials, finding that nothing else could be done, purposely wrecked a train of freight cars at the crossing, and stopped all further work by anybody. A little later General Manager Mellen of the Northern Pacific wired his subordinates to make some peaceable arrangement with the street railway people, which left only the Great Northern, with 2,000 feet of right of way, in the fight. The Great Northern finally gave up the contest. Before the end, however, seventeen injunctions had been served upon each other by the contending parties.

Henry C. Payne does not give any credit to the story that Henry Villard will be compelled to retire from the presidency of the Edison General Electric company. Mr. Payne, by the way, was in Minneapolis last week, and while there ordered three cars from the Northern Car company. The cars are somewhat longer than those now in use, and one of them will arrive in a few days. The Villard syndicate has ordered cars from every builder in the United States, and the builder whose cars are shown to be the best will receive the order for the new cars with which it is intended to equip the various lines in the city.

Cleveland, O.

CLEVELAND December 26.—The Cleveland Electric club is in a flourishing condition and it numbers among its members all the prominent men in the business in this city. The success of the organization is due to the efforts of C. W. Foote and S. D. Nesmith.

The new Western Union building will be equipped by the Fisher Electric company of Detroit.

The Postal Telegraph company, owing to a recent fire, will remove to new quarters.

It is said that the Thomson-Houston Carbon works at Fremont be will removed unless the city will grant a $25,000 bonus.

An electric light plant is to be erected at Wilmington, Clinton county.

Ground has been broken for the new electric belt line at Findlay.

The survey of the Galion-Bucyrus electric railway is completed.

The Ashtabula electric road is in operation.

A great deal of interest has been awakened by the bid of the Cleveland Electric company (now a $100,000 corporation) to illuminate the entire city with 1,300 arc lights of 2,000 candle power each for $163,000 a year.

The Cowles Electric Smelting & Aluminum company has begun a suit against the Pittsburg Reduction company for infringement on electric smelting.

The Long Distance telephone company will be allowed to bring its wires into the city overhead.

It is probable that the city will build one or two electric light plants next year. Several estimates have been submitted, one of which places the approximate cost of a 2,000 arc light plant and five hundred miles of wires at $365,000.

A type written summary of the business of the year just closed has been issued by the Short Electric Railway company of Cleveland, which gives some interesting details, showing the rapid growth of the electric street railway business in general, and of this great corporation in particular.

The first contract made for the equipment of a street railway system by this company was under date of September 23d, 1889—only a little more than two years ago. This road, located at Muskegon, Mich., put in, at the time indicated, an initial equipment of five cars, since which time three additions have been made to the plant until now it has 18 cars in operation with a generator capacity of 305 horse power. The last road equipped by the Short company, the contract for which was signed under date of November 30th, 1891. has just been put in operation within the past ten days at East Liverpool, O. Since the first road was built 35 lines in all have been equipped with the Short double and single reduction and gearless motors covering nearly four hundred car equipments. A number of the roads have started with a few miles of track and later have built extensions, in several instances there and four additional orders having been given for motors and other apparatus.

Among other roads using the Short system are the Rochester Railway company, Rochester, N. Y., 100 cars Pittsburgh & Birmingham Traction company, Pittsburgh, Pa., 20 cars; Jamestown, N. Y., Street Railway company, 19 cars; Trenton, N. J., Passenger Railway company 15 cars. The following named roads have been equipped since September 16th, of which no previous record has been made: Denver Tramway company of Denver, Colo: Alliance Street Railway company, Alliance, O.; Ashtabula Rapid Transit company, Ashtabula, O.; Trenton Passenger Railway company, Trenton, N. J.; Atlanta & Chattahoochee River Railway company, Atlanta, Ga., and the East Liverpool & Wellsville Street Railway company, East Liverpool, O.

This summary indicates a very prosperous and satisfactory year's business for this company, placing it among the leading corporations engaged in street railway equipment in this country.

Concord, N. H.

CONCORD, N. H., December 26.—Plans are being made for developing the water power of the Merrimack river at Sewall's Falls, about two miles from the central part of the city. A company has been formed which will build and equip a model electric generating station for the transmission of power, light and heat. This company will use 2,000 horse power, and it claims that it can furnish power so cheap that every steam engine in the city will be supplanted by the electric motor. There will be a surplus of 3,000 horse power over which this station will require, which may be utilized for manufacturing purposes.

The Shawhan Electrical Works, which started here some months since, have suddenly ceased operations. The type of the company's dynamo, it is claimed, was almost identical in size and form with the Sprague stationary motor.

Penacook, a suburb of Concord, is just installing a lighting plant for arc and incandescent lamps. Water power will be used when possible, but a boiler and engine are provided for emergencies.

The Concord & Montreal Railway company has just installed a large isolated lighting plant in this city for its depots and repair shops.

The Whitney Electrical Manufacturing company at Penacook is to make additions to its already extensive buildings for the manufacture of a new portable electric fire engine invented by E. R. Whitney. He claims that by this invention the weight of the engine is reduced 2,000 pounds. It will be operated by storage batteries.

The West End extension of the Concord Street railway is exceeding the expectations of the company. It was thought that the line would not be made to pay, and a sum of money was subscribed to induce the company to build it. The patronage is so large that other extensions will undoubtedly be made in the spring.

A. B. C.

Appleton, Wis.

APPLETON, Wis., December 26.—Electrical matters have been booming here, and the year 1891 will show more electrical work than any previous two years together. Within the last year the city of Appleton has been favored with an electric street railway and arc lights for illuminating the streets. The street railway, which was put in operation October 3d, is giving the best of service. The present equipment consists of five motor cars, made by the St. Louis Car company, and operated by five Edison single reduction motors of 25 horse power each, and six trailers. The trailers will be used only during the summer, as the traffic is not heavy enough now to require their employment. It is the intention of the company to lay new rails in the spring, as the old rails are thought to be too light. Girder rails will be used.

The Edison company is installing a plant of 540 lights at De Pere, Wis., for the Kimberly Clark Paper company. Two Edison dynamos of 270 lights each will furnish the current, and Okonite wire will be used throughout. The work is in charge of J. A. Peterson of this city.

The Edison Electric company has just completed the plant for the Kimberly Clark company at De Pere, Wis., and is now busily engaged on the new plant of the Van Nortrick Paper company at Combined Locks, which will consist of an installation of 200 incandescent lamps, and a 300-light Edison dynamo. The Kaukauna Electric company has just finished a new central station. It has put in a new 200 horse power Corliss engine owing to low water, and two more Edison dynamos of 300-light capacity each, and expects to add a 30-light arc machine before spring. The work is being done by the Electrical Engineering company of Chicago, under the supervision of William Fisher of Chicago.

The Telulah Paper company of Appleton now uses steam throughout for operating its mill and dynamos, a 700 horse power Corliss engine having been installed by the Allis company of Milwaukee.

A. C. Langstall, electrician of the Edison Electric company, will pass his Christmas at his home, La Crosse, Wis.

L. C. A.

Denver, Colo.

DENVER, Colo., December 26.—President Otto Mears of the Rio Grande Southern Railway company has organized a company to be known as the Ouray & Ironton Electric Railroad, Light & Power company. The company has been incorporated with a capital stock of $800,000. The incorporators are Otto Mears of Denver, Charles Munn of Ouray, Fred Walsen of Denver, Joseph N. Cassanova of Phillipsburg, Pa., and William A. Wallace of Clearfield. The principal office will be located at Ouray. The company will build an electric road and telegraph line from a point near Ouray to where Red Mountain creek empties into the Uncompahgre river, and thence up Red Mountain creek to Ironton, also, from the point where Red Mountain creek empties into the Uncompahgre river, up the river through Poughkeepsie Gulch to the head of Cement creek. The Tramway company's Nineteenth avenue electric line is now in operation. This takes the place of the Eighteenth avenue line.

Mayor Rogers is convinced that tower lights are not what the city wants, and says that there will be no appro-

priation for them next year. They are expensive, it is claimed, according to the present charges, and some of them will doubtless be abolished. The mayor says there will be a general re-arrangement of street lighting the coming year.

The Park Hill motor line is to be operated by electricity. The line is owned by Merritt, Grommon & Winne, and the Chamberlain Investment company, and runs from the city park to Park Hill and More's Park Heights near Mont Clair, being four miles in length. Only one car has hitherto been run over the road, but the increase of business warrants the change which will be made in a few weeks. The power house is to be located at Park Hill. Electric lights will also be furnished by the company.

Within the last two months there has been a notable increase in Denver's street car facilities. On December 19th, the new system of the Metropolitan Street Railway company was put in operation. The system includes the line to the Gentlemen's driving park and the South Tremont, Thirteenth street and Eleventh avenue line, all operated by electricity. With this system and the Stout street line, which will soon be completed, the Denver Tramway company will have in operation 41¼ miles of railway; electric, thirty-five miles; cable, six and a quarter miles. Denver now has fifty-six and three-quarters miles of double-track electric and cable street railways traversing every portion of the city.

Irving Hale is in Breckenridge making arrangements for putting in an electric light plant there.

Ogden, Utah, is greatly interested in a projected electric power plant, to be erected on Ogden river. O. D. Banks and Wm. M. Thompson, representing California capitalists, are exploiting the scheme, and have secured a fifteen year franchise from the city. The plant will be of 1,900 horse power and cost $100,000. E. C. D.

PERSONAL.

E. T. Gilliland was in Chicago for several days last week.

Henry S. Thornberry of the Toronto Electrical Works was in Chicago on Monday.

C. H. Barney, of Alexander, Barney & Chapin, New York, is visiting the World's Fair city.

C. A. Benton, manager of the railway department of the Detroit Electrical Works, was in Chicago last week.

H. A. Pevear, president, and C. A. Coffin, vice-president and treasurer, of the Thomson-Houston Electric company, Boston, visited Chicago this week.

W. E. Gump, general manager of the Writing Telegraph company, New York, was in Chicago on Saturday on his way home from St. Paul where he had been in the interest of his company.

NEW INCORPORATION.

A. C. Robertson company, Princeton, N. J.; capital stock, $50,000; to manufacture and sell electrical supplies of every description; F. A. Dennis, Princeton, N. J.

Royal Electric Shield company, Portland, Maine; capital stock, $200,000; to manufacture and deal in electrical goods and appliances; Benjamin G. Ward, Portland, Maine.

Municipal Fire & Police Telegraph company, Kittery, Maine; capital stock, $250,000; to manufacture and deal in police, fire telegraph and other electrical apparatus; Frank E Rowell, Kittery, Maine.

Du Laney Clock company, Chicago, Ill.; capital stock, $300,000; to manufacture, sell, lease and deal in electrical clocks and other electrical appliances and apparatus, time registering devices, motors and meters; Gregory, Booth & Harlan, 152 Dearborn street, Chicago, Ill.

Green River Coal & Coke company, Seattle, Wash.; capital stock, $1,000,000, general coal, coke, railroad, steamboat, manufacturing, mining, smelting, mercantile business; also erection and operation of gas and electric light works and waterworks; A. S. Dunham, Seattle, Wash.

United States Portelectric company (incorporated in W. Va.), New York, N. Y.; capital stock, $5,000,000; conducting the business of propelling by electrical means merchandise and other articles of trade and manufacturing the apparatus and machinery for the above purpose; E. W. Wilson, Charleston, W. Va.

Boonville Electric Light & Power company, Boonville, Ind.; capital stock, $10,000; to manufacture electricity and electric lights and other kinds of light, and to furnish motive power for the running of other machinery and for the sale of electric and other forms and kinds of light; Hatfield & Henenway, Boonville, Ind.

Mexican Chemical-Electric company, Chicago, Ill.; capital stock, $2,000,000; to manufacture and sell galvanic batteries, portable electric lamps, fans, pumps and all other things appertaining thereto, also to sell rights for any towns, cities, counties and states in the republic of Mexico; W. S. Baker, Illinois Trust and Saving Bank building, Chicago, Ill.

ELECTRIC LIGHTING.

The Badger Electric company of Racine, Wis., operates 150 arc and 3,000 incandescent lamps.

The city of Henderson, N. C. has advertised for proposals for lighting the city by electricity.

A company has, it is stated, been organized to establish an electric light plant at Wichita Falls, Tex.

The city council of Mobile, Ala., will meet on January 5th to decide the question of purchasing an electric light plant.

It is said that the American Construction company has obtained franchises to erect electric light plants at Batesville and Dardanelle, Ark.

The Owensboro, Ky., Gas Light company is reported as having purchased the plant and franchise of the Owenboro Electric Light company.

The new electric light and power house in Brunswick, Md., was totally destroyed by fire recently. The flames originated where the smokestack of the boiler passed through the roof. The estimated loss is $10,000.

The London Board of Trade will shortly have under consideration upward of thirteen applications from local bodies in London and from private companies for permission to light with electricity various districts within the metropolis.

Those present at the station of the Edison Electric Illuminating company, Paterson, N. J., Saturday before last witnessed a very pretty sight when the new 250 horse power compound engine, built by the Ball & Wood company, was started. Little Elizabeth Brock, four-year-old daughter of the general manager of the company, after some climbing, successfully reached the throttle valve, and exerting all her strength, gave it a twist which threw 2,500 lights into the dark places of the city.

The Newark Electric Light and Power company of Newark, N. J., has brought suit before Vice-chancellor Green against the receiver of the United Traction company for rent for the use of the wires and franchise of the former company The suit discloses the terms of a contract made in 1888 by which the Traction company leased the privilege obtained from the Electric Light company. The Traction company agreed to pay a rental ranging from $1,750 to $2 450 per year for fifteen years, to supply power to the other company, pay all taxes on the property leased, and abstain from all competition. The franchise in question comprises only a part of the public grants to the Newark Electric Light and Power company.

A judgment for $15,000 and costs in favor of the Brush Electric Light company of Buffalo, N. Y., against the Cobb Vulcanite Wire company of Wilmington, Del., and others, has been ordered in the special term of the supreme court. In May, 1890, the plaintiff made a contract with the Wilmington company for laying wires and subways and connections thereto in the streets of Buffalo, agreeing to pay $25,361 for the work as specified. Work was begun about three months later, but about February 1st the defendant discontinued the work, which was still incompleted. The plaintiff claims that the work is of no value whatever to it in its present incomplete condition, and that the defendant has been often requested to go on with it. The plaintiff further claims that in order to procure an electrical system equivalent to that required to be furnished by the defendant's contract in a completed state, it has been put to an additional expense over and above the contract of at least $15,000. It is also claimed that $5,000 worth of business was necessarily refused by the plaintiff because the work was not completed.

ELECTRIC RAILWAYS.

It is said that an underground electric line is to be built in St. Louis.

The first section of the San Francisco and San Mateo electric road has been completed.

The Houston City Street Railway company of Houston, Tex., will erect a brick shop and make its own cars.

By June 1, 1892, it is expected that the street railway at Eureka Springs, Ark., will be operated by electricity.

An electric road is to be built at Kenosha, Wis. It will connect the outskirts with the business portion of the town.

Residents of Cape May, N. J., have a plan under consideration to build an electric railway along the entire beach front.

It is stated that arrangements have been concluded for the necessary funds for equipping the Anniston, Ala., street railway as an electrical line.

A new electric railway is to be built between Haverhill and Lawrence, Mass. It is presumed the Thomson Houston company will furnish the plant.

The council of Hot Springs, South Dakota, is considering an application for a franchise for an electric road to extend from the Catholicon Spring to the Plunger Bath.

The Atlanta West End & McPherson Barracks street railway and the Grant Park electric street railway of Atlanta, Ga., has been consolidated. The new company will be known as the Atlanta Traction company.

The Short company of Cleveland, has the contract to construct the electric railroad of the Atlanta & Chattahoochee River Railroad company. The line will be 15 miles long. It is said that the power house will be located near Bolton.

An electric railroad, 25 miles in length, on the island of Martha's Vineyard is proposed. The line, as projected, will run from Cottage City, through Tisbury and Chilmark, to Gay Head. Scenic attractions are largely relied upon to make the route popular.

ELECTRIC MINING

A new type of mining locomotive has been leased for the Loyal Hanna Coal company's mine by the Edison General Electric company. The motor is of the four pole type, protected by heavy castings. A specially devised regulating mechanism is used. The requirements of the contract stipulated that the locomotive should be capable of delivering 360 tons of coal every hour to the hoist wagons at the bottom of the shaft. This meant the hauling of a train of thirty coal cars over a distance of 3,000 feet every fifteen minutes. The total weight of such a train is about 120 tons. Sharp curves and heavy gradients, some of which run to four and five in a hundred, necessitated great traction force. The usual speed is 7½ miles, but under test this was increased to 12 miles.

TELEPHONE.

O. H. Guion and W. W. Clarke have been granted a franchise to construct a telephone line at Newbern, N. C.

The Austrian minister of commerce has announced that telephonic communication will shortly be opened between Vienna and Trieste.

Superintendent Mallett of the Bell Telephone exchange in Rochester, N. Y., reports long-distance business as increasing rapidly.

The York Telephone & Telegraph company, recently incorporated, is privileged to construct telephone lines in certain counties of Virginia.

A Paris correspondent writes that the London-Paris telephone line has proved so successful that increased facilities will have to be provided to meet the great demands made upon the service.

The Adirondack and St. Lawrence Telegraph and Telephone company has been incorporated with a capital of $75,000. The lines of the company are to be extended through Herkimer, Hamilton, St. Lawrence and Franklin counties in New York state. The managers are William Seward Webb, Henry L. Sprague, Edward M. Burns, Frank G. Smith, F. Egerton Webb, John H. Prall and James Eagan.

TELEGRAPH.

It is reported that work on the cable to connect Florida with the Bahamas will be begun this month. The line will be 225 miles long.

The *Daily Financial News* says that the sales of Western Union that recently broke the price to 80⅝ were on Philadelphia orders, and are believed to be based on the postmaster-general's action in recommending a postal telegraph scheme. The Western Union officials say that the proposed measure will not be reached at this session of congress.

MISCELLANEOUS.

Electric interlocking signals are to be used on the Pennsylvania railway.

All the electric wires in Melbourne are to be laid under ground at a cost of $400,000.

A mechanical letter stamper, operated by electricity, is on trial in the postoffice department at Washington.

A great celebration was held recently at Berlin University in honor of the seventieth birthdays of Professors Helmholtz and Virchow. The occasion was observed with much enthusiasm.

The New York correspondent of the *Chicago Tribune*, who is not always reliable, by the way, "hears" that there is a project on foot for the establishment of an electrical factory at Pullman by the Thomson-Houston company.

Is is asserted that pieces of aluminum may be successfully soldered to each other, and to other metals, by using silver chloride as a flux in conjunction with ordinary solder. The metals, one or both of which are aluminum, are placed in the relative position required in the joint, finely powdered fused silver chloride spread along the line of junction, and solder melted on with a blowpipe or other device It is claimed that joints are thus easily and rapidly obtained, and become hard and perfectly sound on setting.

An ingenious Frenchmen has invented an electro-chemical method of sharpening files. The inventor immerses the files, which have first been thoroughly cleaned of grease, for twenty minutes, suspended from a metal plate, in a mixture of 100 parts water, 6 parts nitric acid and 3 parts sulphuric acid. The plate is placed in connection with a number of carbons immersed in the same liquid. The corrosion of the metal takes places in the cavities only, so that the edges are sharpened in exactly the same manner as if the operation had been performed by a file cutter. The process is stated to be very satisfactory from both a practical and an economical point of view.

TRADE NEWS.

The New York Insulated Wire company has removed its New York office from 649-651 Broadway to Nos. 13,15 and 17 Cortlandt street.

The Law Telephone company, 85 John street, New York, has sent out a very unique catalogue in the shape of a profusely decorated stocking of true feminine length and beauty.

The Dixon Crucible company, Jersey City, has issued a very neat and beautifully illustrated catalogue, showing the different kinds, sizes, etc., of its well-known pencil, and also explaining the use of graphite in electrical work.

The Vulcanized Fibre company of Wilmington, Del., is to have a very handsome exhibit of its wares at the Electrical exposition in the Crystal Palace, Sydenham, England. The display embraces not only the various forms of fibre used as insulating material, but also a great number of other articles of general interest. The general European agents for this concern are Mosses & Mitchell,

68, 69 70 and 71 Cheswell street, London, E. C. This house has been established for about sixteen years. The warehouse of the firm is a four-story building about eighty feet square, which is almost exclusively devoted to these goods. The Vulcanized Fibre company has sub-agents in the leading cities in Europe, whom it supplies from the London warehouse.

To judge from the list of sales of the Page Belting company, Concord, N. H., a considerable amount of new electrical machinery must be in the course of erection both in this country and abroad. Not only are the sales for the United States most encouraging, but the foreign orders are indicative of a healthy trade. This company has lately shipped belts to Russia, Brazil, Cuba and Venezeuela.

The Link Belt Machinery company, Chicago, has recently issued a new price list and catalogue that will be sent free to all persons interested. The company manufactures the Ewart detachable link belt in all sizes, a labor-saving device that is in very general use for elevating and conveying machinery, and many other appliances for handling raw or manufactured material in bulk or packages.

It isn't often that the electric light man dabbles in the tender passion, but this Christmas there was one at least of the Chicago fraternity to whom Cupid was no stranger.

The best of all will grow on us
Until we cannot hide our love.

Such words as these on a business card of greeting would seem to indicate that the little god who sports the bow and quiver is a welcome visitor in at least one commercial establishment in this city.

Prof. Albert C. Carman of Purdue University, Lafayette, Ind., in a letter to the Hine Eliminator company of New York, says: "Our Hine eliminator works to our entire satisfaction. Steam comes about nine hundred feet, and we have had great difficulty with wet steam. This relieves us completely." The company has also sent the third eliminator to the University of Michigan, at Ann Arbor for use on one of the high speed engines in the electrical laboratory of that institution.

One of the most novel and best arranged holiday show windows in Chicago is that of the Electrical Supply company, corner Randolph street and Michigan avenue. A fountain in the center throws up a flood of water which falls in prismatic colors over numerous Sunbeam lamps artistically arranged around the base. Hundreds of curiously tinted bulbs and shades combine to fill the window with a spectacular irridescence that is almost bewildering at night. A tasteful disposition of handsome electrical hardware serves as a finishing touch to the attractive display.

The Consolidated Electric Manufacturing company, 154 Franklin street, Boston, Mass., has just placed on the market a little fixture called the Eclipse bell pull attachment. The object of this little novelty is to obviate the trouble of having to take a bell-pull to the shop to be fitted up so that it could be used as an electric bell. The aim was also to furnish the hardware trade with an attachment whereby customers buying a bell-pull and wishing it fitted so as to ring an electric bell might be supplied at a moment's notice with an attachment that might be relied upon as positive and durable.

It may be remembered that it was at the last moment that the Weston Electrical Instrument company, Newark, N. J., decided to exhibit its electrical measuring instruments at the Frankfort Electrical exhibition. At the exhibition these instruments were brought into direct competition with those made by such prominent firms as Siemens & Halske, Hartmann & Braun, and other makers of good reputation and recent developments show that the confidence of the manufacturers in the merits of the Weston instruments was not too great. The company has received most favorable notice in many of the German scientific journals; and, what is more important, numerous orders for voltmeters and ammeters have since been booked from many of the best electrical engineering firms in Germany and other countries, including Siemens & Halske, Ganz & Co., Shuckert & Co., Lahmeyer & Co., Allegemeine Electricitats Gesellschaft, the Societa Generale Italiana di Elettrecita and the Brush Electrical Engineering company. Orders have come, too, from many of the most distinguished electricians of Europe, notable among whom are Prof. H. F. Weber of Zurich, Prof. Kittler, Prof. Kohlrausch, Prof. Perret and Prof. Lichtheim. Prof. Weber was a member of the Testing Commission of the Frankfort exhibition, and had an opportunity of thoroughly examining into the merits of the Weston instruments.

The efforts on the part of the Crocker-Wheeler Motor company, New York, to make an attractive display at the exposition in Augusta seem to have been appreciated by the Southerners. The Augusta *Chronicle* fills the larger part of a column with a description of the exhibit. George C. Field, the company's representative in charge, is to be congratulated upon the good impression created. Quite a variety of applications of motors were shown. On the right of the entrance to the Crocker-Wheeler space was a Hardy ice machine driven by a one half-horse power motor. Next to this the Gould triplex pump, operated by a one-quarter horse power motor, was shown. There was also a skeleton frame of a motor illustrating how the machines are wound. An interesting feature of the exhibit was a 45 light dynamo, run by a three horse power motor. By this plant the lights of a revolving sign were kept burning while a little arc motor revolved the sign. Besides the main exhibit, the Crocker-Wheeler Motor company had its motors on an electric piano and a sewing machine at the exhibit of Thomas & Barton. The Field electric dental outfit also excited a great deal of favorable comment. In connection with this equipment there is a small search lamp that is placed in the mouth of the patient, and with the combined use of a tongue depresser and a small looking glass, a tooth may be thoroughly inspected. Mr. Field left the exhibit in the care of the company's agent, W. Edward Platt.

BUSINESS.

The Union City Electric Light company, Union City, Tenn., has just received an 80 horse power Ball engine.

The Perkins Electric Switch Manufacturing company, Hartford, Conn., is already in receipt of a number of orders for '92.

B. L. Coe, secretary of the Steele & Johnson Manufacturing company, Waterbury, Conn., has a large number of orders booked for future delivery.

General Manager P. T. Pulsifer, of the Mather Electric company of Manchester, Conn, will start on an extended western trip soon after January 1st.

The Ohio Baking company, Cleveland, O., has just added an 80 horse power automatic cut-off engine built by the Ball Engine company, Erie, Pa., for electric light purposes.

The Crocker-Wheeler Electric Motor company, New York, has again taken additional space in the building which it now occupies at 430 and 432 West Fourteenth street. More machinery will be put in.

The Lawrence Gas & Electric Light company, New Castle, Pa., has been increasing its capacity by the addition of a 150 horse power Ball engine. Dravo & Black, the Pittsburg agents of the Ball Engine company, made the installation.

General Manager E. L. Frisbie of the Benedict & Burnham Manufacturing company, Waterbury, Conn., states that he is very well pleased with the growth of business in the electrical trade, especially in the West, where it has increased largely in excess of his anticipations.

R. F. Blodgett, secretary of the Pratt & Whitney company, Hartford, Conn., has been confined to his home for several weeks with a severe attack of gastric fever. He is improving very rapidly, though, and expects to be able to be back at his desk soon after the first of the new year.

The Hart & Hegeman Manufacturing company, Hartford, Conn., is very busy perfecting a number of novelties which will be offered to the trade in the near future. The Hart & Hegeman switch is meeting with remarkable success, and already a number of orders have been booked for the coming year.

The electric light plant being erected at Key West, Florida, is a source of great curiosity to a great many of the natives, who had never seen anything of the kind before. The three large compound engines furnished by the Ball Engine company, Erie, Pa., are the center of attraction. The largest engine on the island hitherto was one of antiquated type of 6 horse power.

The Norwich Insulated Wire company, 58 Cedar street, New York, has recently been making a number of tests of its fireproof wire under the supervision of F. J. Clark. Mr. Clark reports that he overheated the wire without any sign of bubbling or the compound boiling out or softening of the covering Other experiments demonstrated the truth of this concern's claims for a fireproof wire.

The New England Electrical Supply company of Bridgeport, Conn., has arranged a very unique display of electric lighting in the windows of Reade & Company's dry goods store in Bridgeport. The display consists of a miniature trolley system with signal lights, and a background of miniature houses. The whole is lighted with 1 candle power lamps and there is also a windmill and an electric plant in operation.

The Eddy Electric Manufacturing company, Windsor, Conn., reports that its business during the months of October and November was larger than that for any two previous months since it has been in business. Four years ago this concern moved from Hartford to the present site, with a force of workmen that required hardly a portion of one floor. Now the entire building is not only occupied but in order to meet the increasing demands of the trade, there is under consideration the building of an addition to the present factory, or the erection of a new one.

The Peckham Motor Truck & Wheel company, Kingston, N. Y., has been in receipt, of late, of some valuable testimonial letters. The Rochester Railway company writes that up to November 23d it had not taken out one Peckham wheel on account of being flat. The wheels have been in use under ten trucks over twelve months on this road. The Butte Consolidated Railway company states that the trucks which it is using have so far given entire satisfaction, and in future it may use them in place of all others. Of the interchangeable wheels the Jamaica & Brooklyn Road company writes that they have given perfect satisfaction, and are considered by the company to be the most economical wheels for electric cars. The Long Island City & Newtown Railway company is much pleased with the radial geared centilever truck sent for trial. It has been in service for about two months, and is giving entire satisfaction. This truck prevents the oscillation of cars, takes the curves easily and is easy riding. The action of the brakes also excited favorable comment. These are only a few of the flattering testimonials received by the Peckham company and they certainly speak for themselves as to the excellence of the firm's work.

ELECTRICAL PATENTS.

Issued Dec. 22, 1891.

465,444. Electric Switch. Henry Barton, London, Eng.

The fifth claim reads as follows:

"In a locked electric switch, the combination of a laminated spring-brush, and actuated-handle, two oppositely placed cylindrically formed terminal contacts made adjustable inwardly, and a base-plate for each contact, with adjusting-screws substantially as and for the purpose herein described."

465,447. Guard for Trolley Wire Insulators. Francis O. Blackwell, Lynn, Mass.

465,469. Electric Railway Trolley. Charles S. Foster, Whitesborough, N. Y.

465,470. Globe Holder for Electric Arc Lamps. Horatio A. Foster, New York, N. Y.

465,501. Train Signaling Apparatus. Paul Synnestvedt, Chicago, Ill.

The objects of this invention are to provide an absolutely reliable train signal which shall be of simple and cheap construction and adapted to be operated at will through the medium of signal cords provided in the usual position in each car, which will instantly give notice of any defect in the apparatus or in the electrical connections thereof, and which, though in constant operative condition, may be very economically maintained and that with the slightest degree of attention from the trainmen.

465,508. Cut-Out for Incandescent Lamps. Herbert C. Wirt, Boston, Mass.

465,511. Electric Snap Switch. William S. Andrews, New York, N. Y.

465,512. Rheostat. William S. Andrews and Alfred K. Warren, New York, N. Y.

This invention relates to means for controlling the speed of electric motors used to drive ventilating fans; and the invention consists in supporting a resistance conductor on the fan guard, and in certain combinations of devices fully described and claimed.

465,514. Electric Arc Lamp. Henry P. Ball, Brooklyn, N. Y.

465,525. Electrolytic Apparatus for Treating Metals. Edward S. Hayden, Waterbury, Conn.

465,548. Annunciator for the Supposed Dead. William H. White, Topeka, Kan.

The object of this invention is to provide a means whereby the supposed cadaver (buried before life is extinct) on regaining animation may sound an alarm through the annunciator located at the superintendent's office or other suitable place, by which a signal of life may be imparted and also immediate rescue rendered to the recuperating body by means of fresh air until the said body is disinterred, and medical aid summoned.

465,564. Conduit for Electric Wires. Henry W. Johns, New York, N. Y.

465,592. Gearing for Electric Motor Cars. Owen F. Evans, Columbus, Ohio.

465,594. System of Electrical Distribution. Frederick A La Roche, Philadelphia, Pa.

465,602. Electric Circuit Closer for Burglar Alarms. William C. Thompson, Minneapolis, Minn

The last claim reads:

"2. The circuit-closer consisting in the combination, with the spring carrying the roller, of a hook insulated therefrom a lateral pin provided upon the roller and adapted to be brought against the hook to close the contact therewith when the roller is rotated in one direction, and a stop in the path of the pin for limiting the movement of the roller.

465,613. Electric Railway. William H. Applegate, Atlantic, Ia.

465,618. Electric Switch. Gwynne E. Painter, Baltimore, Md.

465,648. Combined Signal and Telephone System. Thos. W. O'Brien, Wilkesbarre, Pa.

Of the four claims the third is given:

"The combination with an annunicator system consisting of two or more individual signaling circuits extending from a central station to two or more subsidiary signaling points, of a key at each signaling point, which, when not employed in transmitting a signal, normally maintains contact with a branch of a normally open return circuit, a speaking instrument capable of being placed in operative connection with each such branch, and a speaking instrument in said return circuit at the central station."

465,655. Independent Electric Clock. Walter J. Dudley, Somerville, Mass.

465,665. Hanging Device for Arc Lamps. William K. Howard, Jr., Fredericksburg, Va.

465,684. Incandescent Electric Lamp Fixture. Gustave E. Villaret and Victor E. Rondel, Philadelphia, Pa.

465,685. Electric Arc Lamp. Henry C. Waldecker, Austin, Minn.

465,767. Low Water Alarm. Franck St. Clair, Manchester, N. H.

465,778. Adjustable Support for Telephones. Charles H. Gatchell, Fredericton, Canada.

465,801. Fire Extinguisher. Cassius M. Radford East Concord, N. H.

465,805. Means for Turning On and Off Electric Currents. Thomas C. Smith and Benjamin D. Acker, Philadelphia, Pa.

465,806. Electric Railway Trolley. Frank J. Sprague and Patrick F. O'Shaughnessy, New York, N. Y.

465,808. Dynamo Electric Machine. Rene Thury, Geneva, Switzerland.

The first of the three claims reads as follows:

"A multipoler dynamo electric machine or generator comprising two concentric rows of field magnets disposed the one within the other and having the unlike poles of the magnets of the respective rows in juxtaposition, a rotatable armature composed of a divided hollow, thin iron cylinder mounted between said rows of magnets and provided on the inner face with internal axially disposed conductors, and on the outer face with external axially disposed conductors and connections at the respective bases of the armature for coupling up said conductors from pole to pole."

465,809. Electrical Testing Instrument. Richard Varley, Jr., Englewood, N. J.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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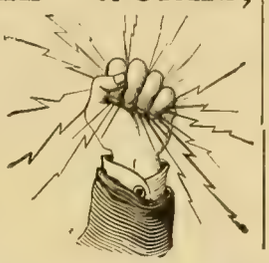

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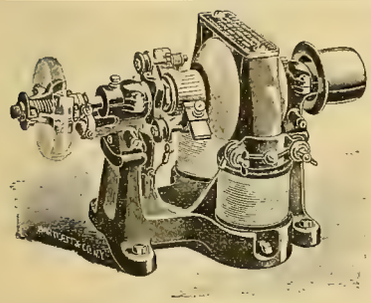

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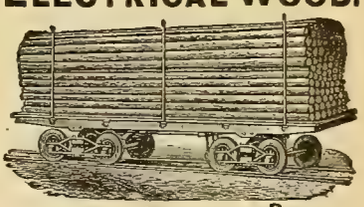

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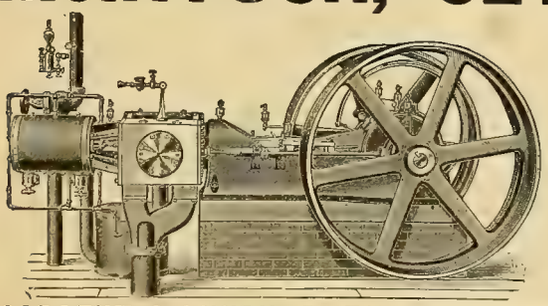

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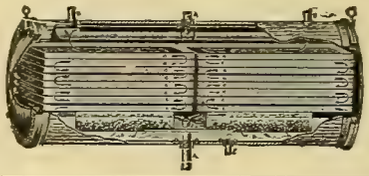

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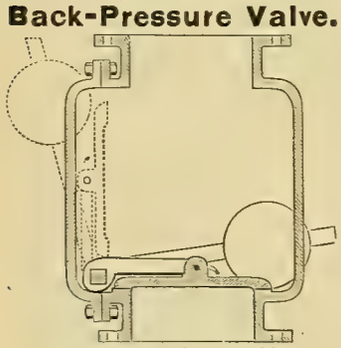

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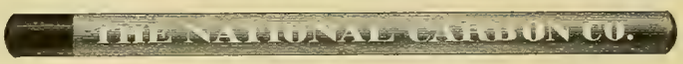

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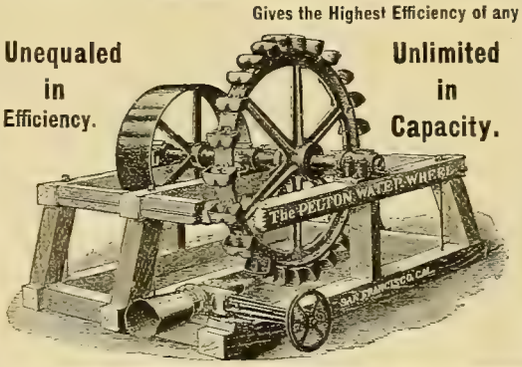

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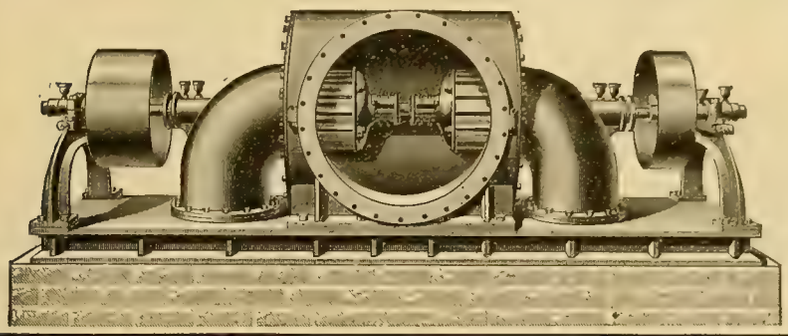

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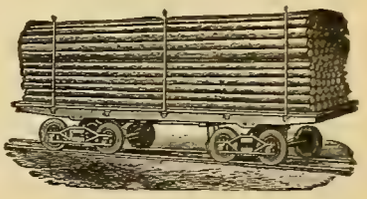

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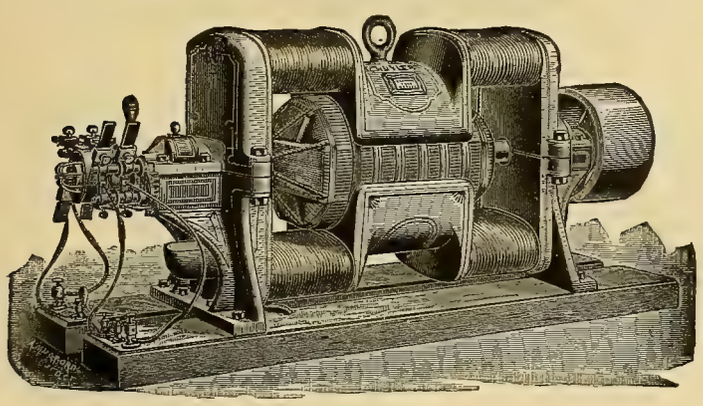

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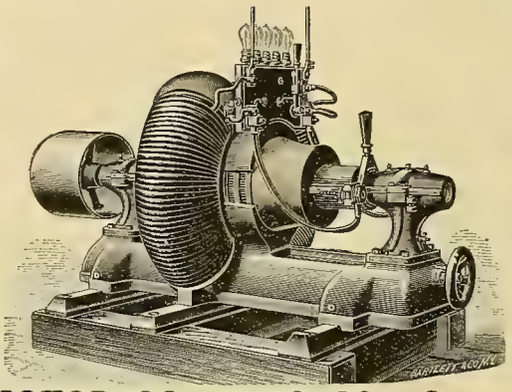

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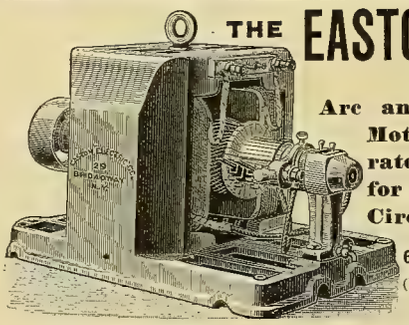

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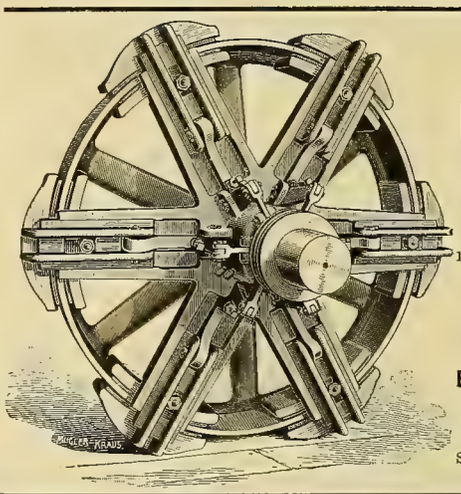

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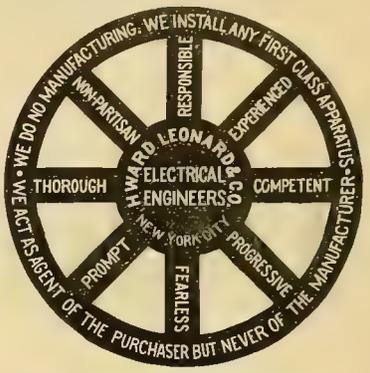

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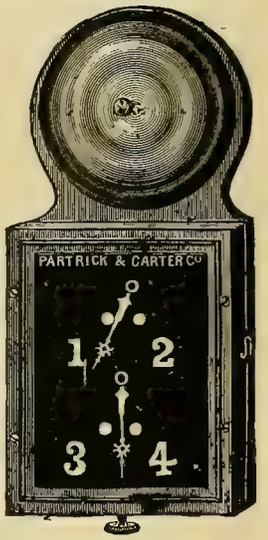

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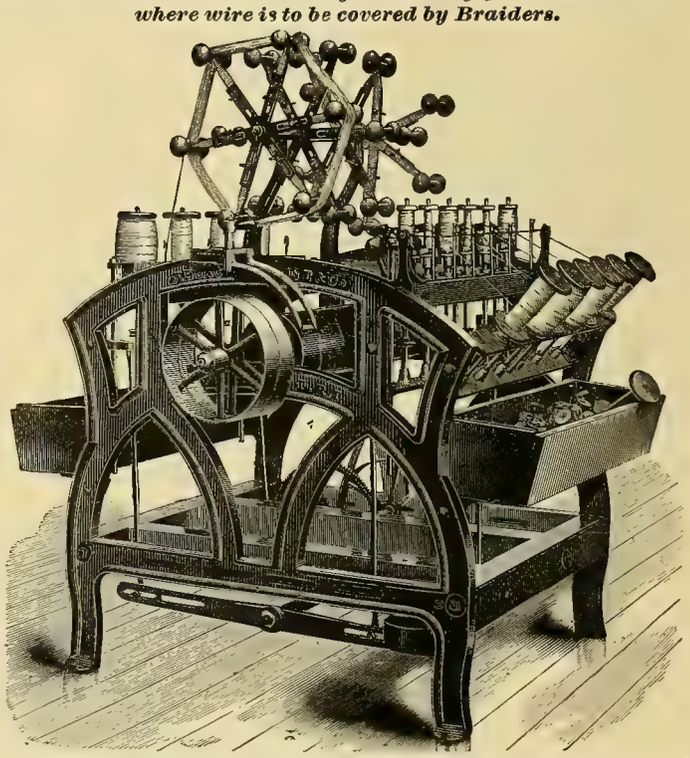

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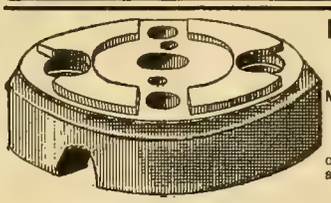

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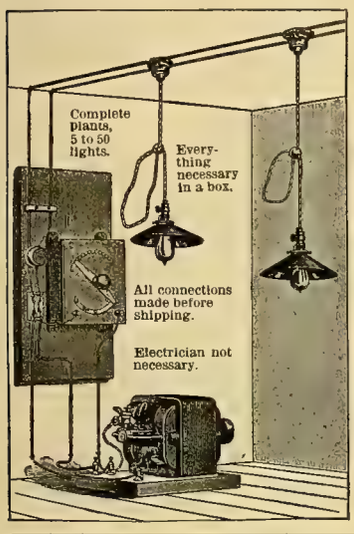

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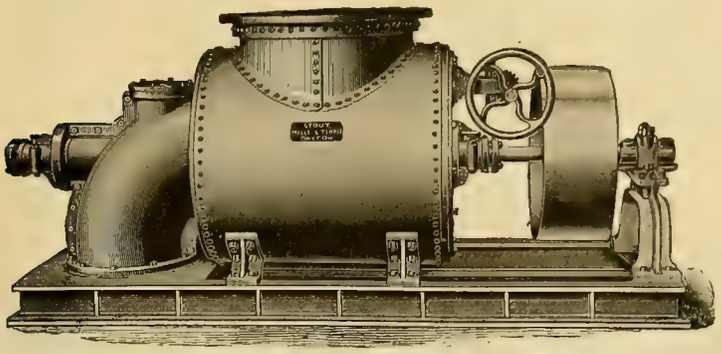

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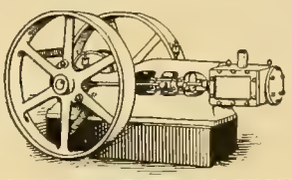

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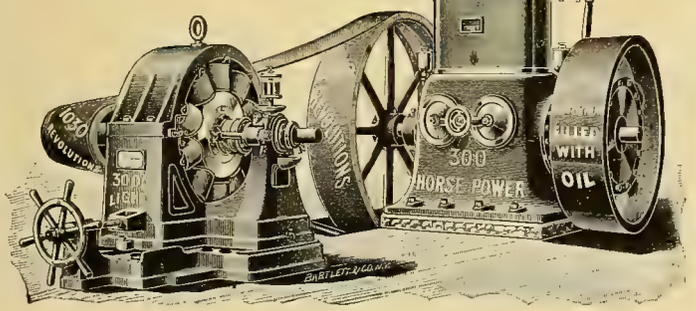

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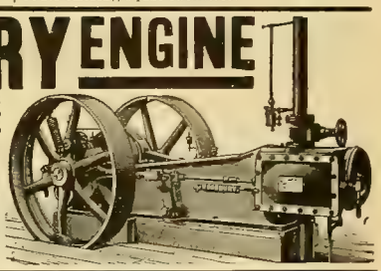

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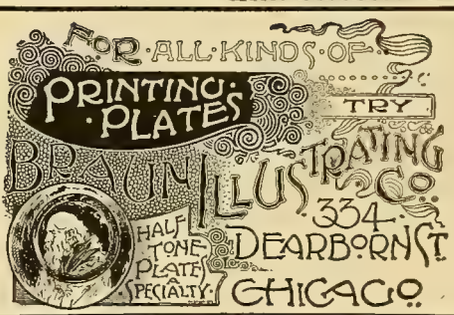

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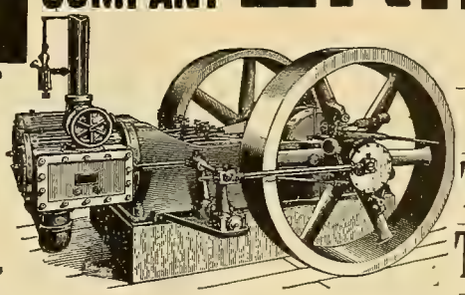

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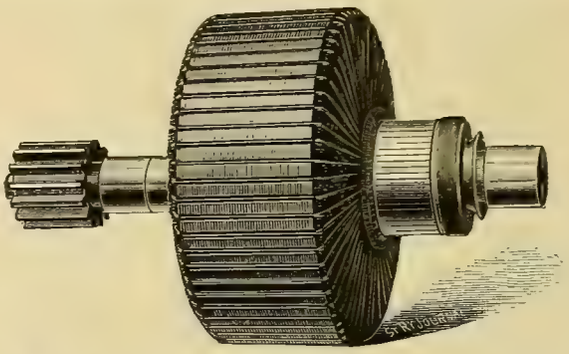

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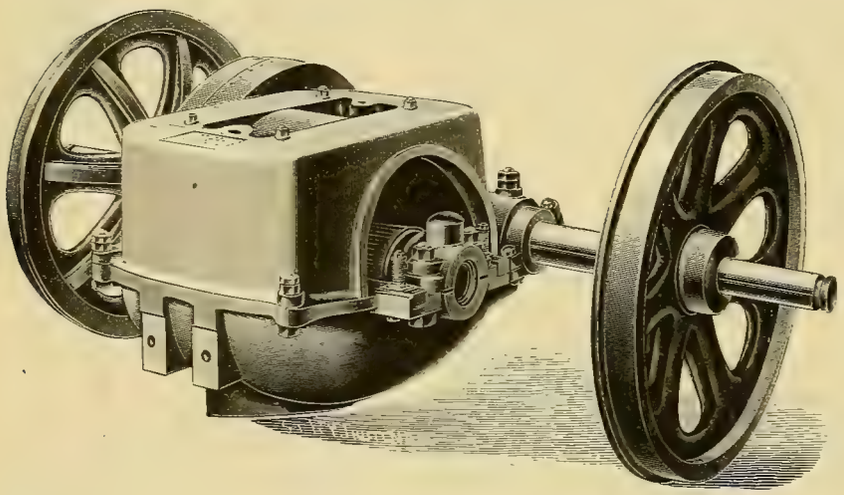

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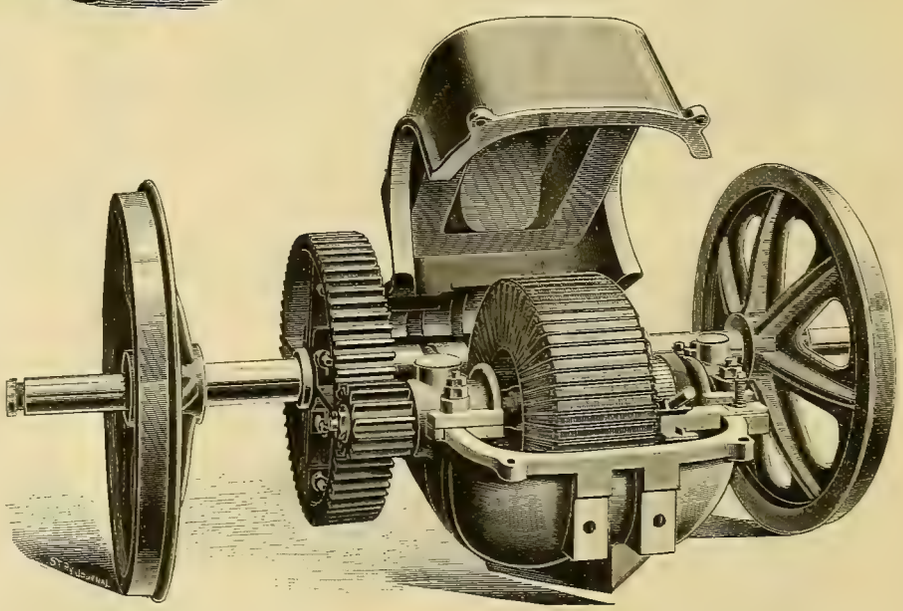

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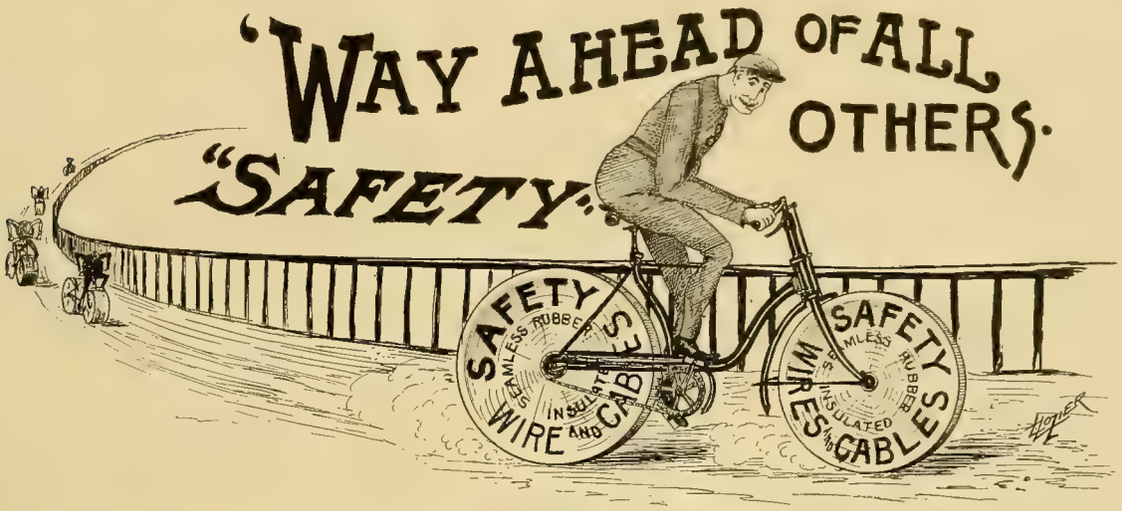

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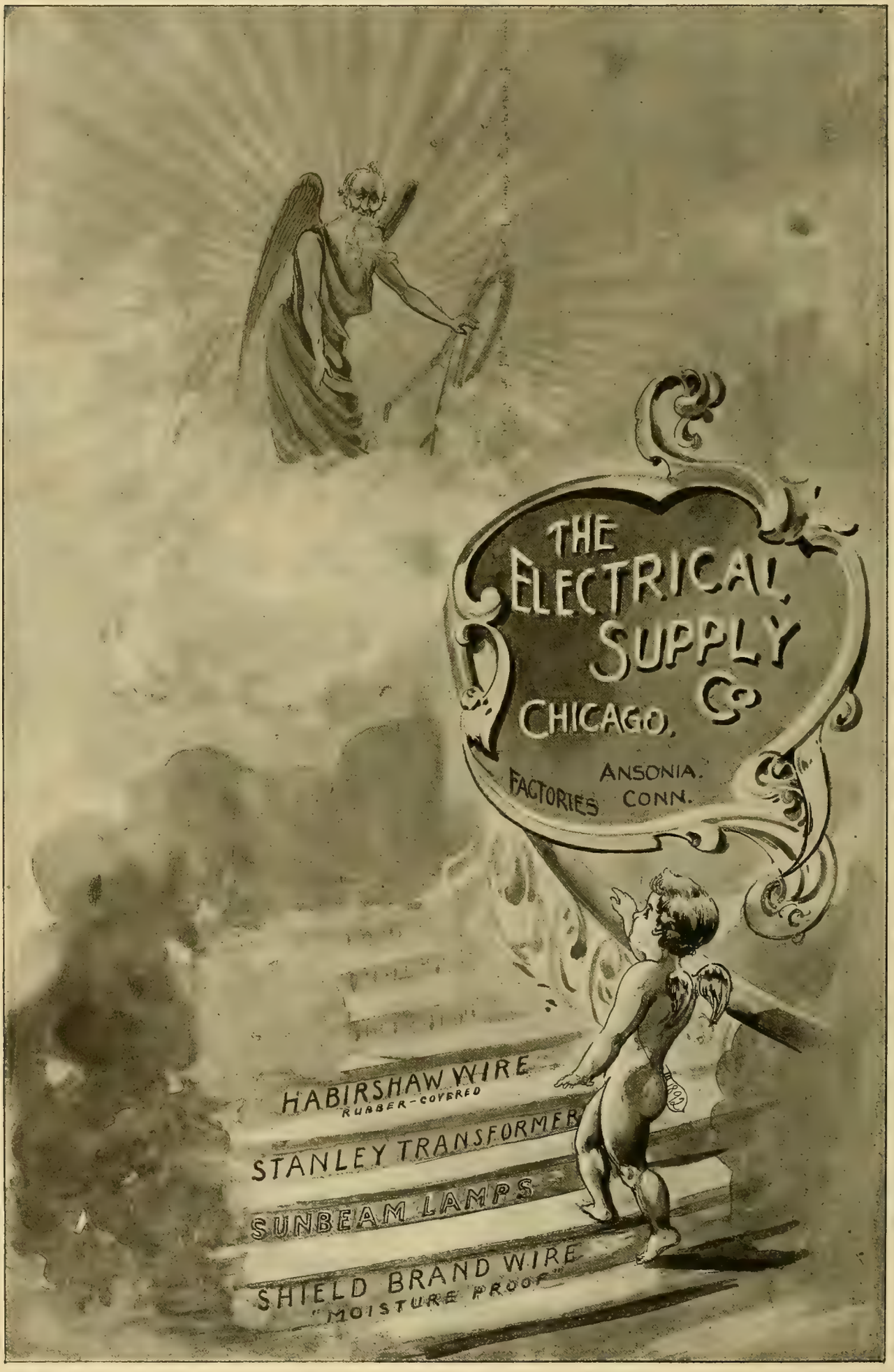
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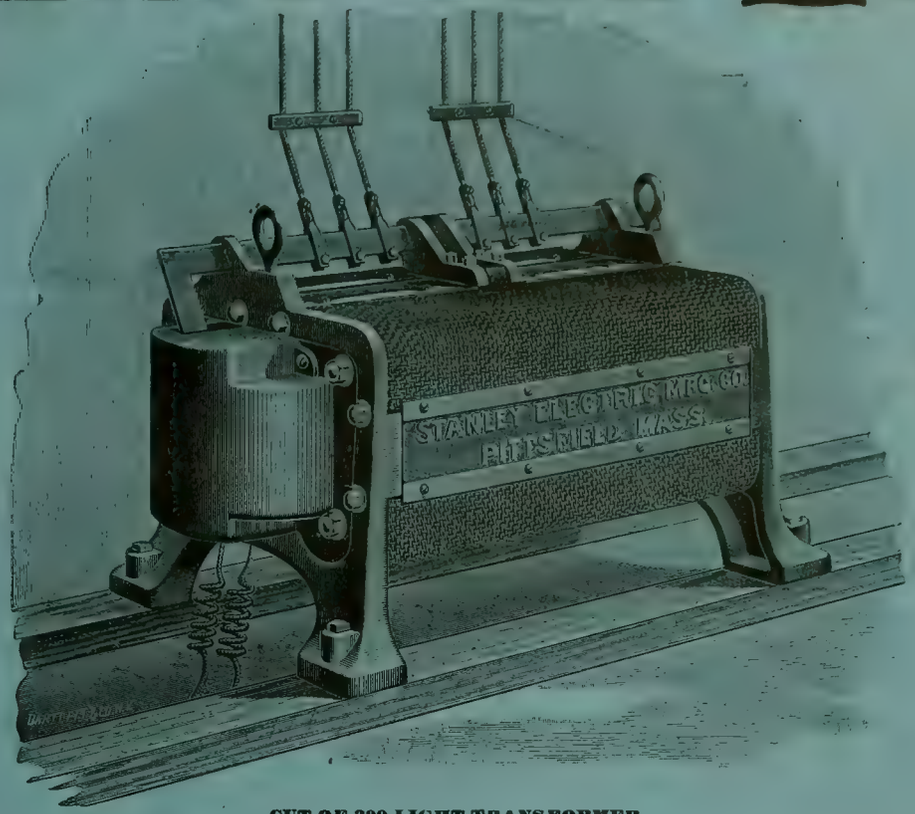

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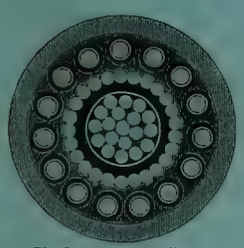
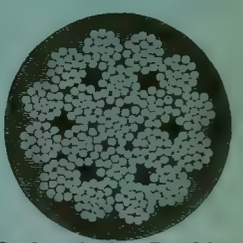
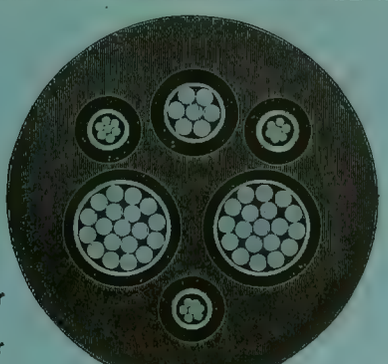
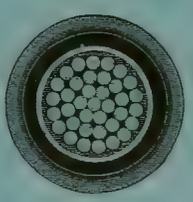

Underground Core.


Feeder Cable. Brooklyn Edison Electric Light Co.

Underground Core, N. J. Central R. R.

Feeder Core. Broadway Theater.


Submarine Work. Edison Electric Light Co., Easton, Pa.


Naval Core, United States s. s. "Chicago."

Portable Cable. Broadway Theater.

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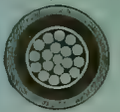
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Adopted by the Navy Department, and thus far employed on board the United States steamships Trenton, Chicago, Boston, Yorktown, Pensacola, Philadelphia, Petrel, Atlanta, Baltimore, Newark, Vermont, Charleston, San Francisco, Concord, Bennington and monitor Miantonomah.

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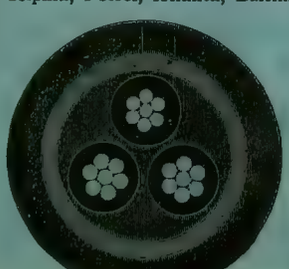
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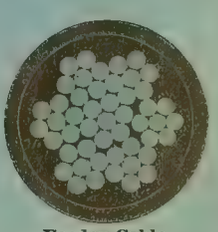
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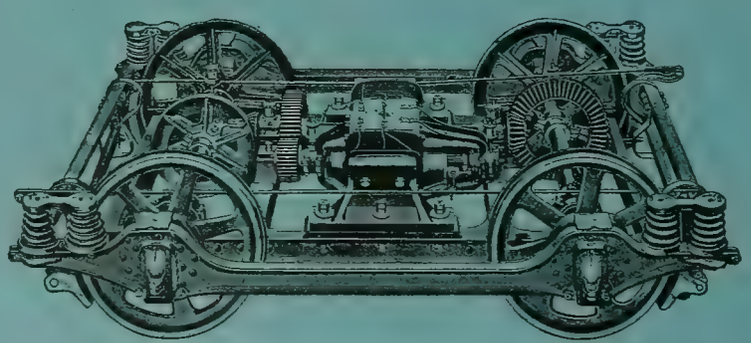

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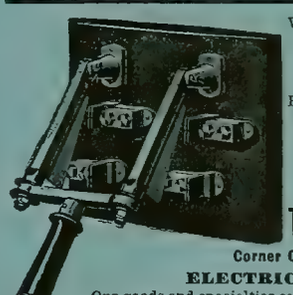

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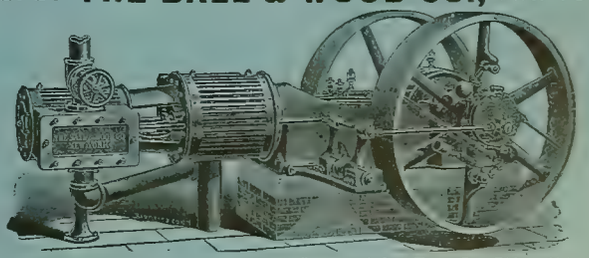

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Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Sterling, W. C.

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Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co., The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
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Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

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American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.

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Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Electric Mfg. Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
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Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
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Edison General Electric Co.
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Beckerleg, Jas. G.

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American Electrical Works.
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Knapp Electrical Works.
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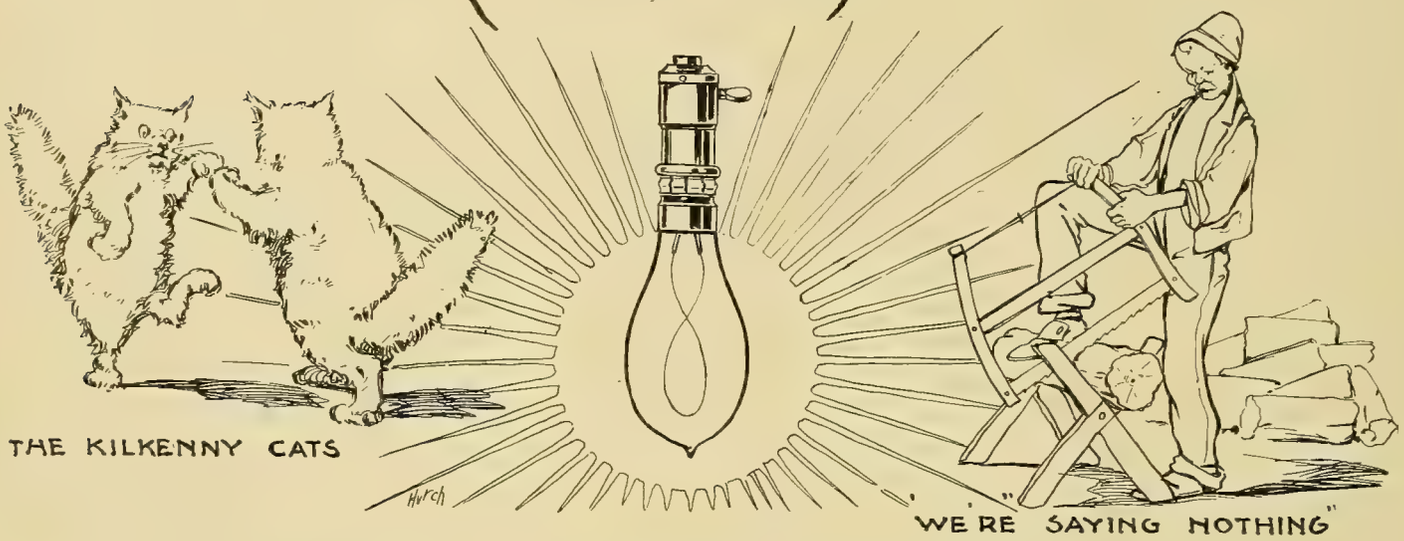
(That's us)



While our worthy competitors are tearing each other to pieces — we will we are selling Packard Lamps.

THE ELECTRICAL ENGINEERING & SUPPLY Co.

ST. PAUL
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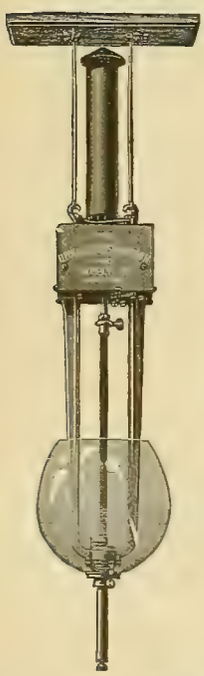
931 Rookery - Chicago

"WARD" ARC LAMPS.



The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

EDISON ELECTRIC LIGHT & POWER CO.,
OF ST. PAUL, MINN.

ST. PAUL, MINN., August 28, 1891.

**Messrs. McDougall & Cummings, Western Managers,
The Electric Construction and Supply Co.,
Phenix Building, Chicago, Ill.**

DEAR SIRS:—We are using your arc lamps on our lines, and with great satisfaction both to ourselves and our consumers. They are the only arc lamps we are using, and in our opinion are the best lamp of the kind that have come to our notice. Our continued orders to you not only show our appreciation of their merits but also the fact that we find them a good paying investment. Very truly yours,

EDISON ELECTRIC LIGHT & POWER CO.,
G. H. FINN, General Manager.

EDISON LIGHT & POWER CO.,
OF MINNEAPOLIS.

MINNEAPOLIS, August 22, 1891.

**The Electric Construction & Supply Co.,
18 Cortlandt Street, New York City.**

GENTLEMEN:—Within the last eighteen months we have been installing a number of arc lamps on our incandescent circuits. We now have one hundred and ninety-six of your "Ward" lamps in operation, and it gives us pleasure to state that they give the very best of satisfaction, both to ourselves and our customers. We consider them a most excellent lamp. Yours truly,

EDISON LIGHT & POWER CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

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Established 1881.

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STILL LEADING.

The only wire that NEVER goes back on its friends is

We are General Western Agents for all Okonite Products, which includes the highest grade of

Insulated Wire,
Commercial Lamp Cord,
Improved Candee Weatherproof Wire,
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THE BUNNELL
GALVANOMETER
GAUGE.

$9.00.

A thoroughly reliable Pocket Battery Gauge, Circuit Indicator AND Detector Galvanometer.

No Springs or Electro-Magnets.

Discount to the Trade.

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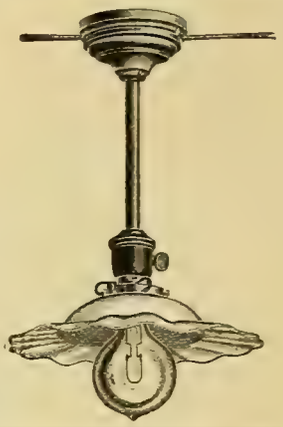
INCANDESCENT LAMPS
-FOR-
ARC LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.



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W-I-R-E-S:

I. C. Weatherproof Wire, W. E. Underwriters' Wire, Okonite, Kerite,
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SUNBEAM INC. LAMP CO.
SUNBEAM
INCANDESCENT LAMP
CHICAGO ILLINOIS U.S.A.

"The New Year indeed is the true Year. **Acts** are the only resolutions with which to propitiate it."

Apropos to this line of thought, a "Central Station" friend writes us: "Your advocacy of an Economy that reduces the cost of Fuel, Oil, Labor and Wear and Tear of one's mental capacity by the use of your **Efficient** lamp, at a fair price, rather than chasing that "Will o' the Wisp" a **low first cost** lamp, has found lodgment, after a long and unfruitful experience, in the mind of the writer. Because of the **larger return** in light and life, and the **decreased** cost in the production of the same, our profits show a handsome increase for 1891. For this gratifying result, we are indebted to the **Sunbeam.**"

All of which means **promises kept** on the part of this Company. Need more be said?

THE SUNBEAM INCANDESCENT LAMP COMPANY,
805 Chamber of Commerce Building, CHICAGO, Ill.

THE

WASHINGTON CARBON COMPANY'S

WEEKLY BULLETIN TO ITS FRIENDS.

Last week we stated that the ***Carbon Trust*** proposed to drive us out of the business by monopolizing the supply of raw material. ***To this end IT is bending all ITS energies.***

MORE ABOUT TRUST METHODS:

A representative of the ***Trust*** visited people who supply us with raw material and proposed the following:

"The Trust will buy raw material from YOU, if you will agree to charge outsiders twenty-five per cent. more than you charge the Trust."

This little scheme would have enabled the ***Trust*** to ***Advance the price of Carbons***

$2.00 PER THOUSAND,

but ***it failed.*** By ***"Outsiders" it*** meant ***The Washington Carbon Company. It is part of its creed that no one but the Trust has any right in the business.***

We are glad to be "outsiders." We propose to keep on being outsiders, for it pays, as our order books show.

We are very busy, but have time enough to keep an eye out for the ***Trust*** and have gathered much interesting matter, which we propose to deal out in weekly installments.

As we have arranged for an abundant supply of raw material, we are prepared to make contracts for carbons at fair prices for a term of years.

THE WASHINGTON CARBON COMPANY,

LOOK OUT FOR NEXT WEEK! Washington, Pennsylvania.

EDISON GENERAL ELECTRIC COMPANY.

Electric Generators and Motors.

—— HIGHEST EFFICIENCY. —— —— PERFECT RESULTS. ——

ELECTRIC MINING MACHINERY,

LOCOMOTIVES, DRILLS, CARS, Hoisting and Ventilating Apparatus.

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Orders Executed Correctly and Promptly.

SOCKETS.

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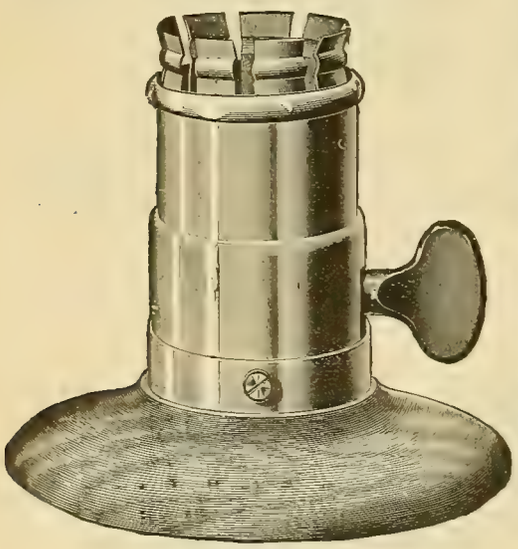
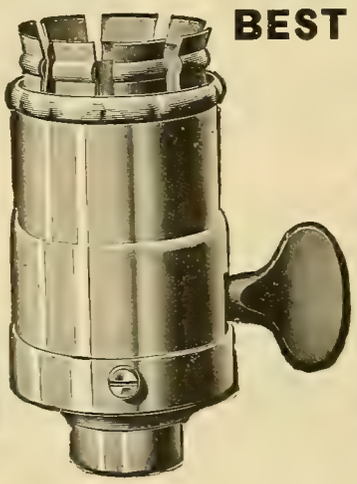
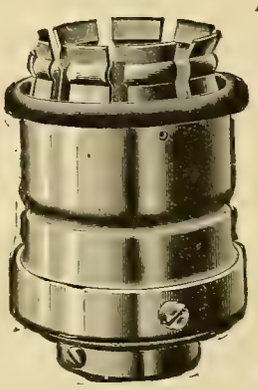


No. 125. Key Wall Socket—Porcelain or Wood Base.



No. 110. Key Socket.



No. 120. Keyless ⅜ inch Socket.

ALSO—

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No. 130. Keyless Wall Socket—Porcelain or Wood Base.

No. 145. Keyless Socket for 75, 100 and 150 c. p. Lamps.

No. 150. Waterproof Socket.

No. 140. Attachment Plug, with Fuses.

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JUST OUT. SEND IN YOUR APPLICATION.

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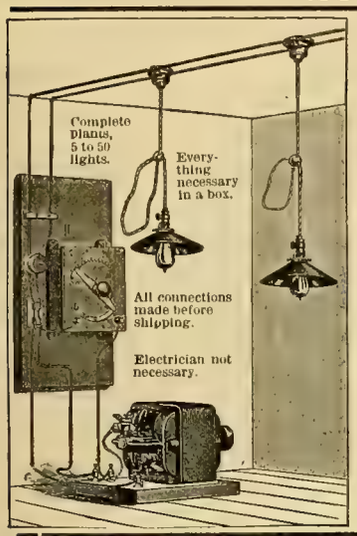

You can Put It up Yourself. Lights Are Standard And Full size. Thoroughly Reliable And Practical. Prices Reasonable. Send For Illustrated Pamphlet.

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REPAIRING ELECTRICAL MACHINERY

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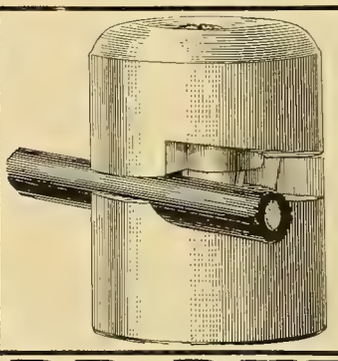

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An Insulator that is easily and quickly adjusted, and will securely clamp the wire without injury to the Insulation, thus doing away entirely with tie wires, and effecting a large saving of time and labor in wiring. Wire from ⅛ to ⅜ of an inch may be used, thus allowing of a variation of ¼ of an inch in size of wire. Made of the best Vitrified and Non-Absorbent Porcelain.

Write for Price and Full Particulars.

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POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

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Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

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Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

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MANUFACTURERS OF BARE AND INSULATED WIRE.

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Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

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FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

SOMETHING ENTIRELY NEW. Saves the Current, Regulates the Light. An Innovation in Electric Lighting. SIMPLE, EFFICIENT, ECONOMICAL.
INDORSED BY THE ELECTRICAL PRESS and prominent Electrical Engineers and Electricians.

NO RESISTANCE, OR ANY OTHER CURRENT-CONSUMING DEVICES USED.

The Price of our No. 1 Ries Regulating Socket (for lamps 16 to 25 C. P. 50 volts) is

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Only One Night on the Road.

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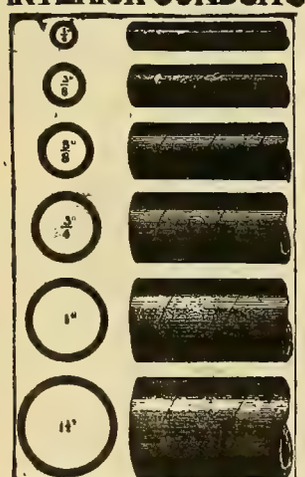

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Electric Light, Annunciator and Office Wires, Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

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INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This System Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

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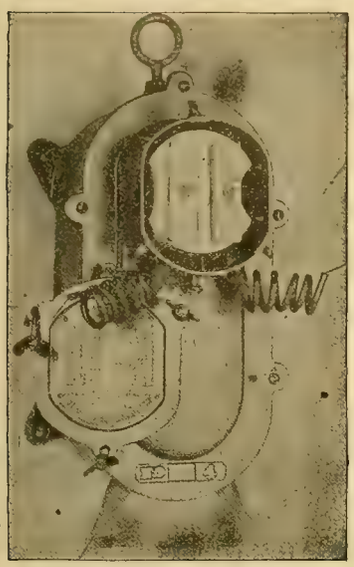

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HIGHEST EFFICIENCY,
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OUR **Meters** ARE

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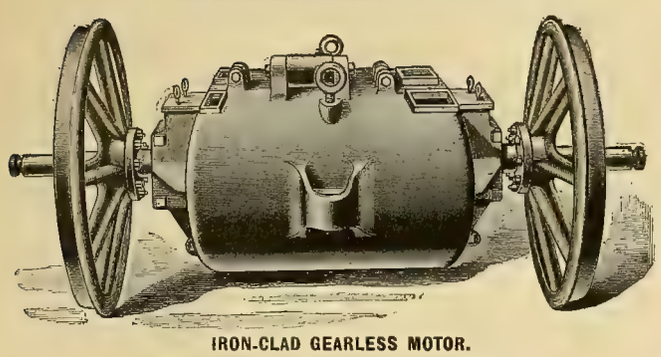

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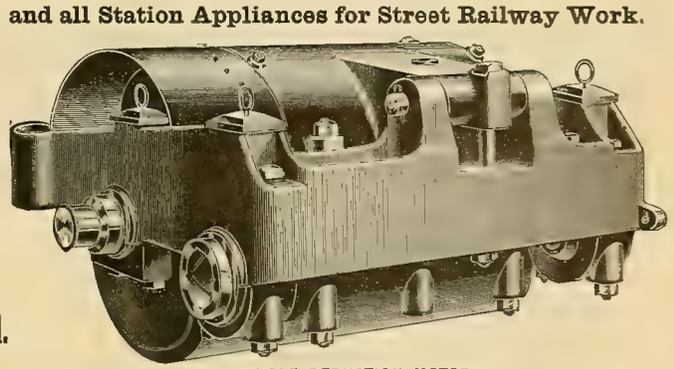
and all Station Appliances for Street Railway Work.



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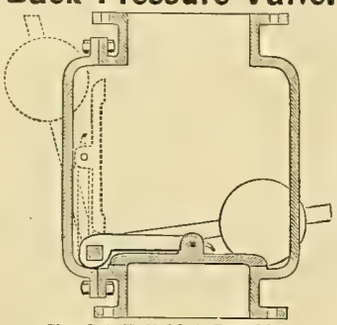

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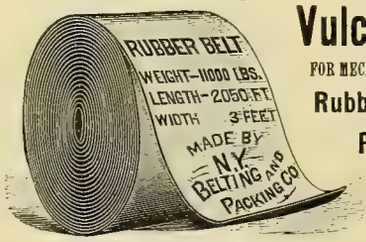

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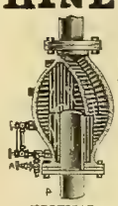

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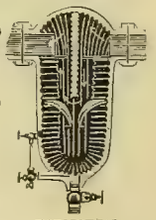

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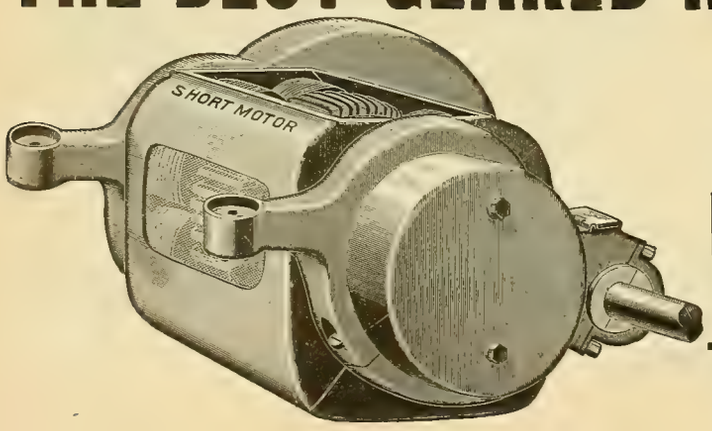

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Vol. X. CHICAGO, JANUARY 9, 1892. No. 2

Electric Drilling in the Bed of the Mississippi.

Undoubtedly the rock drilling that has been done by electricity in the bed of the Mississippi river, between Rock island and Moline, Ill., signalizes the completion of the largest contract of the kind thus far undertaken, and the work therefore possesses a peculiar significance to all who are interested in electrical advancement. It is gratifying to be able to announce that the contract requirements have been successfully met. The practical working and results of electric drills, on a larger scale than they have heretofore been employed, are graphically represented by the illustrations which accompany this article. They show that these machines can be operated with success amid unfavorable conditions.

The electric drilling at Rock island was done under the terms of a contract made with the government of the United States by F. B. Badt, western manager of the Thomson-Van Depoele Electric Mining company. The government, which owns Rock island, where it has established the largest arsenal in the country, has for some time been engaged in the work of deepening a portion of the southern channel of the Mississippi, which here flows from east to west. This is done with the two-fold purpose of securing a more plentiful supply of water power, which is used at the shops on the island, and to provide a navigable channel at Moline, which has heretofore been debarred by shallow water from sharing in the commerce of the nation's greatest river. A coffer-dam has been erected at the head of the island at a cost of $25,000 or$ 30,000, and the government is now deepening a channel four hundred feet wide to the extent of four feet—that is, it is doing so as fast as the congressional appropriations will allow. The coffer-dam is not, of course, absolutely watertight, and it may be mentioned here, as an interesting fact, that much trouble is caused by muskrats, who do considerable damage by burrowing under the dam. The watchmen are paid premiums for shooting the troublesome little animals.

The particular portion of the work on which electricity was employed is a strip of limestone rock about 600 feet long and of an average width of fifty feet. It is on this that the drills are at work, as shown in the general view, Fig. 1, in which the power house is shown at the right.

FIG. 1. ELECTRIC DRILLING IN THE BED OF THE MISSISSIPPI.

The remainder of the rock is a much softer sandstone and can be profitably drilled by hand. It has been shown, however, that electric power only costs about half as much as hand drilling in the harder rock. Nine drills were used on the work. Eight of these were mounted on weighted tripods in the usual manner, while one, Fig. 2, somewhat larger in size, was mounted on a carriage, and wheeled about on a temporary track. The machines used were the regular Van Depoele reciprocating drills, which have heretofore been described in this journal.

Current was obtained from a generating plant installed in a temporary power house erected on the island, the interior of which is shown in Fig. 3. This building was an addition to a rough pumping station put up by the government for the purpose of clearing the bed of the river from water coming from leaks in the coffer-dam and from springs. This pumping engine is of the vertical type, and was built in the government shops, being rated at 25 horse power. It was utilized in driving the generators steam being furnished by a 40 horse power boiler. The government gave the use of the engine and boiler, when not used for pumping, as a part of the contract. The generating plant consisted of two Thomson-Houston dynamos, with revolving brushes, one of 20 and the other of 10 kilowatts capacity. These, with a four-light arc machine, are shown in the picture. The arc lights were rigged up near the drills to enable the work to be carried on after dark. An incandescent circuit served to furnish light for the interior of the power house, which was adequately supplied with suitable switches and measuring instruments.

An idea of the line construction can be gained from Fig. 1. About 700 feet of line was used, strung on improvised tripods, as shown in the illustration. These were made of scantling, strengthened by cross bars, and steadied by guys on each side. This construction was found to answer the purpose admirably. Poles were, of course, out of the question, owing to the character of the ground. Three copper conductors of No. 4 B. & S. insulated wire were used. Each tripod supporting the line was provided with a three-pole switch and safety fuses. Waterproof cables, shown in Fig. 2, led from the line conductors to the drills.

While the Thomson-Van Depoele company, by the contract, was only required to drill the holes, the government doing the blasting and seeing that the stone was removed, it was nevertheless found convenient to utilize the dynamos and circuit of the drilling plant to explode the dynamite with which the holes were charged. From

50 to 120 pounds of this material were exploded every night from the power station. A vivid idea of one of these blasts can be gained by a glance at Fig. 4. Platinum fuses andfulminate of mercury were used to explode the charges.

And now something as to the practical, commercial results of the operation of these drills. The contract required that as many holes as were necessary should be drilled in the limestone rock to a uniform depth of four feet. The holes were made 1¾ inches in diameter at the top and 1½ inches at the bottom, drills of three different lengths being used. Work was begun October on 23d, and on December 19th, the date of the visit of the representative of the WESTERN ELECTRICIAN, 941 holes had been drilled, many of them exceeding by two or three inches the specified depth. This represented 3,764 feet of drilling. The whole number of nine drills was not employed until the latter period of the work, however, and a carefully kept record showed that at the date mentioned the work had taken 1,085 drill hours. This gives an average of 3.6 feet per hour for each drill, which is very creditable showing. It should be mentioned, also, that many annoying difficulties were encountered. The rock varied greatly, and in many places much trouble was experienced in drilling through to the required depth. Crevices were encountered, and pieces of rock would drop in from the inside, making it necessary to do the work over again. In some instances holes were drilled three times before they could be pronounced satisfactory. Occasionally pockets of sticky, greasy clay were found, and in these the bits would simply seem to churn the mess up, in the most exasperating fashion, without making any progress. That, under these conditions, an average rate of 3.6 feet per hour was made is gratifying. It shows that electric drilling has left the experimental stage far behind.

The work was in charge of A. S. Garfield of the Boston office of the Thomson-Van Depoele company, and it is to this gentleman's engineering ability, untiring activity and ready resource that much of the success of the work is due. He faced and overcame serious difficulties resolutely, and has reason to feel proud of the accomplishment. A force of twelve men assisted Mr. Garfield.

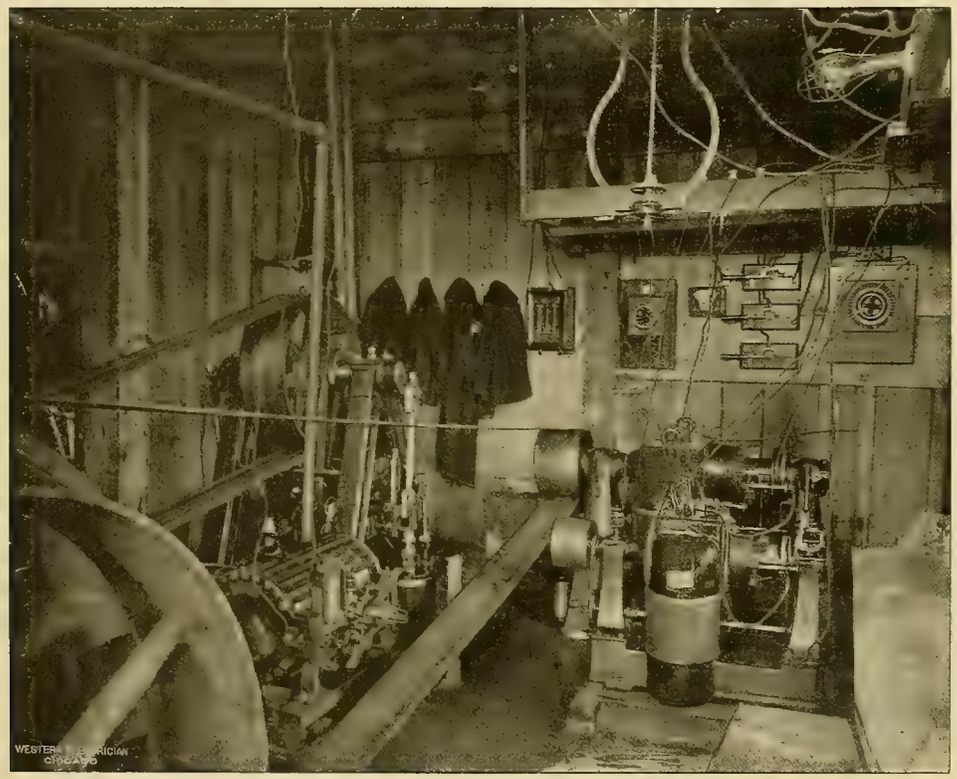


FIG. 3. ELECTRIC DRILLING IN THE BED OF THE MISSISSIPPI.

Prizes to be Offered.

It is announced that the committee of Chicago taxpayers that is considering the rapid transit question "will offer three prizes for the best suggestion for transportation over electric lines. The suggestions and plans will be printed, and it is hoped will result in ascertaining what kind of an electric road the public wants." From this it would appear that suggestions from laymen, and not from electrical engineers,are wanted.

A Thomson-Houston Factory at Chicago.

About a year ago there was considerable talk relative to a rumor current at that time to the effect that the Westinghouse Electric & Manufacturing company of Pittsburg was to establish a factory at Pullman, Ill. Although at one time it appeared as though the project would be carried out, the matter, at least as far as the general public was concerned, never assumed a definite shape. It seems at the present writing, however, that Pullman may after all be the site of a fine electrical factory. But this time it is announced that if the plant is established at Chicago it will, in all probability, be by the Thomson-Houston people and not by the Westinghouse company.

For some months the Thomson-Houston Electric company has felt the need of greater facilities with which to carry on its rapidly increasing western business. From time to time the Chicago quarters have had to be enlarged. Not only has it been necessary to provide more office room, but warehouses have been secured in different parts of the city. The work in the shops, too, which are in the present office building on Michigan avenue, has been of so large a volume as to indicate the wisdom of establishing a local manufactory.

According to B. E. Sunny, manager of the western business of the Thomson-Houston Electric company, the idea is to give the company's western trade a nearer supply than it now has. The new plant will probably be devoted to the manufacture of electric railway supplies, lamps, motors and other kinds of electrical goods covered by the company's patents. "Chicago is the supply station for all the country west of us," says Mr. Sunny, "and all the goods have first to be brought here from the eastern manufactories, and then reshipped to all the many western points where they are needed."

In reply to questions as to the amount of the investment his company would make in the West, the number of men that it was expected would be employed, etc., Mr. Sunny stated that the whole project was as yet in embryo. Nothing definite was decided, not even the matter of site. It may be added also that the enterprise is strictly one of the Thomson-Houston company and is in nowise connected with the Pullman company.

Telegraphers' Strike Settled.

Under date of December 31st a press dispatch from San Francisco says: The trouble between the Southern Pacific company and the Order of Railway Telegraphers has been settled. Concessions were made on both sides, but the result is considered a victory for the telegraphers, who are permitted to join the order, while the company withdraws the objectionable affidavit and compromises the trouble with reference to the employment of student operators.

Lighting Plant at St. Cecilia Church.

The new St. Cecilia church, corner of Forty-fifth and Atlantic streets, Chicago, was dedicated December 20th. This church is patterned after the Notre Dame cathedral, Paris, and Father E. A. Kelly is pastor. In the base of the round dome there are 150 16 candle power lamps and the same number around the arch of the octagonal part.

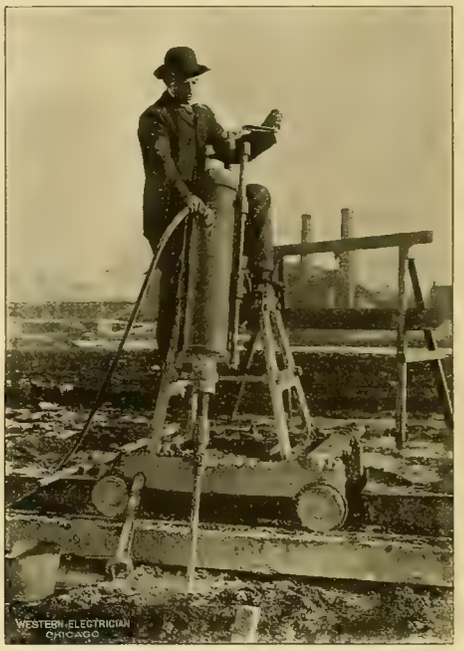


FIG. 2. ELECTRIC DRILLING IN THE BED OF THE MISSISSIPPI.

The effect is very fine, and all parts of the church are equally lighted. The unusual electrical feature, however, is in the method of supplying current, which is furnished by the Englewood Electric Light company from a station over three miles distant. Charles T. Page, secretary of the company, decided to use a "booster" or "step-up" transformer for this purpose, and placed it in circuit with lines feeding that part of the city. The results have been entirely satisfactory to the company as well as to Father Kelly, the lights being maintained at proper candle power without difficulty. The Englewood Electric Light company is supplying about 6,000 lights in the southern part of the city and its service entitles it to its present position as one of the most enterprising institutions of the section.

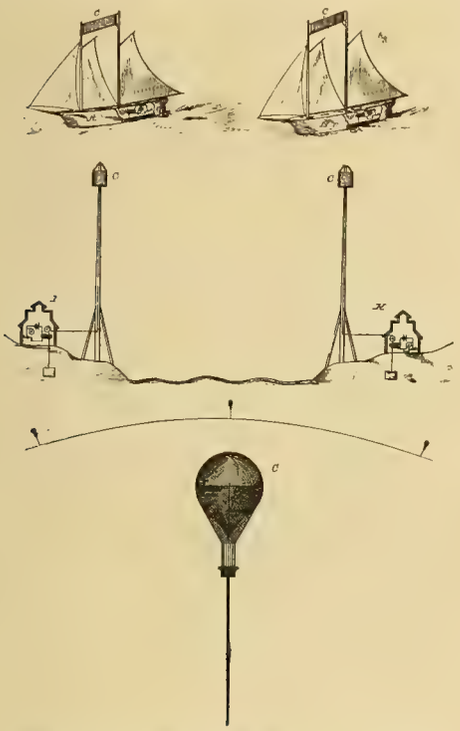
FIG. 4. ELECTRIC DRILLING IN THE BED OF THE MISSISSIPPI.

Chauncey M. Depew is credited with having said that "at the Centennial exhibition at Philadelphia Morse's telegraph comprised almost the sum of our knowledge of electricity, but a building at Chicago twice as large as Cooper's Institute, devoted entirely to electrical appliances and inventions, will demonstrate by the advance in one department the enormous progress of the country in every department since then."

Telegraphing Without a Wire.

An interesting method of telegraphing by induction was recently patented by Mr. Edison. His claims were filed as early as 1885, but from the fact that the phenomena of induction is now being so closely studied by many, a description of the system will be worthy of a perusal.

Mr. Edison claims to have discovered that if sufficient elevation be obtained to overcome the curvature of the earth's surface and to reduce to a minimum the earth's absorption, electric signaling between distant points can be carried on by induction without the use of a wire connection. While the system is particularly applicable to telegraphing across bodies of water, or for communicating between vessels at sea and points on land it may be employed for communication between distant points on land. In the latter case, however, except where the communication is over open prairie it is necessary to increase the elevation in order to reduce to a minimum the induction-absorbing effect of houses, trees, and elevations in the land itself. At sea from an elevation of one hundred feet, Mr. Edison asserts, he can communicate electrically a great distance. In communicating between points on land poles of great height can be used or captive balloons. At these elevated points condensing surfaces of metal are located, and each is electrically connected with the earth.



FIGS. 1, 2, 3, 4. TELEGRAPHING WITHOUT A WIRE.

The high resistance secondary of an induction coil is located in circuit between the condensing surface and the ground. The primary circuit of the coil includes a battery and a device for transmitting signals. This latter may be a revolving circuit breaker operated continually by a motor, and a key normally short-circuiting the circuit breaker or secondary coil. For receiving signals there is located in circuit between the condensing surface and the ground a diaphragm sounder which may be an Edison electro-motograph telephone-receiver. The key normally short circuiting the revolving circuit breaker, no impulses are produced in the induction coil. When the key is depressed a large number of impulses are produced in the primary, and by means of the secondary corresponding variations in tension are produced at the elevated condensing-surface, producing electrostatic impulses. These electrostatic impulses are transmitted inductively to the elevated condensing surface at the distant point and are made audible by the electro-motograph. The intervening body of air forms the dielectric of the condenser, the surfaces of which are connected by the earth. The result is a circuit in which is interposed a condenser formed of distantly separated and elevated condensing surfaces with the intervening air as a dielectric.

In the accompanying illustration Figs. 1, 2 and 3 show respectively two vessels placed in communication by the method, signaling stations on opposite banks of a river, and a diagram of a portion of the earth's surface, showing communication by captive balloons. Fig. 4 is a view of a single captive balloon constructed for use in signaling. Fig. 5 is a diagram showing the details of the apparatus. In Fig. 1, *A* and *B* are two vessels, each having a metallic condensing-surface *C*, supported at the heads of the masts. This condensing surface may be of canvas covered with flexible sheet metal or metallic foil. From the condensing surface a wire extends to the hull of each vessel and through the signal receiving and transmitting apparatus to a metallic plate on

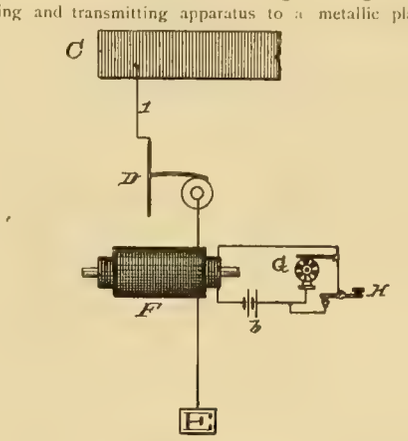
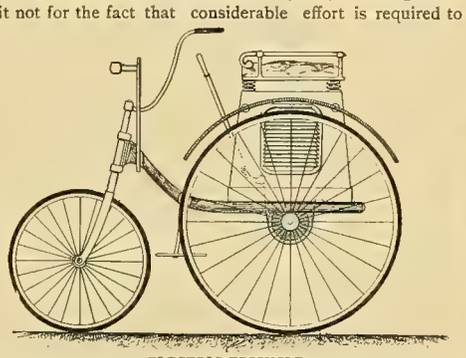


FIG. 5. TELEGRAPHING WITHOUT A WIRE.

the vessel's bottom. This wire extends through the electro-motograph telephone receiver *D*, Fig. 5, and also includes the secondary circuit of the induction coil *F*. In the primary of the induction coil is a battery *b* and a revolving circuit breaker *G*. This circuit breaker is revolved rapidly by a moter (not shown). It is short circuited normally by a back point key *H*, by depressing which the short circuit is broken and the circuit-breaker makes and breaks the primary circuit of the induction coil with great rapidity.

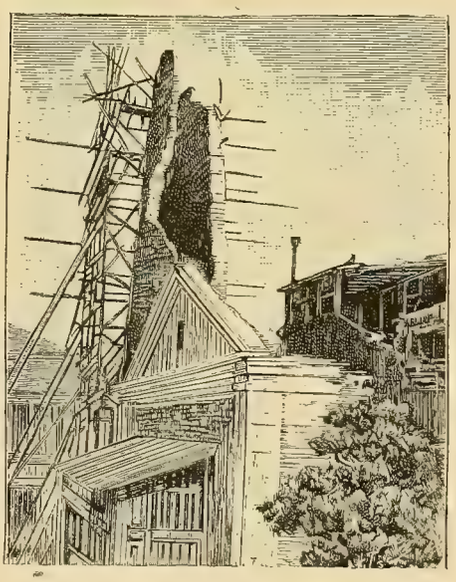
Electric Tricycle.

A great many persons would enjoy tricycle riding, were it not for the fact that considerable effort is required to



ELECTRIC TRICYCLE.

propel the machine. People of this description are waiting for the day when a wheel will be perfected which will be propelled by some energy other than that which they personally expend. There have been a number of machines



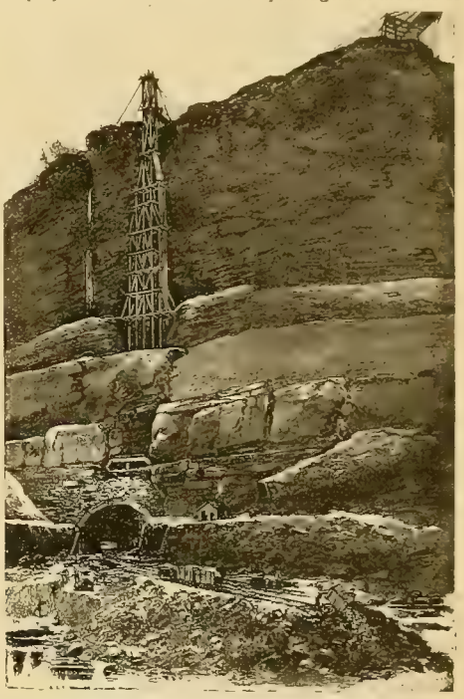
A JAPANESE CENTRAL STATION DESTROYED BY EARTHQUAKE.

designed to meet this demand. A steam tricycle has made its appearance, and its inventor, M. Serpollet, claims that it has been very successful. In fact, this was the first step in the development of the steam carriage which has attracted much attention within the last year.

It has generally been believed, however, that an electrically operated machine would best solve the problem. Several of these have been designed, storage batteries being used in every case. They have not given much satisfaction, however. The batteries were subject generally to all the ills that storage cells are heir to, and they frequently became exhausted at the most highly inconvenient seasons. The plates, perhaps, would buckle, and a new load of batteries would be needed. Experiments with machines of this kind have not been successful enough to encourage inventors.

The latest electric tricycle is that designed by H. Grafigny of Paris, and represented by the accompanying cut. The inventor adopted the primary battery as a source of power. The light box seat covers the motor and a battery composed of 18 chromic acid cells. The weight of the cells is about 54 pounds. The machine is steered by the ordinary handle bar, and a pedal brake is used. The switch, the handle of which extends above the seat, is shown in the illustration. The power from the motor is transmitted to the axle of the machine by a link chain. The weight of the tricycle ready for use is 190 pounds.

Tests of the machine have proved satisfactory to the designer at least. It was shown that the batteries developed about one-third of a horse power at the beginning of the trial and about two-ninths of a horse power after four hours' operation. This power, it is stated, was sufficient to propel the wheel with two passengers at the rate of



NIAGARA POWER TRANSMISSION PROJECT.

eight or nine miles per hour over a smooth road. The cost of the battery power is stated to be about 50 cents per horse power hour. The cut is reproduced from *Le Genie Civil*.

A Japanese Central Station Destroyed by Earthquake.

The earthquake shocks which occurred in Japan on October 28th were the most serious that have visited that country in the last quarter of a century. The instruments register 6,000 shocks from October 28th to November 5th. About 4,000 persons were killed, as many injured and 42,000 houses were destroyed. The people of two provinces were almost without shelter. Among the sufferers in Yokohama was the Electrical company. Its station was practically destroyed by the earthquake. What was left of its tall smoke-stack is shown in the accompanying picture. It toppled over at the first shock. The cut is reproduced from *La Nature*.

The Niagara Power Transmission Project.

Work on the American project for utilizing the power of Niagara is progressing satisfactorily, as can be seen by a reference to the accompanying illustration, reproduced from *Harper's Weekly*, which shows the work on the tunnel. The plan is described in an interesting article by John Gilmer Speed, entitled "Harnessing Niagara." Of that portion of the work shown in the cut he says:

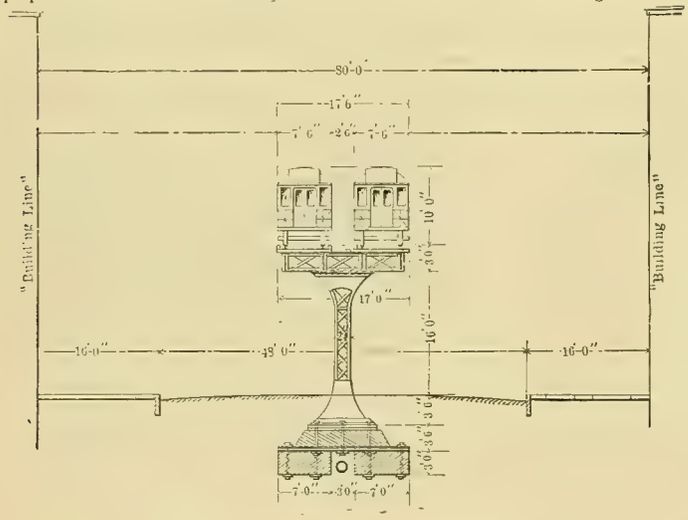
It was determined to build a large canal at the upper river level above the falls. This canal is 1,200 feet long, 200 feet wide at the river, and narrows to 100 feet at its inland end. By means of pits in which turbine wheels

will be placed, the power will be obtained, which will be transmitted to the various mills, and also to points as distant as it will be found to be economical to send it. For a long while men have been working night and day, and the progress has been gratifying and in accordance with the estimates of the engineers. The building of this canal was a matter of course, and there were no considerable engineering difficulties in the way. The same may be said of the immense tunnel which goes from the canal to the lower river, and serves as a tail-race to take off the water which has communicated its power to the turbines and needs an outlet. This tunnel is elliptical in shape, and is 29 feet high and 18 feet wide. It is through solid rock, directly under the village of Niagara Falls, and empties into the river below the falls. This spot is most picturesque, as will be seen by the picture, and is quite easily reached by a footpath over the rocks from the foot of the elevator stairs to the "Maid of the Mist" landing. The end of the tunnel is 214 feet below the top of the high bank of the river, and it ascends to the point where the canal empties into it at a grade of 36 feet to the mile. The head of water thus obtained is 140 feet. Though the tunnel goes through the solid rock it has been thought best by the engineers, so as to make assurance doubly sure. to line it with a casing of hard brick. When the work on this great tunnel was begun, two shafts were sunk to the proper level, and work begun on the headings in both directions from each shaft, and also from the end of the tunnel on the lower river. Thus five gangs of men have been kept at work, and the progress has been satisfactory. Without mishaps and unforeseen detentions the whole 7,000 feet of tunnel will be finished by September of 1892, and the managers are so satisfied that the present progress will be maintained tkat they have already entered into a contract to deliver 3,000 horse power to one corporation next autumn, and they are willing to make other similar contracts.

While the details of the electrical plant have not been settled it is gratifying to know that the construction work is progressing so satisfactorily.

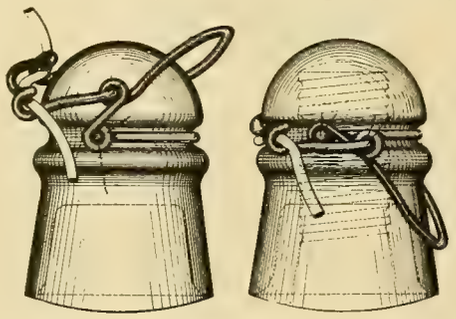
Proposed Elevated Electric Road for Chicago.

The accompanying cut gives a cross section view of the proposed elevated electric railway structure that the Chicago & Evanston Electric Railway company has been organized to build. The road is to connect Chicago and Evanston, and is planned to be partly surface and partly elevated. The route outlined for the elevated road begins on the surface at the corner of Southport and Clybourn avenues and rises by an easy grade, partly over alleys and partly over property to be secured by purchase or condemnation, to Hawthorne avenue just south of Clybourn, thence along Hawthorne avenue to Larrabee street, a distance of about one and one-half miles, and on Larrabee and Chicago avenues to Kingsbury, and on Kingsbury to Kinzie, and on Kinzie to State, and on State across the river with the possibility of a loop through the wide courts between South Water and Lake, and Lake and Randolph. Electricity is to be the motive power, with conductors under the cars on the elevated structure and overhead on the surface. It is claimed that the Edison General Electric company has agreed to furnish the money to build the road if the right of way can be secured. The details of the electrical equipment have not yet been worked out.



PROPOSED ELEVATED ELECTRIC ROAD FOR CHICAGO.

The elevated structure will be of the single column order, as can be seen from the cut. It is described as a single set of columns placed along the center of the street and supporting four longitudinal girders, on which are placed double tracks. The foundations, of beton and masonry, have been carefully planned to sustain the weight of the structure. The base or foot of the column is twelve feet long and three feet wide, and gradually reduced in size by a graceful curve until at a few inches above the street level it is only twenty-four inches long and fifteen inches wide, thus making the least possible obstruction in the street. The column above the ground and to a point twelve feet above it is neatly latticed. It then spreads out and at a height of sixteen feet from the ground is nine feet wide. Upon this is placed a light transverse plate girder, which in turn supports the four longitudinal girders carrying the ties, guard rails and tracks. These longitudinal girders are of a suitable depth and of an average length of fifty feet, and are made of what is known as quadrangular lattice, giving great strength with but little obstruction to light and air. The extreme width of the structure at its highest point is seventeen feet over all and at the height of sixteen feet it is only fifteen feet wide. Below this the street will be practically clear save the 24-inch column in the center.



DEVICE FOR FASTENING WIRES TO INSULATORS.

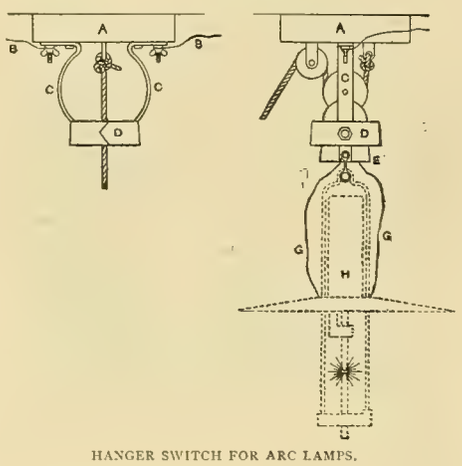
Device for Fastening Wires to Insulators.

A close inspection of the accompanying cut will reveal that the fixture there represented is an insulator and not a bottle neck. The device, which is an invention of G. S. Albanese of Orange, N. J., was constructed with the idea of facilitating the work of the linemen in stringing and repairing telegraph lines. The arrangement consists of an insulator provided with a neck-band sprung, as shown, into an annular groove, a U-shaped lever pivoted to this band and provided with eyes, and a fastening link that is pivoted to the eyes, and provided with a hook-shaped portion for engaging the wire. When the lever is swung in a downward direction the bent portion presses the wire into the annular groove of the insulator so that the rounded end of the bail forms a continuation of the neck-band. In this position the line wire is firmly locked to the insulator.

Hanger Switch for Arc Lamps.

The simple switch shown in the cut, devised for placing an arc lamp in circuit by the act of hoisting, was designed by Messrs. Wagg and Hudson, of England, and, according to the London *Electrician*, is extensively used at Woolwich arsenal.

A wooden disk, *A*, forms a base for the terminals, *B*, and to these the leads are attached. Springs, *C C*, hold a divided ring, *D*. A conical wooden plug, *E*, is fixed to the pulley which supports the lamp, and on the surface of this plug metal strips are fastened. The wires, *G*, connect these strips with the terminals of the lamp. When the lamp is raised, the conical plug opens the half rings and completes the circuit through the lamp. On lowering for trimming, the rings close and maintain the circuit. Modifications of this arrangement allow wire rope to be used, and for parallel working the rings are arranged so that they do not close when the lamp is lowered.



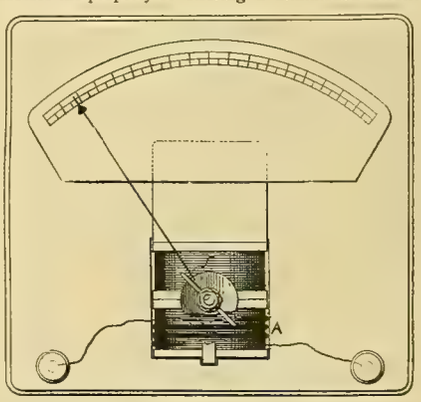
HANGER SWITCH FOR ARC LAMPS.

Weston's Temperature Compensator.

This device is one of the latest inventions of Edward Weston of Newark, N. J. It was designed for the purpose of maintaining constant the electrical resistance of a circuit despite changes in temperature, due to the heating effect of the current and the variations of temperature in the surrounding atmosphere.

The arrangement consists in the combination with the circuit of a body having the following physical property—that when elevated in temperature it decrease in electrical resistance. If an increase in resistance in one part of the circuit is produced by the causes above mentioned, a corresponding decrease in resistance occurs in the interposed body, and therefore the resistance of the whole circuit is maintained practically constant.

Mr. Weston employs this method of compensating for temperature errors in electrical measuring instruments. In such devices containing fine coils, especially of copper wire, the variations which the instrument circuit offers, due to changes in temperature, may be considerable. Thus, for example, the resistance of copper increases at the rate of about two-tenths of one per cent. for every degree Fahrenheit. Hence an elevation in temperature of but five degrees occurring in the coil will increase the resistance offered by it to the current by one per cent., thus bringing a considerable source of error into the instrument. The changes in temperature are, as already stated, caused by the heating effect of the current in the conductor, and also by variations in the temperature of the atmosphere. These sources of disturbance are compensated for in the following simple manner: There is interposed in the circuit of the fixed coil *f* a body *A* of carbon or other material which possesses the property of offering a diminished electrical resistance on being increased in temperature. This carbon is proportioned so that a temperature variation which will produce a certain increase in resistance in the coils will produce a corresponding decrease of resistance in the carbon body, and in this way the resistance of the whole circuit is kept constant.



WESTON'S TEMPERATURE COMPENSATOR.

The carbon body *A* is made in the form of a wire or filament, and it is arranged in close promimity to the coil *f*, so that it may receive heat by radiation and conduction. The ends of the carbon wire are connected to the metallic wire of the coil by copper deposition. The carbon filament is then wound around the exterior of the coil.

Electricity at the World's Fair.

It appears that all the gas men do not support the Philadelphia society which is endeavoring to injure the World's Fair because of the prominence given electricity in the arrangements for lighting. A Chicago correspondent of *Light, Heat and Power* makes some sensible observations on the subject, together with a very mysterious allusion to the "way the electrical interests got their early start here." He says:

> The truth is, if the gas interests are to secure any proper representation, they have simply got to hustle, and do lots of it. * * * It is the solemn truth that, if the gas interests fail, it will be simply and only because they come here too late. You can get all the authority for this statement that you want by merely coming out here and making the proper inquiries.

This is valuable information, and the bellicose Philadelphians should profit by it.

The Thomson-Houston Electric company expects to spend at least $250,000 on its display at the World's Fair.

One of the features of the Western Union exhibit will

be a display of self-winding clocks, regulated by electricity. These clocks are provided with a little battery, which furnishes power enough to wind them up automatically once an hour, thus keeping the springs at an even tension. The Western Union company has 9,000 of such clocks throughout the country.

The grounds and buildings committee has agreed to reserve 7,000 square feet in the central station at machinery hall for the generating machinery of Siemens & Halske, to be shown under load as an exhibit. The committee has also agreed to find a place for a 1,000 horse power motor, which the same firm proposes to exhibit at the exposition. Herrn Vogel and von Babo, the representatives of the great German house, have returned to Chicago. Chief Barrett and Secretary Hornsby escorted them to the principal electrical show places of the city last week.

A report from Contractor Johnson shows that 125 men were employed in the electrical building on Dec. 26th. Lumber to the extent of 2,409,971 feet had been put in position up to that date.

The framework of the electricity building is up to the gallery floor and eight of the big steel trusses for the roof are in place.

Management of Central Station Companies.

The WESTERN ELECTRICIAN is in receipt of a letter from Hon. Erastus Wiman, in which that gentleman states that he has been especially designated by C. R. Huntley, president of the National Electric Light association, to address the next convention at Buffalo, on the special subject of the financial side of electric lighting, and adds: "I am desirous of all the help I can get to make a careful and strong presentation of the merits of this class of property. There is believed to be in the public mind, and especially in financial circles, a growing prejudice adverse to securities based on electrical properties. It would seem important at this juncture that as clear a view as possible should be had of the real facts of the case. Hence it would be very desirable if I could be placed in possession of instances of successful companies, with particulars of the amount of their stock, the length of time before dividends were paid, and the amounts regularly realized, cost of maintenance, and such other facts as can be readily got together. Some special instances of very successful concerns are particularly wished for, and the history of companies which have not at first been successful, but which have since been rescued from insolvency by good management, also any facts relating to combination between gas and electric light companies, and how best it can be promoted."

Mr. Wiman concludes by requesting that information of this character be sent to him in care of Geo. F. Porter, 136 Liberty street, New York.

Electric Mail Car on the St. Louis & Suburban Railway, St. Louis, Mo.

One novelty in the way of electric traction on the St. Louis & Suburban railway now in successful operation in St. Louis, Mo., is the application of electric motors to a United States mail car, which makes regular trips over the entire line, distributing and collecting the mail at the different railway stations, as is done on steam railways. This car is of the same length as an ordinary steam railway mail car and is equipped with double trucks with 36 inch wheels, a Thomson-Houston motor of 15 horse power capacity being connected to each truck. The cut gives an excellent view of the car. A very high speed is attained and the delivery and collection of mail is made without stopping the car, as in steam service. The Thomson-Houston company claims that this is the first mail car that has been electrically equipped in this or any other country. The new service has proved itself of decided advantage to the United States postal department in making collection and delivery of mail to offices along the line of the railway.

ELECTRIC MAIL CAR AT ST. LOUIS.

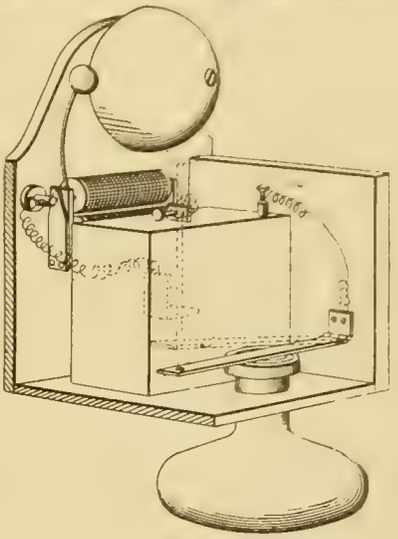
Electrical Transmission of Power in Ireland.

Much interest has been aroused in Ireland by the long distance transmission of power from Lauffen to Frankfort by electricity, owing to the vast amount of water power in the Emerald Isle that is not utilized. A deputation which went from Dublin to the Frankfort exhibition returned highly pleased with the way the water of the Neckar was put to use 110 miles away. The members of the committee state that the experiment has proved that the water power of Ireland may be utilized and brought from the most distant parts to the centers of trade and manufactures at a minimum of expense, and that the water power of the rivers, which is now useless, may be pressed into service and help to compensate Ireland for the want of coal. They add that the success of the experiment leads them to hope that the water power of the Liffey and the corporation waterworks may be soon used to light a great part of the city of Dublin at little or no expense. The Vartry water enters Stillorgan reservoir under a head of 70 feet from Rathmichael, and when the second line of pipes is completed, and suitable turbines placed where the pressure will be most effective, sufficient energy may be generated to light the greater part of the city.

An Air-Electric Fire Alarm.

This compact little device was invented by H. M. Browne of Washington, D. C., with the object of providing a simple and inexpensive fire alarm. In this alarm the expansive power of air is employed in direct connection with the mechanism of an electric bell without the use of any intermediate clockwork. The bell is operated by the expansion of a body of air enclosed in a bulb as shown.

Details will be understood after a glance at the cut. An

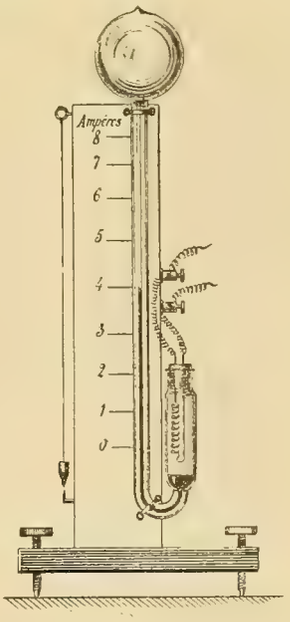


AN AIR-ELECTRIC FIRE ALARM.

India-rubber diaphragm is so arranged in conjunction with a body of air, a bulb, a flat metallic bar having a disk and hinge, a screw, a bracket, a dry cell, and the mechanism of an electric bell, that the circuit is made through the bell when the body of air expands. When the body of air contracts to its former volume the current is broken.

Debrun's Ammeter.

The cut shows a simple ampere meter devised by a French inventor, M. Debrun. This instrument operates either with alternating or continuous currents without a change of graduation being necessary. The operation of the apparatus is based upon the heating of a mass of air by a resistance included in the main circuit. Referring to the diagram, the method of construction and the working of the meter will be easily understood. The resistance is of nickel-iron, and the liquid is a mixture of water and colored glycerine. To secure the wire in the glass bulb M. Debrun uses a cork boiled in Canada balsam and made air tight with Golas cement. The apparatus is calibrated by comparing it with an ordinary ammeter in a continuous current circuit. As the instrument is based upon a calorimetric principle, it is evident that it can be used for alternating currents. It is independent of atmospheric pressure, as it is entirely closed; and it is nearly independent of temperature. Attention should be called also to the fact that as it takes some time to attain an equilibrium, care must be exercised in taking the indications of this meter. The device can also be used as a voltmeter, by putting in a very fine wire, and completing the necessary resistance by an exterior coil. The cut is from *L'Electricien*.



DEBRUN'S AMMETER.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THAT the telegraphers' strike on the Southern Pacific railroad has been settled in a manner satisfactory to both the company and the operators is a matter for congratulation. It appears that the right of membership in the Order of Railway Telegraphers will not be questioned by the company, while the men on their side make concessions.

WHEN rock drilling by electricity has arrived at the dignity of being employed by the government of the United States in the work of improving the water power at its largest arsenal, it is a good indication that this late application of electricity has become a commercial success. This is what has been done at Rock island, as described in another portion of this issue. Our English cousins, who are inclined to doubt that electric mining machinery is employed to any extent in America, are respectfully invited to take notice.

IN this issue of the WESTERN ELECTRICIAN an article on "Rapid Transit in Great Cities," by St. John V. Day, is concluded. This paper was read before the Chicago Electric club December 21st. Mr. Day, as was stated last week, favors an elevated structure as the solution of the rapid transit problem, and his paper relates chiefly to the system which he is now endeavoring to have adopted in Chicago. In explaining his system to the club he spoke of the electrical method for train propulsion. The reader cannot fail to notice the ingenious manner in which he first dwells upon the dangers of the tunnel scheme where the conductor-along-the-route electric system would be employed, and then sets forth the great desirability of the electric method for elevated systems. Mr. Day is, of course, partial to his own system, and his paper shows it.

THAT the electrical resistance of carbon lessens with a rise in its temperature is a fact well known, and this peculiar property has recently been taken advantage of in the construction of an ingenious temperature compensator for electrical measuring instruments. Thermal changes are often the cause of serious error in the more delicate instruments when copper coils are employed. The device referred to is nothing more than a strip or filament formed of carbon and introduced into the circuit, whose resistance is to be maintained constant, at a point where it will be subjected to the same changes of temperature as is the particular part in which a change of resistance will occur. An application of this carbon compensator is described in another column.

A LETTER from Hon. Erastus Wiman is given on another page. Mr. Wiman seeks information from the superintendents of central stations that will enable him to make "a careful and strong presentation of the merits of this class of property" in the address that he is to deliver before the National Electric Light association at the Buffalo convention next month. Mr. Wiman is to speak on the financial aspect of electric lighting, and his tireless activity in advocating the many projects and enterprises with which he is connected is a sufficient guaranty that his address will be an instructive and interesting contribution to the literature of this important subject. Its author should have all possible assistance from the central station men in a matter which is so vitally allied to their own interests

WE are pleased to note that our contemporary, the *American Gas Light Journal,* does not favor the proposition of the Philadelphia gas appliance men who propose to do their utmost to injure the World's Fair unless their demands are complied with. This much we glean from an editorial article in a recent number of that paper in which reference is made to an editorial in the WESTERN ELECTRICIAN on the same subject. The rest of our contemporary's complaint is couched in rather obscure language, and it is difficult to ascertain just what it means. It is noticeable, however, that no attempt is made to controvert the point we made in the editorial to which it refers—that the directors of the exposition were compelled at the outset to recognize electricity as the general illuminant for the grounds and buildings, or else be content with a second-class show. No "influence" was needed to impress the force of so patent a fact on the minds of the gentlemen comprising the exposition management. As to the proposed division of the work of lighting into fifty contracts, we are puzzled to see what that has to do with the question. If gas were to be used, would the men engaged in that industry be content to see one manufacturer furnish it all?

BROOKLYN'S retiring mayor, while not quite sure that the trolley system was the one for his city and not being willing to go on record as either advocating or condemning its introduction, did the next best thing when he allowed the aldermanic resolutions go without his veto. By this action, it is generally believed, the street railways will gain their point, for reasons explained in this week's New York letter, and Brooklyn will soon be not only an object of curoisity, but also a source of information to those who were brought up and have spent their days within the narrow confines of Manhattan Island. Apropos of the prospective comparison of the electric and cable systems with which the metropolis will ere long be provided, it will be well to bear in mind that there is a possibility of the usual trifling mishaps incidental to any newly constructed overhead electric equipment. It would not be amiss for the electric companies to keep the fact well before them that New York, as a whole, is prejudiced against the electric method. For this reason it need not be expected that the usual trifling mishaps incidental to the starting of the machinery will be treated charitably. When the start is made let there be no stoppages. As Mr. Edison once said of the stoppage of a lighting service, the public will forgive once but not twice.

THE WESTERN ELECTRICIAN has several times called attention to the fact that patents issued under our present system are but little better than licenses to inventors to commence litigation to protect rights which ought to be secured by the patent itself. This unfortunate condition of affairs is now generally admitted, but, for all that, we hear of no decided move being made toward improvement. Not long ago there was presented in these columns an interesting interview with Mr. Edison in which he stated plainly that patents were practically of little or no value, except when constituting a basis for a legal fight. London *Industries,* in a recent issue, referred to Mr. Edison's opinion of patents in a manner which would seem to indicate that the dissatisfaction was not all confined to the United States.

It will be remembered that Mr. Edison was reported as advancing the proposition that no one should manufacture anything until he had proved that he does not infringe anybody's patent. This suggestion our contemporary does not hesitate to characterize as being absurd. The great evil, it thinks, is the delay in enforcing rights. "But this is common to many other branches of the law," it adds. "The practice of appealing is a waste of time and money. If the litigants are not willing to abide by the decisions of a lower court, the lower court is useless."

Generally speaking, there is no question but that legal proceedings are superabundantly endowed with the one peculiarity belonging particularly to large bodies. But as far as inventors are concerned the United States patent system should operate in such a manner that the patentee will not be left with only the right to go into the courts and spend thousand of dollars to protect himself from the man who deliberately appropriates his invention. That such robberies are frequently perpetrated upon men without means is a fact which no one will gainsay. Our contemporary's complaint, then, about the tardiness with which legal machinery operates is all right so far as it goes. It would seem, though, that the situation calls for a radical reform in patent law rather than for an attempt to better something that is, perhaps, after all, one of the necessary evils.

ELECTRICIANS will continue to watch with satisfaction the progress of the project for utilizing the power of Niagara Falls and transmitting it by electricity. Two references to the subject appearing in this issue will be read with interest. A great deal has already been accomplished on the American side, while in Canada the promoters of a similiar scheme propose to avail themselves of the distinguished talents of Ferranti in transmitting the power. Here not so much work has actually been done, but there appears to be less doubt that electricity will be utilized, as the American company seems to have paid considerable attention to the use of compressed air. By the time that the water-wheels are installed, however, the projectors of the scheme will probably have been convinced of the superior economy and efficiency of electric transmission.

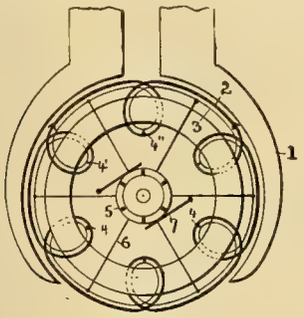
Whenever this subject is considered, the use of the power of Niagara to turn the wheels of the machinery at the Chicago World's Fair presents itself as a fascinating possibility. There is no doubt that this could be done were the necessary capital and activity forthcoming. But no one thinks that such a transmission would be a commercial success, and the proposition must be regarded simply as a possibility and not as a probability. Prof. Trowbridge of Harvard University advances an interesting idea in this connection—nothing less than the transportation of stored-up energy on freight cars. He suggests that the electrical power generated from the cataract at Niagara might be used to charge accumulators, these, in turn, to be loaded on railway cars and shipped to Chicago to dissipate their energy in driving machinery at the World's Fair. He estimates that six horse power per ton could be carried in this way. The idea has the merit of a somewhat startling novelty, at all events, although it can hardly be claimed for it that it has any advantage over wire transmission on the score of either economy or convenience.

It is to be regretted that the present conditions seem to indicate that the World's Columbian Exposition will not be distinguished by the electrical connection of the world's greatest waterfall and its greatest industrial exhibition.

Edison's Method of Reducing Sparking at the Commutator.

This improvement is described in the present instance as being applied to the armature in the form of a Gramme ring. Instead of winding a single wire on the armature core, as usual, Mr. Edison winds two or more conductors at the same time. Of the two wires thus wound, one is preferably a coarse copper wire and the other is a fine wire of a metal having a higher specific resistance, such as German silver. The latter conductor is employed particularly as a resistance wire, while the former is the wire which carries the larger part of the current generated in the machine.

The drawing will give a clearer idea of the method: 1 1 are the two copper poles of a field magnet, 2 is the insulated copper wire of the armature and 3 is the insulated German silver resistance wire. At the center of each section



EDISON'S METHOD OF REDUCING SPARKING AT THE COMMUTATOR.

of the coil of the armature ring the copper and German silver wires are electrically connected, as indicated at 4. The armature coils are connected to the segments of the commutator 5 by German silver or other wires 6, leading from a point approximately midway between two of the connections, 4.

Assuming that the armature is used in a dynamo, the operation may be explained as follows: As the armature is rotated current is generated in opposite directions in the two sides of the armature, and these currents meet approximately over or above the commutator, the direction of the current being indicated by arrows. When the current on one side reaches the section between the points 4' and 4'', it will pass across the connection at 4' to the German silver wire 3, and thence to a commutator segment and commutator brush, and the current on the opposite side of the armature will pass across at 4'' to the German silver wire, and thence to the commutator, thus putting a section of the resistance wire in circuit and reducing the sparking at the commutator when the brushes pass from one segment to another.

It is not essential that the two wires be wound together for the whole length or that they should be wound together at all, and conductors of other materials than those mentioned may be employed. It will be evident that current will also be generated in the resistance wire, which current will be in the same direction as that in the copper conductor.

The Green Electric Railway Patents.

In a recent issue of the WESTERN ELECTRICIAN considerable space was devoted to a description of the broad patent for electric railways granted to George F. Green. The application was made in 1879, but has been in interference in the patent office and the courts since then. The claim that has been allowed is a very comprehensive one, and, if it is finally established, will cause trouble to manufacturers and users of existing apparatus. That there is a prospect of this is shown by the following dispatch from Springfield, O., to the *Chicago Daily News:*

By a recent decision of the Supreme Court of the District of Columbia and by receipt of letters patent O. S. Kelly, the millionaire thresher manufacturer, legally becomes entitled to the sole use of all principles used in the electric street car systems manufactured by the Thomson-Houston company, the Westinghouse company and others. George F. Green of Kalamazoo, Mich., was the inventor of the present electric street car system, but, being poor, before he could secure a patent, there were three other applications for electric railway appliances of Mr. Green's ideas and his was suspended until the question between the three other applicants could be decided.

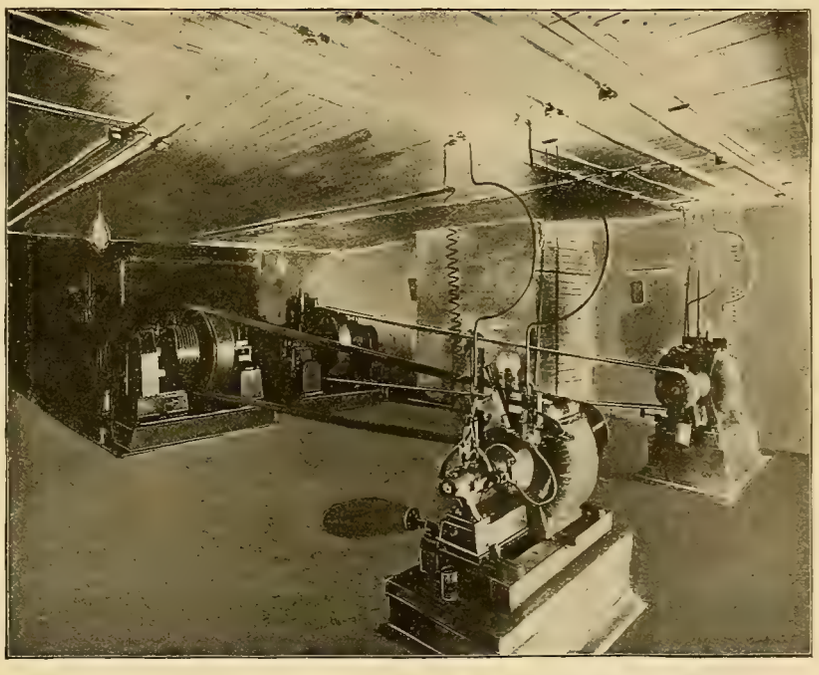
Mr. Kelly said: "I met Mr. Green in 1883 in this city. Mr. Green told me of his invention in the electric street car systems. For a certain consideration I took an interest in it; and in addition was to pay all expenses connected with the case. Mr. Green made his application in 1879 and when I arranged with him in 1883 his patent was still suspended. We waited until 1886, at which time the patent office granted letters patent upon electric railways to a nephew of Justice Field. I then asked to put in an interference, but the patent office, by unusual ruling, held that I could not come into interference with Mr. Field unless I filed an entirely new application, doing it in 1886.

"I filed the application and fought it through, but in 1889 Field was granted a patent on part of Green's invention. In the meantime I had kept the '79 application alive and we came to them with it. They, however, rejected us, and on last August we carried it to the Supreme Court and they granted us the patent. In the meantime I bought out Green."

Mr. Kelly will proceed to collect royalties from almost all the electric street railways in the country.

C. & C. Dynamos in the St. Nicholas Hotel, Cincinnati, O.

The illustration shows the dynamo room in the St. Nicholas Hotel, Cincinnati. The two generators have a capacity of 300 lights each and are of the standard C. & C. type. The dynamos are compound wound, and the entire machine is constructed with a view to attaining the highest possible efficiency. The armature shaft revolves in self-oiling bearings and the dynamo rests upon a sliding base, which can be adjusted to tighten the belt. This installation was made about a year ago, and the dynamos have been in constant service ever since then. The fact that a 40 kilowatt dynamo of the same type has recently been added to the plant to furnish current for an increased number of lights gives evidence of the satisfaction which these machines have given.



C. & C. DYNAMOS IN THE ST. NICHOLAS HOTEL, CINCINNATI, O.

Stories of Electricity.

An amusing and interesting record of alleged freaks of electricity can be made up from the columns of the daily papers. Here are some of the latest:

A freak of lightning occurred the other night near the village of New Salem, Vermont. Arent S. Vandyck occupies an old mansion, in the parlor of which hung a collection of revolutionary swords, one of which was heavily plated with silver. On the night in question a terrific thunderstorm burst, and one particularly fearful crash stunned every one in the house. Quickly recovering, the family hastened to see what damage had been done. Suddenly the younger Vandyck pointed to an old-fashioned sofa. There lay what seemed to be a silver cat, curled up as comfortably as could be. Each glittering hair was separate and distinct, and each silvery bristle of the whiskers described as graceful a curve as if in life. Turning to the swords on the wall, just over the sofa, father and son remarked that the plated sword had been stripped of all its silver; the scabbard was a strip of blackened steel, and the hilt had gone altogether. The family cat had been electro-plated by lightning! A round hole in a window pane, about the size of a half-dollar, showed where the electro fluid had entered. It is thought the plating of the cat's surface will prevent decay, and that she may be retained permanently among the family curiosities.

The foregoing, which was given in an English electrical paper, and alleged to have originally appeared in an American journal, has a certain air of improbability, but the following items are all given in the daily papers as truthful accounts:

A St. Paul dispatch says: T. H. Glaskin, a Chicago traveling man, was standing on the rear platform of an interurban electrical car which was spinning along from Minneapolis to St. Paul at a lively rate shortly after 10 o'clock last night. It was raining hard and Mr. Glaskin raised his umbrella, which struck the electric light wire used in lighting the car. This wire had been hanging on a hook fastened in the ceiling of the rear platform. It dropped, just encircling his ear, and the lightning went clear through him to his toes. He dropped on the car platform unconscious, and it was nearly an hour before he was resuscitated. The inner passage of the ear is seriously affected, and he will sue the street railway company for heavy damages. Two other passengers were stunned when Glaskin fell against them.

Chicago is the scene of the next story, and it is asserted that a sidewalk charged with electricity in front of Johnson's saloon at 140 South Halsted street provided amusement for a large crowd the other night. Electric light wires under the sidewalk had become crossed or disarranged in some way, says the *Tribune*, and one great stone slab, moistened with rain, had become so charged with electricity that every one without rubbers who stepped on it received a shock. Some were shocked only to the knees, others to the waist, while others were actually paralyzed. Along trotted two dogs, tramp dogs, that live off the free lunches in saloons in the neighborhood. When they stepped on the electrified stone they let out a howl of terror, and breaking through the laughing crowd, dashed wildly down the street. Three shop girls came sailing by. Three pronounced screams rent the air as they dashed through the crowd. They came back a few moments later to see what had struck them. A stylishly-dressed young fellow, four-fifths drunk, came rolling along with that peculiarly independent swagger incident to the man with a jag. The crowd parted to let him touch the magical stone. He got his shock and with a yell broke through the crowd and ran clear to Jackson street. As the laughing crowd looked after him they saw him stop under the Jackson street electric light and glance back, with a look of terror on his face, as if he were trying to figure out what kind of a new serpent had bitten him. The crowd grew so large in time that four policemen were detailed from Desplaines Street station to scatter it and allow travel to be resumed on the street. At 10 o'clock the electrical repairman arrived, and the stone was robbed of its shocking power.

A peculiar fatality at a fire in New Orleans is thus described: The wind was blowing hard and made fire fighting a hard task. Chief O'Connor was in charge and was directing Matthew Hannon, a hoseman of Columbia, No. 5, who was playing a stream of water on the fire. The chief took the brass nozzle and continued pumping on the blazing debris, while Hannon went to recover his hat, which had blown off. About this time a telephone wire fell and hung down in the doorway. The chief paid no attention to it and continued pumping. Suddenly he struck the wire with the stream. The water proved to be an excellent conductor, for a current of electricity ran down the stream and the brass nozzle and through the chief. The telephone wire was crossed with an electric light wire. The chief for a few seconds was stunned. Meantime Hannon had secured his hat and came back to continue his fight on the fire. Unconscious of his danger he bounded to the chief's side, and as he did so the swing ing wire struck him on the shoulder. He cried, "Oh, my God!" and threw out his arms. The wire swung away from him, but rebounding came in contact with Hannon's left arm. The unfortunate man shrieked once more, and then, as if to throw the deadly wire from him, he grasped it with both hands, and without a moan fell face downward, dead. One thousand people saw Hannon die, and the ordeal was so terrible that the firemen were for a time demoralized.

A prize is offered by the Societe des Eaux de la Dranse in Switzerland for the best system for the electrical utilization of a fall of water. Particulars of the competition may be had from the secretary of the Societe des Ingenieurs, Civile of Paris.

New Storage Battery Plate.

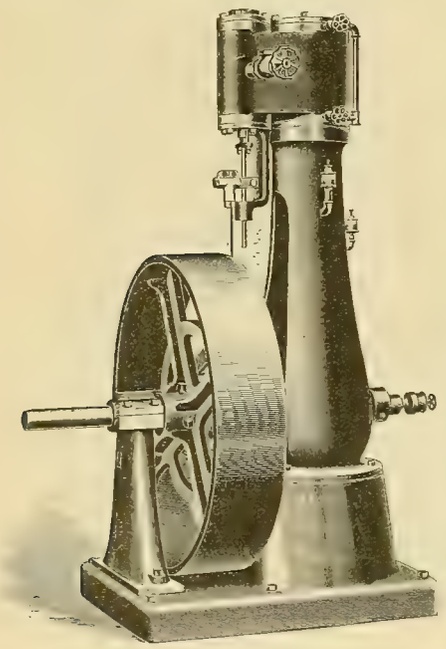
H. G. Morris and P. G. Salom of Philadelphia have devised a secondary battery plate in which they dispense with the high priced oxides of lead—such as minium, litharge, and other lead salts and oxides—now used as the active material in secondary-battery plates, and partially replace such materials with a cheap substance fulfilling, it is claimed, all the functions of the above mentioned compounds.

Messrs. Morris and Salom assert that they have found that electrically the behavior of galena or sulphide of lead is analogous in its chemical reactions to the oxides. In the negative electrode as at present constituted hydrogen is liberated by the action of the current and takes oxygen from the litharge or other oxides to form water. When galena or the sulphide of lead is used as active matter, the liberated hydrogen combines with the sulphur of the sulphide to form sulphureted hydrogen, which escapes as gas. In the positive plate as at present constituted the oxygen which is liberated by the current in charging, combines with the oxide or sulphate of lead and forms peroxide with the liberation of sulphuric acid. When galena is used, the liberated oxygen first oxidizes the sulphide and forms sulphate, which in turn is oxidized to peroxide with the liberation of sulphuric acid.

In making a negative plate compound they prefer to mix the finely pulverized galena with about ten per cent. of litharge, although a greater or less amount of the latter may be used. The litharge acts as a binder for holding the sulphide of lead in position in the plate until it is thoroughly reduced to spongy lead. In making a compound for the positive plate they add to the finely pulverized galena about fifty per cent. of the pulverized peroxide and sulphate, for the sake of economy, using the material obtained from old worn-out elements, which acts both as a binder and as a conductor. Either the positive or negative plate filled with the improved compound may be formed separately or in conjunction with the other plate.

The Racine Engine.

An automatic vertical engine, in sizes from 1 to 90 horse power, has recently been perfected and placed on the market by the Racine Hardware Manufacturing company of Racine, Wis. The automatic governor used on this engine has been so simplified and reduced in cost that it is possible to compete in price with the ordinary engine. It is claimed also that a saving of 30 per cent. in the amount of steam used is effected. The cut shows one of the 15



THE RACINE ENGINE.

horse power Racine engines. The floor space of the base is but 24x36 inches. The steel crank shaft has two wide bearings on the frame of the engine, and in addition a heavy outbearing beyond which it extends far enough to permit of the use of a pulley of almost any desired size. On the short end of the engine shaft is arranged the compression grease cup for oiling the crank pin brasses. The governor is accurately balanced when running at any speed, thus insuring perfect control at all times. By the adjustment of weights and springs, it can be set for a wide range of speed.

The company has four of these engines in use in different parts of its extensive establishment.

Although it counts among its regular customers such firms as the Edison General Electric company, and a half dozen other electrical firms, still a large portion of the Racine company's trade comes from establishments desiring to subdivide their power, instead of having it massed in one large engine. There is a demand for these engines from Maine to California. The manufacturers have recently added several thousand dollars' worth of special tools to the equipment of the engine department, and are usually able to make immediate shipment from stock. The engine is built in sizes ranging from cylinders three inches in diameter to thirteen inches diameter.

Mosher Arc Lamp for Incandescent Circuits.

A new arc lamp for constant potential circuits to be used either with direct or alternating current has recently been perfected by the Mosher Arc Lamp company of Chicago. The lamp possesses several novel features. It is simple in construction, with the regulating mechanism reduced to a minimum. These lamps can be used singly on circuits of any voltage from 50 to 125. They can be run in series of two on a circuit of 100 and 125 volts, and in twos, threes, or fours, on a 220 volt circuit, also in series of five to ten on a 500 volt circuit. They can be adjusted so as to take from three to ten amperes each, and to yield from 500 to 2,500 or more candle power.

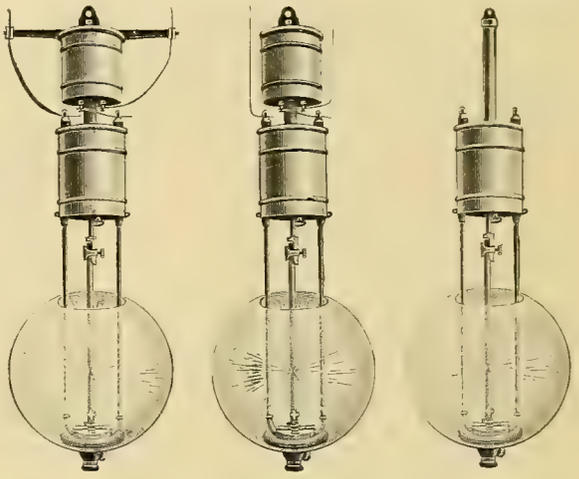


FIG. 1. FIG. 2. FIG. 3.

MOSHER ARC LAMP FOR INCANDESCENT CIRCUITS.

The lamps are made in two sizes. One 42 inches in length, receives a pair of ordinary carbons; another is 52 inches long and will take 24½ inches of carbon. The carbon holders are made to receive pencils varying in size from 7-16 to 5-8, also to fit other lamps than the Mosher. Steadiness of light, the ease with which it can be regulated and adaptability to any voltage or system are among the leading features of the Mosher lamp.

The length of the arc is easily adjusted by means of a regulating screw at the lower end of the spring.

Resistance, composed of fine braided wire, is inclosed in the case at the top of the lamp or may be located at any convenient place away from the lamp. It is also adjustable. No resistance is required for alternating currents.

The lamp is so constructed that a weather hood is unnecessary, and there is, of course, a cut out so that when the carbons are consumed or broken, the lamp will be automatically thrown out of circuit.

Fig. 1 shows the lamp designed for outdoor service, while Figs. 2 and 3 give a good idea of the general appearance of the two lamps designed respectively for direct and alternating currents.

Western Electric Company's Extension.

The Western Electric company of Chicago has purchased the block of ground known as the Collins & Burgie property, which lies immediately south of the Western Electric company's factory on Clinton street. The property has 300 feet of north frontage on Congress street, 200 feet east frontage on Clinton street, 200 feet west frontage on Jefferson street, or thereabouts, and is bounded on the south by Jefferson place. Located on this property are at present the foundry buildings of the late owners. The price paid was about $320,000.

Chicago Electric Club.

At last Monday's meeting of the club the paper of Chief Barrett on "Electrical Exhibits During the World's Columbian Exposition" was read. During the discussion it was voted as the sense of the club that the American electrical companies should distinguish the World's Fair by some scheme of long-distance electrical transmission surpassing the Lauffen-Frankfort experiment.

Rail Bond Infringement Suit

Judge Blodgett of the United States Circuit Court, Chicago, has rendered a decision in favor of the defendant in the case of Charles A Lieb against the Electric Merchandise company. Mr. Lieb brought suit for alleged infringement of a patent for rail bonds.

A novel event in the shape of a chess match played by telephone took place between representatives of London and Liverpool recently. Two games were arranged. The first was won by the Liverpool, but the second was abandoned after 60 moves.

Rapid Transit in Great Cities.

[*Concluded from page* 10]

Let us now consider some facts as to the probable number of trains which will have to be dealt with at a time in the four-tunnel Greathead scheme which Mr. Sterne advocates for New York city.

F. J. Sprague, who has made many careful observations of what takes place on the Third Avenue elevated railway of New York, has drawn attention to the fact that during the busy hours of the day there are at one and the same time in operation on this road, which is only eight and a half miles long, no less than sixty-three trains of four and five cars each on both the up and down tracks, or thirty-two trains, nearly, per track. The two tunnels, which it is intended to be used for wayside traffic, could scarcely have a less number of trains in them at the same time. It seems hardly probable that the traveling public could be induced to go down into such a tunnel when such a number of trains, of the weight per train which would be necessary for the contemplated traffic on the Greathead railway as proposed for New York City, are simultaneously operated from one source, all receiving their current from one and the same source, when, as is sometimes certain to happen from one of many causes, the current is ceased, at which time every one of these trains would be stopped or blocked.

This last mentioned casualty is perhaps the most serious which could arise, and while it is inconvenient enough for stoppage of the current to occur on an above ground railway, it is an intensely more serious a contingency to face in a tunnel.

This conclusion points out that whenever a tunnel system for municipal railway traffic is resorted to, the motive power used should be of such kind that each train is totally independent of any other—that the motive power should be such that if a breakdown occurs to one or more trains the others should not be prevented from moving backward or forward to the nearest station.

This unquestionably indicates that a circuit system operated from a dynamo station cannot be looked upon as a final solution for reliably carrying on the heavy passenger traffic in tunnel railways.

If tunnels in some cases must be resorted to for carrying on such a heavy traffic as corresponds with the case here considered, namely, the Third avenue elevated road of New York city, then the electrically operated circuit system is not safe for it, therefore is not adapted for such traffic with trains of cars each of which weighs fifteen tons when empty, eighteen tons when loaded and twenty-two tons when crowded. Either the steam locomotive, compressed air engines, some form of gas engine, probably such an arrangement as has been recently proposed by E. F. Osborne of this city, or the storage battery must be resorted to.

With regard to the latter there can hardly be any longer reasonable doubt but that the electrical mind is within the precincts of a great discovery, if even that has not already been reached by the use of cellulose for the grids in the Pumpelly battery. This feature of battery construction I look upon as likely to dissipate many of the drawbacks that for operating train motors have in the past attached to the storage battery. There is hardly any field so full of promise for the future of all the railway systems of the world as that which lies within the probable development of the storage battery; there is none other so full of reward to the genius which occupies itself along the highways of scientific discovery, and that of its offspring, the practical inventivity to apply it for the highest ends of humanitarian progress.

In regard to some of the conclusions which I have from time to time advanced against the electrically operated four tunnel system, recent experience in the new subway in London, popularly known as the City & South London electric railway, is held up as a sufficient answer; but I maintain it is not an answer in any sense, when the necessities of traffic are such as have to be dealt with in the extremely crowded business centers or the great cities of the United States. It is desirable to have facts before us in order to institute a proper comparison. In making this my only object is to consider the capability of the electrically operated subway as it is, and then to deal with its relationship to such traffic as has to be provided for in the cases of cities so circumstanced as New York, Chicago or Philadelphia.

Mr. Sterne has explained in New York that the City &

South London road was originally laid out as a "small omnibus line," each car being 26 feet long and having seats along the sides, just as an ordinary street car. Its electric plant is designed to handle a train of three tram-cars, carrying a total load of 100 people or 33 1-3 persons per car, at a maximum speed of 25 to 26 miles per hour. The total weight of the train is from 30 to 40 tons, The seating capacity of the London electric train is 156 feet only; that of the Manhattan train is 400 feet. The London train allows 18 inches for each seat, and therefore seats 100 passengers. The Manhattan train allows 20 inches for each seat, and seats 240 passengers, while it often carries during crowded periods nearly twice this number. The contractors for the system are reported to have guaranteed that the cost for traction for their trains should not exceed 3½d, or 7 cents, per train mile, which amount, it is understood, is for haulage merely, and does not include any charge for maintenance and repairs of the electric plant. Taking from these figures the cost of haulage per ton using for divisor the mean weight of the trains we find $\frac{7}{35}$=.2 of a cent as the cost of hauling a ton through one mile on this electric road.

If we compare this with the actual figures obtained in practice on the Manhattan system of New York the result is not favorable to the London electric railway.

For the year ending June 30, 1890, the Manhattan system made the following expenditure on its motive power plant:

Repairs of locomotives	$242,448.20
For fuel	814,969.32
For oil and waste	69,430.39
For water supply	65,019.93
	$1,191,873.84

With the engine power represented by the expenditure for the year, the Manhattan road made 7,683,520 train miles, which shows the cost for haulage of about 16 cents per train mile. To complete our comparison we must review the character of the Manhattan trains—the maximum of which consists of five cars, each having a seating capacity of 50 persons, or say 250 passengers per train, as compared to the 100 passengers of the London electric train. The average weight of the Manhattan train is 110 tons, and $\frac{16}{110}$=.14 of a cent as the cost of hauling a ton through a mile on that road.

Then .2—.14=.06 of a cent, which shows that the cost of haulage on the London electric road is very nearly 33 per cent. more then on the Manhattan road; and whereas the latter haulage charge does include the cost of maintenance and repairs—while the former appears not to do so—these costs, when included as they ought to be, would show this factor in a more unfavorable light than here appears for the expense of electric tonnage haulage.

In February, 1889, experiments were made by Lincoln Moss on the Ninth avenue line, to determine the relative cost of electric and steam traction, the results of which were very adverse to electric traction. An ordinary steam locomotive was run in competition with a Daft motor, the trains composed of empty cars. The total cost of running by electricity is computed by Mr. Moss as about four times that of steam. The most disparaging element there was the factor for depreciation and repairs. In the case of steam his figures are $24,472, but for the electric plant $385,530. For fuel alone, the relative costs were found to be $90,914 for steam haulage, and $107,583 for electrical haulage—or an excess of nearly 20 per cent. Electrical work has been, however, much advanced since the beginning of 1889, therefore, better results are to be had now.

In spite of the many defects and disadvantages—not least among them the terrible noise—which are admittedly chargeable to the elevated railways of New York city, no sane person could seriously contend that traveling by them is not immensely preferable to traveling underground, on the Metropolitan railway of London; nor in considering the full scope of this matter, may it be forgotten that it is, at least, natural to human beings who are in the plenitude of physical health and full activity of their senses to be in all respects above ground rather than consigned to travel below ground in tunnels.

When the nature of the case renders tunnels compulsory, nothing remains to be said, but why resort to underground travel with all its drawbacks, in American cities especially?—when these cities by virtue of their long, straight and generally broad streets, avenues and alleys, so well admit of a properly devised system of elevated railway which shall accommodate both rapid transit trains as well as slow trains for the intermediate wayside traffic?

While for an ancient city like London, with its very crooked, tortuous and often very narrow streets and lanes, congested as these are with both vehicular and pedestrian traffic, to such an extent that not a day passes without traffic of both kinds being many times brought to a standstill, not for minutes merely, but often for quite half an hour at a time—it is certainly impossible that an elevated railway could be constructed, or if constructed that it could be operated. Because this condition of things rules in London, the old districts of Paris, Vienna, Barcelona and indeed in any other of the ancient cities of Europe so as to compel almost any system of rapid transit to be carried on below ground in the heart of the cities, it does not follow that a modern city like New York, Chicago or Philadelphia, is for the same reasons which rule in London, especially, and in Europe generally, compelled to adopt underground lines of communication.

The case presented in American cities does not enforce any such relegation of rapid transit to tunnels, for the reason that they have been modernly laid out with much wise foresight in long lines of broad, straight streets, avenues, boulevards and alleys, intersecting each other at right angles, so as to most effectually admit of a superb system of elevated railway being carried through their magnificent thoroughfares.

It is certain that an elevated railway having four tracks so as to carry on simultaneously, but non-interferingly, rapid transit traffic, as well as the slower wayside traffic, may be provided at about one-eighth the cost of an equivalent tunnel railway. But an elevated railway for effecting this must be a structure quite unlike the girder frame system at present operated in New York, or the somewhat analogous structures known respectively as the Lake street elevated road and the Alley elevated road recently erected, but not as yet operated, in Chicago.

Still more so must the elevated railway be unlike the grand masonry arcade structures in Paris and Berlin, for the reason that the actual cost of such a structure as the Metropolitan railway of Berlin, including the right of way, reaches the considerable total for seven miles of railway of $15,942,000 or $2,115,000 per mile, of which forty-seven per cent. was paid for property, thus having fifty-three per cent or $1,120,950 per mile, as the cost of the structure. The actual cost of the four-track Stadtbahn, 7.5 miles long, was for right of way about $8,500,000 and for works about $9,500,000 Total, $18 000 000. The estimated cost of the four-track New York viaduct, about 12 miles long, is for right of way and works each $53,000.000 or together, $106,000,000.

To insure a reasonable return upon this as an investment at the average five cent fare for such traffic in American cities, and limited to that kind of traffic alone, it is safe to say that the earning capacity of such a road over a length of many miles, and which length must always be an increasing factor, while the fare irrespective of increasing length of structure, is not likely ever to be an increasing factor, rather from recent indications much more likely to be a decreasing one, does not present a tempting investment. Any elevated railway which is to be largely spread throughout the length and breadth of a city and to extend in all directions into suburban districts, five, ten, nay twenty or more miles away, must be of a very much less costly character than anything yet adopted, in order to be a paying scheme.

We are apt to look at New York as the ideal of an elevated railway system, because of the immense facts which it has developed in this particular class of traffic with four short lines of elevated railway, running parallel with each other throughout the length and breadth of a long, thickly populated, but all the while narrow island. The case presented by the costly elevated railroads of New York City and the long, narrow island of Manhattan, is in no case a criterion for such a city as Chicago, situated with its eastern front fixed by the shore of a vast lake, while its northern, southern and western divisions are ever extending with untrammeled strides outward, over an almost boundless prairie.

A few lines of elevated railway running parallel to each other while meeting much of the demands of Manhattan island could not possibly suffice for Chicago.

Here we must have a great system of elevated railways trending in all directions, capable of unlimited extension in all directions, and forming numerous loops to accommodate even the present requirements of the community, while it would be idle, nay reprehensible in the extreme, in a case such as Chicago represents, where the population is at present doubling itself in from every ten to twelve years, to refuse in laying out its elevated railways, to neglect the adoption of a system which shall continue to pay for all possible extension a sufficient return upon the investment.

No elevated railway for carrying on such traffic as a great commercial city requires has yet been built wherein the superstructure has cost much of anything less than $380,000 per mile. A very much less cost is necessary to carry elevated railways into distant suburban districts, that is to say into less and still less populous districts so that they may pay.

Hence the question arises, "Can this be accomplished?" I hope to show in what follows that it can. It cannot, however, be accomplished by any system which involves in the structures used the employment of the larger part of the material in compression. As wrought iron or steel is with a given section three or four times stronger in tension than in compression, it follows that if the mechanical design will admit of a structure of considerable length of section being built, with all or practically all of its parts subject to tensile stress alone, while maintaining the requisite rigidity of structure, a saving of from two-thirds to three-fourths of the material requisite for the compression members of a truss or girder structure may be effected.

Nearly ten years ago my mind became closely concentrated upon this problem, and I was ultimately led to devise and experimentally test a variety of structures, arriving eventually at the production of a frame capable of supporting continuous lines of railway, in which all the parts should be in tension.

After some measure of success, commingled with not a little disappointment, my thoughts resorted to a plaything of almost every boy in his school days—the unbroken loop or belt of twine with which is played, the variations of structure commonly known as the "cats cradle." I quickly saw that given the necessary material, stretched with the necessary tension, and with sufficient depth of structure so as to give vertical stiffness, and with the length of the "cat's cradles" divided into panels, each division of which could be connected by transverse beams between a pair of "cat's cradles" arranged side by side at the requisite distance apart, I should obtain the supporting points of a continuous platform either horizontal or to suit any required grade which would be capable of carrying, either a single railway track, or two, three, four, or more tracks on the same level, or in two or more tiers, one above the other. These considerations led me to make practical experiments under every variation of load that is ever likely to occur. The result of these experiments was to prove beyond question not only that an ordinary suspension cable may be stiffened against deformation, without considerable addition to weight of structure, but that it may be sufficiently stiffened to carry unusually heavy dead and live loads by the use of a second and much lighter cable curved inversely to its own curvature.

The structure to which I direct your attention is not only capable of accommodating rapid transit trains but wayside trains also. It is so designed as not to shut out the passage of light to the streets and abutting buildings. In its operations, particularly in respect of noise and smoke, it is not a public nuisance. In respect that the structure is composed of long spans of three hundred to four hundred feet each, carried on piers springing from the curb lines of the sidewalks, it does not impede vehicular, pedestrian or equestrian traffic in the streets through or across which an elevated railway is carried.

By extending the floor beams at either side of the structure it may be made to carry elevated sidewalks, which will relieve the pressure of the crowds from the ordinary sidewalks on the street level. The structure can also be used to carry the telegraph and telephone wires, thus getting rid on one hand of the unsightly poles which line so many streets, and on the other the heavy cost of laying conductors underground, together with the concomitant hindrances due to tearing up the streets.

To illustrate the extreme importance not only for elevated railways but for suspension bridge structures generally of the "cat's cradle" principle, I will here refer to some comparisons which have recently been made by my friend, Theodore Graham Gribble, who has drawn attention to the primary fact that the comparative efficiency of the primary suspension principle with that of the girder may be illustrated by supposing the transportation of a light weight across a ravine 400 feet wide. A girder constructed merely to carry its own weight and that of a man would weigh at least one hundred tons, that is to say, on the purely imaginary hypothesis of its requiring no lateral stability. As a matter of fact it would require to be built of two or more ribs and weigh from 400 to 500 tons. A steel wire of .03 inch diameter, weighing only 100 pounds, having a dip of about 35 feet and anchored at each end would not only support its own weight but would carry many times the weight of a man safely across. During the transit, the wire would assume undulations which would not affect its safety. If, however, a series of independent weights had been suspended from the wire, the passage of a load would create sudden vertical movements of those weights causing sharp shocks upon the wire, which would produce an immeasurably more destructive effect than the application of those same loads in a uniform and steady manner.

It is therefore the principal aim in designing ordinary suspension bridges to diminish the deformations of the structure under variable loads. This is accomplished in several ways by independent downward ties, carried back to the piers; by bracing the cables; by trussing the roadway or by framing from the roadway to the cable. The independent tie, apart from the fact of its detracting from the natural beauty of the suspension curve, is at best only a local remedy. It prevents deformation at one point only, and that but partially, because the lengths being unequal, the varying expansions render it impossible to obtain a uniform tension upon them. For instance, if an independent tie could be carried from the foot of the pier to the center of the bridge it would exert its maximum effect under certain conditions, but under others it would be entirely useless. The expansion of the bridge being provided for at the piers, the center would remain stationary, lengthwise, but under a rise of temperature would be depressed vertically by the slackening of the cable, thus shortening its distance from the point of attachment of the tie at the pier. But the tie itself, being lengthened by expansion, would exert no pull upon the bridge beyond its own weight. The same defect in greater or less degree is common to all independent ties.

Trussing and framing of suspension bridges is a compromise between two essentially different principles of construction and produces a hybrid structure. The weight is greatly increased, the symmetry marred and the general effect gives rise to the query whether an arch, truss or cantilever would not have been preferable.

In the tension frame which I have devised and constructed, the general effect is that of a suspension of increased symmetry, having the straight lines of the roadway relieved by the upturned curve of the under cable. The appearance is, however, only the adjunct of an important mechanical alteration in the distribution of stress. The tension frame contains an almost continuous communication of stress from an upper to a lower cable during the passage of a moving load and that by means of tension members only.

It is obvious that the so called elasticity of suspended structures is due to deformation alone. There is no more elasticity in steel under tensile than under compressive forces. If the simple suspension wire already alluded to could be anchored down by a series of vertical ties throughout its length, the wire being unable to depress under the load without elevating the opposite end and being resisted in so doing by the ties, would replace movement by stress and be as rigid vertically as a girder.

In the tension frame, the lower upturned cable is maintained in tension by straining devices at the pier and being considerably flatter and consequently shorter than the upper cable is not capable of the same extent of deformation as the upper cable. It affords a resistance to vertical movement in the ratio of the decrement of its length apart from the effect of the bracing. In addition to this a complete system of diagonal bracing has not only the effect of communicating stress from the upper to the lower cable, but in each panel offers resistance to distortion. On examining the distorted panels formed between the cables we see that one diagonal is lengthened and the other shortened. from which it is evident that if the vertical rods were replaced by a pair of diagonals, deformation could not take place without straining one of them. Both being tension members, they act alternately or conjointly, according to the positon of the load; one of them becomes redundant when the load is uneven and they

[1] Trans. American Society of Civil Engineers.

both act together when the load passes over them. The same effect as this, though in less perfect degree is produced by the stiffening trusses on the double decked system The tendency to movement is mainly vertical and is therefore practically met by the vertical tie in consequence of the latter being prevented from assuming an oblique direction over a considerable portion of its length by means of the stiffening truss, the stress being finally communicated to the under cable. The conditions demanding diagonal bracing are mainly the ratio of permanent to moving load and that of the dip to the span. When the curves are flat and the permanent load great in propoption to the moving load, the tendency to deformation is slight. The horizontal component of the resistances of the suspension rods is small, and is largely taken up by the internal stiffness of the cable.

Another important office of the under cable is in distributing the load between adjacent spans when the total loads are themselves unequal. The reaction of the piers is vertical when the spans are equal, whether loaded equally or not. When the spans are unequal the reaction lies in the direction of a diagonal to a pair of tangents to the curves at the piers. In a series of ordinary suspension spans, the only means of preventing overbalancing would be either to anchor them by independent downward ties, the defects of which have already been touched upon, or else to fix the cables at the piers. The result of the latter plan would be to deflect the reactions of the piers very considerably from the perpendicular and the overturning moment, acting with a leverage of the whole height of the pier, would require a large increase of material and a wide base of the pier. The action of the lower cable in the adjacent span of a series of tension frames is to carry the reaction of the balance of the unequal load to a point comparatively close to the base of the pier.

With regard to the distribution of stress in any single span of a tension frame under a moving load, if we could imagine the upper cable transformed into a stiff inverted arch having a moment of resistance capable of resisting deformation, we could determine the stresses upon any cross section when the curve of equilibrium became external to it, by means of an equation derived from the curve of bending moment. The tensions upon the bracing are those forces which balance, or take the place of that moment of resistance, which is lacking in the cable. The only limit to the rigidity of such a frame is the freedom to deform between the points of attachment of the bracing and the reflection of the whole frame after the manner of a girder. It is probable that these can be reduced by proper apportionment to an imperceptible vibration.

A braced invert would resist the same deformation in a different manner, the relation of stress to strength being found by equating the moment of resistance to the bending moment at any cross section. Such an arch, apart from its heavy appearance, would have to furnish all the required resistance to deformation within the small compass of its own cross section. The braced suspension bridge, possesses more leverage against deformation but is quite distinct in its distribution of stress from the tension frame. It would be better termed a suspended truss. Its principal defect is the loss of uniformity in the stress upon the upper chord, which being resolved amongst the bracing is almost nil at the center under unequal loads. Moreover as will be seen from the diagrams, the bracing is all in tension under uniform loads, but acts alternately as struts and ties under uneven loads. Consequently the use of steel wire is precluded for the cable and the bracing, having to resist heavy alternating stresse, sproduces a wasteful and inelegant structure. In the tension frame the stresses are so nearly uniform even under unequal loads that wire rope of uniform section can be used with economy both for cables and tracing.

With regard to the effect of winds upon the tension frame a few words are necessary. The vertical component of wind pressure is generally due to obstructions. The more open the sweep of a hurricane, the more nearly does it approach to a horizontal force. It is on record that winds have lifted roofs having a weight of ten pounds per superficial foot, but the action has probably been as follows: Moving air and moving water (as demonstrated by Hutton and others) act on precisely analogous principles. A horizontal wind impinging upon the vertical side of a building, curls upward as when a wave strikes a revetment, and meeting the projecting eave forms the roof into a lever with the opposite wall plate as a fulcrum. In an exposed position such as a suspension bridge usually occupies, it is not so much the amount as the continuance of unresisted force which has been so dangerous to such structures. When lacking any downward tie or stiffening truss of any kind the vertical component of the wind sets up a gradually increasing undulation along the bridge, like the swelling of a riple into a wave until, at last it becomes a series of mighty shocks which wreck the bridge.

The introduction of the under cable is a complete provision for the vertical action of any wind. It meets the trouble at the beginning so that the bridge cannot commence to undulate. The strength moreover is so great and so directly carries an upward force back to the foot of the piers that if we were to suppose so absurd a thing as that the wildest hurricane ever known were to swerve from its normal path and sport with the law of gravitation underneath the bridge every member of the tension frame would be adequate in its place to resist it. The action of the horizontal component of the wind is met in the usual manner by an inward lateral slope of the cables toward the center and by wind bracing, but the effect of the under cable is equally valuable in this phase of resistance, seeing that it pulls against the outer cable.

In the case of the proposed elevated boulevard and elevated railway, it is intended furthermore to adopt a flooring for the carriage way which will form a lateral girder of enormous strength. It consists of deeply corrugated plates of high moment of inertia connecting the cross girders clear across the bridge. The cross girders fifteen feet apart form the posts of the lateral girder and the flooring the web, the depth available for resisting horizontal stress being fifty feet, that is to say, the total width of the bridge.

The comparative weights of various standard types of bridges has been given by the late Prof. Fleeming Jenkin in a paper read before the Royal Scottish Society of Arts. He gives the weights of the main members and bracing exclusive of roadway which is common to all. The moving load is supposed to be 1.4 tons per foot run. The maximum intensity of stress upon all types except the suspension bridge is 4 tons per square inch. The suspension principle being adapted to the use of steel wire of high tensile strength is supposed to be subject to eight tons per square inch. The following is an extract from the table:

Span in Feet.	Weight in Tons.			
	Suspension Bridge.	Arch.	Bowstring Girder.	Lattice Girder.
200	19	41	70	83
400	83	194	375	475
600	200	530	1,260	2,220

From the same table we find that a girder of 700 feet span would weigh more than a suspension bridge of 1,280 feet span.

Adopting a 400 foot span and adding the weight of the roadway in both cases we can compare the tension frame with the girder as follows:

		Tons.
Girder	Main members	475
	Roadway	140
		615
Tension frame	Upper cable and bracing	83
	Under cable	45
	Roadway	140
		268

Or about 43 per cent. of the weight of the girder. The total cost of a mile of double-decked elevated railway upon the tension frame system is in close analogy with this. It is estimated at $231,000, as against $500,000 for the ordinary elevated railway construction.

The method and time of construction are an important feature in this system. Instead of requiring the occupation of a portion of the streets by continuous rows of columns, the structure will bridge from cross street to cross street. Instead of being carried forward from one or two ends only it will be constructed simultaneously throughout an avenue. The tiers will be erected from a scaffold arching the cross streets and having a minimum headway of sixteen feet to allow the traffic to proceed undisturbed. The cables will then be swung from pier to pier as over a chasm. In this manner the whole work can be carried out almost as rapidly as one block. This fact, it need hardly be said, has a very important bearing upon the time during which capital would have to be locked up, and the time within which a city would obtain relief to its overburdened existing means of transit.

Mr. Gribble has made certain further investigations in respect of the deflection of different structures under moving loads which show in a most striking manner the importance of the tension frame principle of construction, and the further stiffening of that frame against deflection produced by diagonal cross bracing instead of undivided or parallel ties.

At the conclusion of Mr. Day's paper considerable discussion ensued, participated in by Theodore G. Gribble, E. A. Sperry, Carl Kammeyer of Eau Clalre, Wis., G. K. Wheeler, T. G. Grier, G. E. Dorman, and Mr. Day. Much was said in relation to the best method of overhead construction. In answer to a question from Mr. Kammeyer, Mr. Day made this statement in reference to the motive power of the road:

"As I stated in my paper, the storage battery is a matter that is undergoing very rapid and decided evolution at the present moment. In my mind there is not the slightest doubt that in the near future great progress will be made in this direction. I do not especially advocate the adoption of the storage battery or the continuous conductor system at the present time. What I draw attention to is the utter uselessness of the continuous conductor in tunnels at present and the appalling results which must necessarily follow in tunnels where a large number of trains are running. These conditions do not apply, by any means, upon an elevated structure. And in this respect I speak with reference to any elevated railway. I am not speaking of my own system in particular, but any system of elevated railway affords facilities for the use of a continuous line conductor, with a power station, which are not possessed by any tunnel system or by any surface road, for the simple reason that the conductors can be laid between the tracks. I do not mean between the wheels of the cars, but between the pair of tracks. A trolley projecting from the side of the motor cars can run on top of the conductor, and in that way perfect contact can be made by gravity alone. That, of course, is of great importance in connection with the movement of passenger traffic."

Regarding electrical stocks as an investment the Boston *Commercial Advertiser* says: "Electric companies have an immense, practically new field before them, and there is no reason why the securities of thoroughly well managed concerns should not be favorably regarded by investors. Large amounts of money are necessary to carry on a general electrical business as is natural in a growing industry of its magnitude. That the three or four largest companies will eventually cousolidate is considered very probable, indeed, it is said that the men in Boston and New York who are backing both the Thomson-Houston and the Westinghouse desire a union of these two interests at least. It would certainly make a strong concern, and reduce competition very materially. But these gentlemen are understood to desire it mainly from a financial standpoint."

Niagara the Motor for the World's Fair.[1]

By Prof. John Trowbridge.

The remarkable new developments in the subject of the transmission of power by electricity come from the employment of a high electrical pressure or voltage generated by a to-and-fro, or alternating, current, instead of a direct current; and, strange to say, an apparatus which has long been used on professors' tables to illustrate the conversion of a low pressure current of electricity into a high pressure current has now come to have a great commercial value—this apparatus is the Ruhmkorff coil. In its elements it consists merely of two coils of wire entirely separate from each other, which are slipped on a bundle of iron wire which forms a core. If an alternating or rapidly interrupted current of electricity from a battery or a dynamo is sent through one of the coils, a current is generated by induction in the neighboring coil. The pressure in this latter coil depends largely upon the number of windings in it. A pressure of only two units in the coil which is connected with the battery or dynamo can be exalted to a pressure of 12,000 to 100,000 units in the independent coil by properly increasing its windings. Again if the sparks from a Leyden jar which is charged to 100,000 volts by an electrical machine should be sent through a coil of many windings, a neighboring independent coil can be made to give a pressure of only 4 volts, with, however, a large current for an instant. The Leyden jar current is a very feeble one, although it has a high pressure.

It it were possible to direct a bolt of lightning through a coil of many thousand windings of fine wire, a neighboring coil of few turns of coarse wire entirely unconnected with the coil through which the bolt of lightning passes could be made to furnish a current for an instant which would decompose water into oxygen and hydrogen, although this would have been out of the power of the original bolt of lightning. In this system of exalting the pressure by employing induction in independent circuits, for instance, between two coils slipped upon an iron rod or a bundle of wire, we have the modern transformer system, which marks a great development in the subject of the practical application of electricity. It will be noticed that we have a step-up transformer when we exalt a pressure of 4 volts to 100,000 volts, and a step-down transformer when we use a pressure of 100,000 volts in a fine wire coil to produce a pressure of 4 volts in a neighboring coil of coarse wire. A dynamo therefore producing only a 1,000 volt pressure, and the dynamo ordinarily used to-day safely can stand this pressure, can be employed to send an alternating or pulsating current through the coarse coil which we slip upon our iron rod, and the fine wire coil of greater number of turns which is placed near but unconnected with the coarse coil can be made to give by induction a pressure of from 12,000 to 20,000 volts. This pressure can be transmitted over a fine wire 100 miles, passed through another fine wire coil upon an iron rod, and a neighboring coarse coil can be then made to yield a lower pressure suitable for decomposing water, running an electric motor without burning it up, or doing any work which the generating dynamo at the sending end is capable of.

In 1883 the attention of mankind was directed to producing dynamos which would give the steadiest continuous current; to-day we are striving to produce dynamos which will give to-and-fro currents; for the success of the new method of transforming electricity from one pressure to another depends upon the fluctuation of a current, and not upon its steadiness. It may be said that our inventors unconsciously have been imitating nature; for every bolt of lightning is not one continuous discharge, but is an alternating current which pulsates to-and-fro ten or twelve times or even more in a millionth of a second.

The recent success in transmitting power over one hundred miles is due not only to the method of transforming a current of low pressure to a high pressure and then transforming back at the receiving end, but also to the invention of an alternating motor. At first sight it seems impossible that an alternating current flowing through a dynamo could make the armature of the latter revolve, for the pole of the electro-magnets which attract the armature become alternating north and south poles and apparently neutralize each other's effect on the armature. Here we are brought again to see an apparatus which has long been exhibited on lecture tables, developed into an important commercial engine.

Arago showed that a copper disc suspended by a thread above a revolving magnet would be dragged around by this magnet. Its motion was due to the reactions on the magnet of the currents formed in the copper by the motion of the magnet. Professor Farraris in Italy and Mr. Tesla in America showed that instead of rotating a magnet, magnetic poles could be formed at different points in a collection of electro-magnets by means of alternating currents in such a manner as completely to imitate a revolving magnet.

The copper disc would therefore follow the changing poles. Instead of a disc an armature consisting of copper rods was made, and the new alternating current motor sprang into existence. Its most striking peculiarity consists in its absence of brushes, such as are used on ordinary dynamos. Its armature, or revolving part, is practically a copper disc revolving under exactly the same conditions as in Arago's experiment. To this or to a similar alternating current motor we must look for aid in transmitting power over a wire from Niagara Falls to Chicago.

It is interesting to note that the conditions for the transmission of power by electrical means over long distances are closely analogous to those which are employed in long distance telephony. The transmitter is an alternating current machine operated by the human voice, and the telephone at the receiving end is an alternating current motor which impresses its motion upon the air and thus reproduces the speaker's voice four hundred miles away.

1. Abstract of an article in the January *Chautauquan*.

In long distance telephony, too, the step-up transformer is used.

It seems to me undoubtedly true that a diminution in our coal supply would result in making the transmission of power from Niagara Falls to New York a success. Economically considered it would be cheaper for the directors of the World's Fair to obtain 5,000 horse power from coal at Chicago. The sublimity of the attempt, however, possesses its attractions. Mankind has often cast uneasy glances at these unemployed giants, waterfalls and tides, as if envying them their freedom. If we could make them store up their energy and hand it over to us we should no longer be compelled to delve in mines a mile under the earth for coal, and we could fold our hands while the water ran on and did our work.

When the storage battery was invented it was thought that Niagara Falls had lost its freedom and would be immediately set to work. There was a period when the elation of mankind grew less and faith in storage batteries declined; for they were far from perfect and could not be relied upon. It was much as if the swift trotting horse had appeared before long experience had been obtained in training him and in properly nourishing him. The early experimenters endeavored to drive the storage batteries too hard, and the battery broke down under severe usage. To-day the storage batteries are becoming a commercial success and people understand better how to keep them in condition. There is therefore a possibility of employing them to convey a portion of the power of Niagara to Chicago. Let us see what this possibility is.

Roughly speaking 6 horse power can be stored in a ton of material which constitutes the storage battery. The equivalent of 50 horse power could be certainly carried in one freight car and it would therefore require 100 freight cars to transport 5,000 horse power from Niagara Falls to Chicago. The cost of the batteries would be in the neighborhood of $2,000,000 and in order to maintain 5,000 horse power in Chicago relays of batteries would have to be employed. Against the expense of this method we must place the cost of the high insulation of a line of 400 miles under a pressure of 20,000 volts. In both cases, neglecting the factor of sublimity, it would be more economical to generate the electricity at Chicago from coal by the ordinary method of employing a steam engine to drive a dynamo. Improvements in constructing high insulation wires and in transforming high electrical pressures to low ones and *vice versa* may make a greater revolution in the subject than has been made since the first experiments of Depretz in 1882.

It is interesting to note in connection with the plan of utilizing the power of Niagara Falls that some of our most thriving manufacturing centers are not located on water courses and depend upon coal and not upon water power. The cities of Fall River and New Bedford, in Massachusetts are rivaling Lawrence and Lowell in the number of their spindles, Both can obtain their supply of coal by cheap transportation in vessels. The cost of regulating water power is a large item in the use of it and steam is found to be more reliable and cheaper in many instances. There is no doubt that it would be more economical to generate 5,000 horse power in Chicago by means of coal than to attempt to transmit it from Niagara Falls. A great change, however, in our coal supply would speedily turn attention to the immense waste of energy which is going on at Niagara Falls and might convert New York state into a beehive of industries and Chicago might then find its proposed experimental line of 400 miles of great value

There is now an opportunity for a millionaire to provide the means of transmitting 5,000 horse power or more from Niagara Falls to Chicago. He will certainly have his name inscribed in the temple of fame.

The Field of Electricity.[1]

By F. S. Terry.

While electrical people can feel reasonably well satisfied with the progress of business during the last year, it has not been as great as was hoped for, nor as the earlier months gave promise of. This is largely due to the fact that during the last year electricity has not been used as much as heretofore in booming the growth of many of our Western towns. This, taken in connection with the constantly increasing numbers of those who have come into the electrical field, thereby largely increasing competition and reducing profits, has aided to retard somewhat the growth of the business for the last year, and has made the results rather disappointing.

Many of those who have gone into the business have been more or less irresponsible, and have labored under the additional difficulties of lack of business training and experience. I do not know of any line of business that demands these qualities to a greater extent than do the electrical industries. The fact that many of these people have ultimately failed has not had a stimulating effect, as the prices that they have established have remained in force.

The phenomenal growth of incandescent lighting is an evidence, however, of its increasing popularity. It seems to me almost an established fact that in a few years incandescent lighting will be practically general, while the older forms of illumination will be things of the past. Just as candles and oil have been superseded by gas, so electricity will succeed gas. Water gas is more or less poisonous in its effects, while illuminating gas is more or less unhealthful, as the oxygen of the air is rapidly consumed. Besides this, the flame in time will blacken walls and decorations, while the actual amount of light returned is very appreciably less than that afforded by the electric lamp. These facts, perhaps, are not thoroughly appreciated by any save those who have been accustomed to gas, who have then used the electric light and ultimately returned to gas. Those that pursue this course are positive grumblers at the inefficiency of gas light, while you will find them most enthusiastic over the electric light.

The fact of the matter is that electricity costs but little more than ordinary gas, while there is no oxygen consumed, no blackening of walls and decorations, and the little key in the socket is always near at hand and light can be turned on at any time. Of course without the use of matches the danger of fire is reduced to a minimum. With the increase of personal safety and the large amount of light returned in excess of gas, it seems to me almost incredible that the universal adoption of the incandescent lamp should be a matter of more than a few years. I believe that gas will soon cease to be used as an illuminating agency, and be confined to fuel purposes exclusively.

In fact, to sum up, there is every reason why electricity should be used, and no really plausible reason why it should not be. With the adoption of the electric light there is another possibility which promises to be almost as extensive in its use as the incandescent lamp. I refer particularly to electric power as obtained from motors. You will remember the large number of little fan-motors that have been used in almost every office during the last year or two. The same principle has been applied to larger motors, some of which have been constructed for 1,000-horse power. In fact the range of these motors runs from that of a 100 horse power to a thousand. I predict that it will be but a few years before you will see all the power in a number of large cities disseminated from the central station, while the mills, machine shops and factories will each be operated by an individual motor.

As demonstrated by results, it is impossible for electricity to grow in any one special direction unless in all. This fact you will find exemplified by the growth of such articles as are used in domestic electricity. By this I mean especially bells, batteries, annunciators, burglar alarms and kindred articles. I will venture to say that out of every hundred houses being erected, 75 per cent. are wired for annunciators and bell calls, as well as for electric gas lighting, in those localities where for various reasons it has been inconvenient to put in the regular incandescent lamp.

Of the electric railway it is hardly necessary for me to speak, and were you to take a tour through any of our states you would find that in large numbers of the cities, even down to those having only 10,00 inhabitants or so, the electric railway has superseded the horse road. It has been found that better service is obtained, quicker time made, and at a greater economy than under the old system. I might add that the prospects for the installation of electric railways during the coming year are simply enormous. I know of small towns that have not heretofore been able satisfactorily to support horse roads that are putting in electric systems. The better service afforded induces increased local patronage, and roads that under the old system were steadily losing money are paying satisfactory dividends by the use of electricity.

As to the electrical supply business, it seems at present that there is a movement toward centralizing in a number of large houses. The vast number of articles that it is necessary to carry in an electrical supply stock involves a large amount of capital, and for this reason the smaller concerns appear to be dropping out of the business.

I am justly enthusiastic on the subject of electrical growth, and until some more economical agency can be found to take its place electricity offers every evidence of becoming universal in its applications, from the tiniest household convenience to the largest enterprise to which power is applicable.

1. From the *Chicago Daily News*, in a review of the year.

He Knew What He Was Doing.

The *Chicago Mail* is responsible for the truth of the following story:

He apparently was a visitor from the rural districts who was totally unacquainted with city ways. He entered one of the offices at the city building, and finally attracted the attention of a clerk, who rather gruffly inquired; "Well, what is it? What can I do for you?"

"Where's your telephone?" asked the caller, taking a survey of the room.

"Over there."

Without saying another word the caller walked across the room, timidly took down the receiver, placed it to his ear, and stood for a minute as still as a statue, evidently listening and waiting for the mysterious instrument to "say something" to him. Then he carefully hung up the receiver, glanced around the room, and noticed that the face of every clerk was stretched out of its normal shape by a smile of generous proportions. Again he returned to the attack. After listening as before he tapped on the transmitter several times Again he waited. Then he glanced about him, put his lips close to the 'phone, and said quietly – very quietly, "Hello!"

This was too much for the amused clerks to stand, and after a hearty chorus of laughter one of them kindly volunteered to show the old man how to operate the new-fangled talking machine.

'Hang up that receiver just as it was when you found it. Turn that little crank at the right, which rings the bell. Then take down the 'phone and place it to your ear, and when the central girl answers, tell her—"

The old gentleman slowly turned, and gazing long and steadfastly on his young friend, remarked in that same sad, sweet voice.

"Say! Don't get gay, now. I'm the inspector, and I'm just testing your telephone."

Differences will occur even among the best regulated electric companies. Thus a laconic paragraph in a Rochester, N. Y., paper says: "Employes of the Edison Electric Illuminating company attempted to place a wire on the poles of the Bell Telephone company on East Main street Thursday night, but were prevented by the linemen of the latter company."

Cable "Bumpers" in San Francisco.

Criticism of the dangerous and inefficient cable system for street railways continues to spring up on every hand in cities where cars of this description are operated. In San Francisco, where a number of accidents have recently occurred, an especially dangerous feature of the cable has recently been ventilated in the press. This is a pleasing device known as the "bumper," and the *Chronicle* of that city, in an article headed "The Deadly Bumper," thus describes some of the peculiarities of this pretty toy:

There is one device in general use among the cable railways of the city which superintendents and chief engineers do not care to discuss in any detail. It is used upon every road on the streets near the power houses and where cables cross each other. That it is extremely dangerous the death of several persons and the serious injury of hundreds of others amply testify. Scores of serious accidents arising from its use have received public attention, but there are any number of cases which are never reported. This simple but deadly little piece of mechanism is called the "bumper." Every element of a cable system but that received widespread explanation, discussion and commendation. Each part of the complicated machinery, every department of the wonderful system receives more than its meed of praise, but the deadly bumper is put carefully in the background without investigation and with but very little comment.

The "bumper" occupies an anomalous position in the equipment of a cable road Every other part of the system is intended primarily for the convenience and safety of its patrons for great speed, rapid changes and general comfort. The bumper is the most important safeguard each company has for its property. It is a strong, practically immovable obstruction deliberately placed in every cable channel to destroy, to injure, and very often to kill. It is powerful enough to stop any car, and many people whose heads have been jammed through broken windows can tell with what marvelous suddenness a car stops when the grip strikes the iron bar beneath.

The "bumper" is not embedded in the rope conduit to fail in its purpose. It is put there to prevent damage to the property of the road. If a careless or forgetful gripman neglects to let go his cable wherever his line crosses beneath another he will cut one or both the ropes as if they were of paper instead of steel. That means a shutdown for the road, perhaps both of them, a delay of three or four hours, the expense of repair and the loss of patronage, which in the morning, at noon and at night is a very material loss to any of the cable companies. If a negligent gripman does not let go the cable where it enters or leaves the power-house he will snap it and perhaps derail the car, results for which the companies have a natural aversion.

The only method by which to obviate these difficulties at least the only one adopted by the cable roads, is the "bumper," dangerous to life and limb, but admirable as a means of doing the least amount of damage to the property of the company, at all events, when damage must be done. To save their property the cable companies deliberately endanger the lives of their patrons. When limbs are broken, faces slashed and scarred, and not infrequently lives lost by a crash into the "bumper," it is the result of no accident or circumstance beyond control, but the outcome of a plan and purpose that have taken a great deal of experiment to bring to perfection. A chief engineer on one of the cable roads says of this device: "The beauty of the bumper is that it destroys the least amount of property. When it is hit something else has to give way. It may break the grip, it may shatter the car and make the passengers uncomfortable, but the rope is saved and a in few moments the track is again clear."

Because the cable companies have but little confidence in the reliability and vigilance of their employes they put in the bumpers. If those in authority could feel assured that gripmen would not inflict serious damage to cables there would be no need of the dangerous obstructions. As they cannot trust their men and will not suffer loss they compel the public to assume a far greater danger. "On an average," said an officer in one of the companies, "we strike six or eight bumpers in a week. It doesn't hurt much. There is a slight jar, the car stops, and the gripman is suspended."

Not long ago one of those "slight jars" shattered half a dozen windows in a car, threw the people in it into a heap in one corner and brought the vehicle to a dead stop. If that had not occurred, the rope would have been cut. On another occasion, on a different road, a car struck the bumper. The front and rear trucks crashed together. The passengers on the open section were hurled in various directions. All were more or less injured and one had his shoulder-blade broken. It is a rule on that road on such occasions to discharge the gripman if he is not killed.

Stories of accidents caused by bumpers on every road in the city are without number. People have been maimed and disfigured for life, and still the evil is a standing one not likely to be abated. Whenever a new and inexperienced man is employed the danger is increased, but at all times it is present. It is the only means the companies have seen fit to adopt to save their property.

The contrast between a system employing devices of this dangerous character and the electric cars is too obvious to need comment. Electric railroads are now no novelty in and about San Francisco, and the bringing to light of facts such as the foregoing cannot fail to increase their popularity.

The contract for furnishing and putting electric light plants into cruisers Nos. 5 and 6 has been awarded by the Bath, Me., Iron Works to the Fisher Electric company of Detroit, Mich.

CORRESPONDENCE.

New York Notes.

NEW YORK, Jan 2.—It seems now to be a sure thing that Brooklyn will have the trolley system, for Mayor Chapin finished his last day as chief magistrate of the city of Brooklyn by neglecting to sign the aldermanic resolutions granting the local surface railroad companies the right to substitute the trolley system for horses as a motive power. The view of the railroad men and their counsel is that the trolley deal will go through without Mayor Chapin's signature. The resolutions were passed on December 21st, and the charter provides that all resolutions that have not been signed within ten days after their passage, and have not been vetoed, become operative without the mayor's approval. The ten days since the passage of the trolley resolutions expired Thursday, at midnight, and the resolutions became operative at that hour. The mayor's intimation, therefore, that he would let them go over to his successor is looked upon as a mild sort of deception.

William J. Richardson, secretary of the Atlantic Avenue system and a son of the president, on being interviewed, said: "There is no doubt about the trolley resolutions becoming operative, and without Mayor Chapin's approval. He would not sign them, but he agreed to keep his hands off That's all there is about it. Further than that I do not care to be quoted."

The Rapid Transit commission has decided to apply to the General Term of the Supreme Court for the appointment of a commission to determine whether the road shall be built or not, as provided by the Rapid Transit Act. Should the commission decide the question in the affirmative, that decision will do away with the necessity of obtaining the consents of the property owners The Rapid Transit commissioners find it impossible to obtain the necessary consents of the majority of the property owners along the designated route for the building of the proposed rapid transit railroad within a reasonable time. It has been found that it would take far too long a time to obtain the consents in legal shape. The reason for this is that so much of the property along the route is in estates, and it is necessary to get the consents of all the executors or all the heirs or other owners, and that is a very difficult thing to do because they are scattered all over the earth.

In addition to the application to the Supreme Court it is probable that the commission will ask the Legislature to make some modifications in the act so as to remove or change certain restrictions, which, it is believed, if allowed to remain, would deter capitalists from investing money in the enterprise.

It will be remembered that reference was made in a recent letter to an investigation which was being carried on in Plainfield, N. J., relative to frauds in the city lighting service. The committee appointed by the common council to investigate these charges made its final report Thursday night. It submitted detailed reports of tests made by experts from Stevens Institute of Technology and the Edison laboratory at Harrison, which declared that the city had been receiving only two-thirds of the value of electric lighting it had been paying for. Payment of the December bill for lighting has been refused, as a partial reimbursement to the city of its alleged losses. An accounting with the company will be demanded.

The Erie railroad has been experimenting with automatic bell signals for the grade crossings in places where the public roads are so little used that there are no flagmen and gates. The experiment has not been altogether satisfactory, but a large number of crossings in Bergen county are thus equipped. A train approaching in either direction starts an electric gong at the crossing, which can be heard an eighth of a mile away. Nearly all the grade crossings from Jersey City to Suffern are now provided with gates or these alarm bells.

There was considerable talk during the summer about the establishment of an extensive electric railway system on Staten Island. Erastus Wiman, of course, was the prime mover in the scheme, and he proposed to erect a large power plant on the site, or in the neighborhood of, his burned electric light station. For some time nothing further in regard to Mr. Wiman's plans has been heard, but on Monday evening last the matter came up again, and a public hearing was given by the New Brighton, Staten Island, trustees as to the application for a trolley system electric railway franchise from Port Richmond to Prohibition Park. Dr. I. K. Funk, Erastus Wiman, W. Jennings Demorest, E D. Clark, Col. Bacon, and others were present and spoke in favor of the petitioners, and only one gentleman appeared against the application. A contract will be drawn and presented to the trustees for approval at their next meeting, a week hence.

There is considerable dissatisfaction in certain portions of Staten Island, and it is all indirectly due to the misfortune of the Richmond Light, Heat & Power company. For three nights most of the streets in the villages of New Brighton and Edgewater, South Division, have been in darkness owing to the failure of Erastus Wiman's company to light them. The service of this company has been very unsatisfactory since its plant was destroyed by fire six months ago. Wednesday afternoon the Edgewater trustees held a special meeting and passed a resolution notifying the company that if the service was not made better at once the contract would be annulled.

Word comes from Westchester county that a temporary injunction has been granted prohibiting the trustees of Williams Bridge from allowing a franchise to the East Chester Electric Light company to light the streets of the village.

E. C. Bradley, manager of the telegraph system of the Pennsylvania railroad, has been appointed general manager of the Postal Telegraph Cable company. He will assume part of the duties now performed by President Chandler. Mr. Bradley is now stationed in Pittsburg. His new appointment takes effect on January 1st.

The Jersey City and Bergen railroad company has perfected its plans for equipping its lines of horse cars with electric power. The preliminary expense will be met by the issue of $130,000 of treasury stock. W. F. O.

San Francisco, Cal.

SAN FRANCISCO, Jan. 2.—The California State Board of Viticultural Commissioners has been experimenting with a view of ascertaining the effects of alternating currents on domestic wines. A continual flow of wine was passed between electrodes and treated to a current of 2,000 alternations. The results are reported to be remarkably satisfactory. Sherries, ports, brandies clarets and white wines were successfully tried, all of California make. A marked result was attained in the experiments with dry wines, especially clarets. First a sample of the untreated wine was exposed to the air In a short while it gave evidence of possessing strong acidity. Some treated dry wine exposed under similar conditions remained unchanged, showing convincing indications of sterilization. In the other instances the wines treated underwent emphatic changes. Their bouquet was very much developed, their harshness was mellowed down, and their taste so much altered that they appeared to be different wines entirely. Generally speaking, the wines treated had really been artificially aged. The experiments established the fact that the alternating electric current tends to preserve wine from ferments, to develop whatever qualities might be acquired by age, and to add a healthy tone to its condition.

Here is a case where a telephone wire that wasn't "loaded" killed a man. Daniel S. Lundy, an old farmer, was driving up the Mount Hamilton road toward the famous Lick Observatory near San Jose a few days ago when he was caught under the chin by a telephone wire that had sagged down across the road, and was thrown violently to the ground, killing him instantly. The coroner's jury returned a verdict in accordance with these facts and charged the telephone company with criminal negligence.

The grand jury of San Francisco, in discussing the vice and crime that is prevalent in the alleys of Chinatown and the disreputable quarters, reports that "the police department wants more light, and we recommend that every dark spot in the city should be illuminated by electricity. Rascality of every kind shuns the light"

Irwin C. Stump and associates have been granted a franchise in San Francisco from Mission and Sixth streets down Sixth to Brannan, to Eighth and thence by various thoroughfares to Railroad avenue and Sixteenth streets, South San Francisco. The cable system is to be used in the district within which overhead electric construction is prohibited. Outside of that district the system will be electric.

Geo. P. Low, electrical inspector for the Pacific Insurance Union, recently read a paper before the California Electrical society upon the "Inherent Hazards of Electric Lighting and Power Circuits," giving a general discussion of the elementary principles involved preparatory to subsequent papers that are to be read. This series comprises the papers that are being delivered before the Fire Underwriters' Association of the Pacific coast.

All the overhead construction of the San Francisco and San Mateo electric road has been completed and the roadbed has been ballasted, as far as Baden, fifteen miles distant. It is expected that the road will be in operation soon. The company has applied for a new franchise for an electric or cable road in three branches which will give its various lines access to Golden Gate Park.

The Salinas City, Cal. Gas & Water company has increased its facilities by placing a 500 light incandescent machine of the National Transformer system. The National Electrical Development company of San Francisco installed the plant.

The lines of the San Diego, Cal., Street Car company, which are being changed from horse to electric equipment by the Thomson-Houston Electric company, will consist of 2¾ miles of double track, and 2½ miles of single track. Nine single truck cars using single reduction motors will be placed, and the initial generating plant is to consist of two 80 kilowatt dynamos. Work on the road is already progressing rapidly. Dr. Addison, of the Thomson-Houston company, has also secured the contract for the equipment of the Metropolitan Electric railway of San Francisco. The initial equipment is to be twelve cars and three 110 horse power generators.

Los Angeles, Cal.

LOS ANGELES, Jan. 2.—This city claims to have the first tower clock actuated by electricity in the United States. It has just been put in successful operation in the new courthouse in this city. This pioneer timepiece, that is commonly termed "the big clock," might be called in botanical parlance a composite, for it is in reality four clocks, as each dial in the tower is supplied with its own separate apparatus, operated by wires from the main battery. There are also sixteen smaller clocks located in various parts of the magnificent new building; and these twenty clocks beat time together without ticking, but with instantaneous precision. The regulator that does the timekeeping is a large eight-day clock which differs only from an ordinary regulator in being provided with two insulating wires, and when its second hand completes its round it comes in contact with a platinum point, which instantaneous touch makes a momentary electric circuit by means of the wires, the current communicating with all the other clocks, and each obeys the telegraphic mandate by pointing a new minute.

The source of the electricity for all this automatic whispering is found in batteries that are located in one of the tower rooms, where two separate installations, each containing 211 cells, are in a cabinet together. Only one of the two sets is, however, required at a time—the other is simply for use in case of an emergency, and it is but the work of an instant to connect the whole apparatus with the unused battery by simply turning the handle of a compound switch. The clocks need not lose a minute in the change, for the switching can be accomplished between the electric flashes. Among the interesting parts of the ingenious mechanism is a relay through which all the electric currents pass. This relay has at one end an armature and magnet similar to, but larger than, those seen in a common telegraphic sounder. The lever of the magnet works a shaft that causes 18 brass fingers to vibrate. When the fingers fall they complete the electric current in 18 wires that run to the 20 dials, connection being as simultaneously broken when the fingers are raised. Ocular proof of the presence of electricity is given in green sparks on the tips of the brass points when the connection is broken.

Many persons climb the extra flights of stairs above the battery room and only pause in the section of the tower where the four great dials are placed. The gigantic hands of rolled steel each weigh 40 pounds, and are to be seen dimly through the translucent glass of the dials, that are about 16 feet in diameter. The shaft that carries the hands pierces the center of the disk, where it is connected with a large armature with an attachment of brass cogwheels. Each flash over the wires leading from the battery room whirls through the big spool of wire in the armature, magnetizes the soft iron core and shield, swings a rachet lever, gives a turn to the brass cogwheels and thus causes the minute hand outside to swing along nearly ten inches. We go down to the outside world 200 feet below, and when we look up once more at the minute hand we understand that its seeming short steps each announce that down in the heart of the great building the tiny, trembling second hand of the great regulator has just completed another delicate cycle, and marked the flight of another minute. N. S.

Indianapolis, Ind.

INDIANAPOLIS, Jan. 2.—The Citizens' Street Railway company has completed its College avenue electric line as far north as Tenth street. It commenced running cars recently, and so far has had no trouble of any kind. The motor cars for the new line have not all arrived, and for the present the company is using cars from Illinois street. The new line probably has the best constructed

track of any in the city. Rails are 70 pounds to the yard, and tie rods every five feet. Poles carrying feed and trolley wires are set in the middle of the street.

Twenty new motor cars were ordered from St. Louis some time ago, and on their arrival the company will have forty closed motor cars.

The North Indianapolis line opened some time ago, and has given entire satisfaction M.

PERSONAL.

Queen Victoria has raised Sir William Thomson to a peerage.

M. O'Dea, electrician of the University Notre Dame Notre Dame, Ind., was in Chicago last week.

C. A. Daigh of the Electrical Engineering & Supply company returned to the city on Tuesday morning.

A. P. Brayton, Jr., general manager of the Pelton Water Wheel company, San Francisco, was in Chicago last week.

A. D. Lundy of Sargent & Lundy has recently returned from a business trip through Kansas, Nebraska and other western states.

Frank B. Rae, formerly with the Detroit Electrical Works, will soon open an office in Detroit as a general consulting electrical engineer.

In an article on "American Supremacy in Mechanics," in the last number of the *Engineering Magazine*, a portrait of Prof. Elisha Gray is given as that of an eminent electrical inventor.

H. K. Gilman of the Great Western Electric Supply company. left for New York on Sunday night last. He will visit Boston, Philadelphia and other eastern cities, and expects to be absent ten days.

Professor von Helmholtz, the great German electrical scientist, is among the victims of the influenza in Berlin. As Herr von Helmholtz is now seventy years old some fears were entertained at first regarding his recovery, but late reports say that he will probably get well.

Don Alonzo Watson of Rochester, N. Y., died at midnight on January 1st. The deceased, who was several times a millionaire, laid the foundation for his large fortune by association with Hiram Sibley in the formation of what is now the Western Union Telegraph company.

NEW INCORPORATIONS.

Louisville Electricity company, Louisville, Ky.; capital stock, $25,000; to manufacture and sell electrical appliances.

Canisteo Valley Electric Railway company, Canisteo, N. Y.; capital stock, $20,000; to operate a street surface railroad.

Chicago Town company, Chicago, Va ; capital stock, $500,000; real estate and improvements, water, gas and electric works.

Electric Light Company of Kirksville Mo.; capital stock, $15,000; to establish and operate an electric light plant; John L. Porter, Kirksville, Mo.

Electric Light & Power company, Troy, Pa.; capital stock,$10,000; supplying light and power by means of electricity; A. C Fanning, Troy, Pa.

Breckenridge Electric company, Denver and Breckenridge, Colo.; capital stock, $20,000; to generate and distribute electricity for light, power and heat.

Clemons Electrical Manufacturing company, Attleboro, Mass.; capital stock, $25,000; manufacturing electric supplies and equipments; Philip E. Brady, Attleboro, Mass.

Davenport Power & Light company, Davenport, Ia., capital stock, $50,000; construction and operation of a power, light and heating plant; Davison & Lane, Davenport, Ia.

Crawford & Fort Robinson Motor Line company, Crawford, Neb.; capital stock, $50,000; to construct a steam or electric motor line between Crawford and Fort Robinson.

Dolgeville Electric Light & Power company, Dolgeville, N. Y.; capital stock, $25,000; manufacture and use of electricity for light, heat and power; Edward A. Brown, Dolgeville, N. Y.

Sea Medicine company, Chicago, Ill.; capital stock, $20,000; manufacture and sale of medicines and electric appliances; Leon M. Conroyd, 45 North Curtis street, Chicago, Ill.

Ozone Park Electric Light & Power company, Jamaica, N. Y.; capital stock, $2,000; to manufacture and use electricity for light, heat and power; Francis H. Van Vechten, 44 Broadway, New York, N. Y.

National Railway Exposition, Chicago, Ill.; capital stock, $10,000; to exhibit railway, electrical and other mechanical appliances and inventions, and to maaufacture and sell same; Herrick & Allen, 23 Portland block, Chicago, Ill.

Grandview Traction company, Pittsburg, Pa.; capital stock, $15,000; constructing and operating motors, cables and other appliances for supplying motive power to passenger railways; Kirk Q. Bingham, 155 Fourth avenue, Pittsburgh, Pa.

North Baltimore Electric Light & Power company, North Baltimore, Ohio; capital stock, $50,000; conduct and operate an electric light plant for illuminating purposes and furnishing electric and motive power; W. H. McMillen, North Baltimore, Ohio.

North River Electric Light & Power company, New York, N. Y.; capital stock, $200 000; manufacture and use of electricity for light, heat and power in the city of New York and adjacent towns; W. B. Putney, 115 Broadway, New York City, N. Y.

Magnete Electric Manufacturing company; (incorporated in W. Va.) New York, N. Y ; capital stock, $500,000; manufacturing and selling magnetic and electric goods and other patented articles and specialties; A. S Hatch, 15 Cortlandt street, New York City, N. Y.

Crown Point Electric Illuminating, Heating & Power company, Crown Point, Lake county, Ind.; capital stock, $60,000; to purchase, own and maintain an electric plant for the purpose of manufacturing and furnishing electricity and electrical power for illuminating, heating and motor purposes; W. H. Tompkins, Crown Point, Ind.

ELECTRIC LIGHTING.

It is said that Paris has 63,500 electric lamps.

Augusta, Ill., will establish an electric light plant to cost $ 0,000.

An electric light plant will be put in the state insane asylum at Raleigh, N. C.

The Boston Electric Light company has increased its quarterly dividend from 1½ to 2 per cent.

There are in operation in the streets and the parks of New York 26,634 gas lamps and 1,108 electric lights.

The Suffolk, Va., Light & Water company is reported as about to increase the capacity of its electric light plant.

The city of Harriman, Tenn., contemplates the erection of an electric light plant and the construction of waterworks.

The city council of Oxford, Ala., is said to be negotiating with a Philadelphia company for the erection of an electric light plant.

The Thomson-Houston company has secured the contract for the erection of an electric light plant at the Norfolk, Va., navy yard.

Dubuque, Ia , is another of the cities considering the matter of operating its own electric light plant for the lighting of the streets.

Medals and certificates will be awarded the most economical electric lighting exhibits at the Kimberley, South Africa, exhibition to be held this year.

According to the *Manufacturers' Record*, an excellent authority, 41 electric light plants have been established in the South within the last three months.

The Brooklyn, Mich., common council has granted a thirty-year franchise to an electric light company to light the village. Water power will be used.

On New Year's day the 100-foot chimney of the Hyde Park Electric Light & Power company of Chicago was thrown down, entailing a loss of over a thousand dollars and seriously interfering with the furnace fires.

Mason City, Mich., has been reduced to total darkness. When the contract of the firm that engaged to light the town expired, the council refused to renew it at the old figure, offering $60 a year per light instead of $78, as heretofore. The firm refused to accept the council's proposition.

Some quick work has been done in connection with the re-arrangement of the Chicago Arc Light & Power company's station recently destroyed by fire. On December 8th this company placed an order with the Chicago office of the Pond Engineering company for a 200 horse power Armington & Sims engine. The engine was shipped complete, from St. Louis, on the 9th inst. The railroad company delivered it in Chicago on the 14th. On the 17th inst. the engine was ready for operation, and is now regularly pulling six 50-light arc dynamos.

ELECTRIC RAILWAYS.

An Omaha man is reported as considering the construction of an electric railroad in Tampa, Fla.

The electric railway connecting East Liverpool and Wellsville, O., has been opened with much enthusiasm.

The Port Norfolk, Va., Electric Railway company hopes to begin the construction of its railroad within a few days.

The Georgia Electric Light company has been granted the right to build and operate an electric road at Atlanta.

New York capitalists have purchased the Wilmington, N. C., street railway and propose to erect an electric power plant to operate the railway.

The tramways of the city of Hobart, Tasmania, which have recently been purchased by a London syndicate, are in the future to be operated by electricity.

A surface electric railway is proposed for the vicinity of Seventy-fifth street, in Chicago, from the Rock Island railroad to the eastern branch of the Illinois Central.

The car house of the Bristol, Tenn., Belt Line Railway company was recently destroyed by fire, involving a loss of $20,000. Additional equipment has been ordered from the Short company.

It is expected that the new Atlanta & Chattahoochee electric railway will be in operation by February 15th, with fifteen miles of track completed. Nearly one half the track will be inside the city limits, and the new line promises to be one of the most important in Atlanta. The Short system will be used, and the power house will be built of granite.

In reporting on the several methods of operating electric railways, City Engineer Cunningham of Tronoto calls particular attention to the fact that, out of a total of 3,009 miles of track over which electric cars are being operated in the United States, all but 20 miles represent the overhead system, which he states is the only practical system at present available for operating street cars on an extended scale. "The storage battery," he continues, "might be used in small level systems where only a few cars are run, at very considerable time intervals, and where no high speed is required; but it is unsuited to the large traffic of such a city as Toronto."

ELECTRIC MINING.

Electricity will be used in the development of the Gold Hill mines of Wyoming, and in working the rich ores of the camp. The great advantage to be derived from harnessing the mountain torrents to produce electricity in the use of mining is just beginning to be recognized. Electrical experts have opened correspondence with people interested in Gold Hill, relative to the project under consideration. Within a few days a company will be organized to carry out these plans.

TELEPHONE.

An effort is being made to introduce the theatrophone into London.

Telephone communication between the towns of Sofia and Philippopolis in Bulgaria, a distance of almost 100 miles, has been recently established.

No bids having been received for establishing the direct telephone lines between Madrid and the important provincial towns of Cordova, Seville and Cadiz, in Spain, the government has decided to establish those lines as a national service, and the erection will be proceeded with at once.

It is said that traveling salesmen are not very favorably disposed toward the telephone. After quoting prices or selling goods to one concern they are likely to learn that other houses in the same trade have been informed of the prices or sales, and the information hampers them in their subsequent efforts to sell.

TELEGRAPH.

During the year 1890 7,612,436 telegrams were dispatched in Hungary.

The postoffice and telegraphic departments of Spain have been consolidated.

The Japanese government proposes to connect the various islands comprising the empire by telegraph cables at an estimated expense of $2,000,000.

The Western Union office in Rochester, N. Y., has been removed to the rooms in the Arcade formerly rented by the government for the postoffice. The location is a very central and desirable one. All of the departments will be on the ground floor, and easily accessible to one another. The operators will especially appreciate their commodious and splendidly lighted new room after their long confinement in the dingy and cramped quarters formerly occupied. The partitions separating the various departments of the new office are composed largely of glass, and the woodwork is handsome in design and finish.

The London correspondent of the *Pittsburg Dispatch* sends his paper some facts about the big London government telegraph office. He says that it contains more than three thousand operators, and its batteries are supplied by a plant of 30,000 cells. This office, it is said, does more business than any office in the United States. Of the three thousand operators about one thousand are women. They have a room to themselves, and they do their work with American Morse instruments with registers and paper reels. In the other parts of the office all sorts of instruments are used, and the Hughes printing instruments are the most popular.

MISCELLANEOUS.

A company has been formed in Berlin to exploit an aluminum accumulator.

The Pittsburg Electric club opened its house at 802 Penn avenue on New Years day.

An electric "provision cart" has just been completed for a prominent grocer in the north of London.

It is stated that the profits of the Thomson Houston company for the ten months ending December 1st were over $1,700,000.

The Edison General Electric company has begun the publication of a prettily printed periodical entitled the *Monthly Record*.

A. F. Collins of San Jose, Cal., is said to be the inventor of an arc light carbon that will burn for sixty-four hours. It is spiral in form.

On January 27th Prof. William A. Anthony will lecture before the Thomson Scientific club of Lynn, Mass. on "Electrical Terms and Units of Measurement."

Reisser & Co. of Stuttgart, Germany, are erecting a power transmiseion plant of 80 horse power in connection with the paper mills of Kutten & Co. in Wolfegg, in Wur-

temberg. The water fall from which the necessary power is obtained is about 880 yards from the paper mills.

It is said that the largest electric hoisting plant in the country has been installed at the docks of the Wilson Steamship company at Brooklyn. There are nine hoists and each is rated at 10 horse power and designed to carry 1,400 pounds. On tests they will lift 3,000. Current is furnished from a plant on one of the piers.

TRADE NEWS.

The Day Construction company, Chicago, has removed from the Adams Express building to 209 Home Insurance building.

B. M. Downs, general manager for Wm. Brookfield, 83 Fulton street, New York, reports that he has a large number of orders booked for the screw glass insulator which is becoming very popular in the East and West.

The Central Electric company, Chicago, is sending to its friends a handsome calendar for 1892. It has also ready for distribution a handsome lithographed circular of the Bryant specialties which have earned such a well deserved reputation.

The Nassau Electric company, 112 White street, New York, reports brisk demand for the Capsule batteries, which are meeting with remarkable success. The many other miniature electrical devices which this company manufacture always find a ready sale in the market, both East and West.

Ernest L. Clark has severed his connection with the Illinois Electric Material company, Chicago, as secretary and manager of the pole department, and will hereafter be found at the office of the Ernest L. Clark company, 331 Rookery, Chicago. Mr. Clark is ready to attend to the wants of all interested in the purchase of prime white cedar poles for electric construction.

The Riker Electric Motor company, Brooklyn, N. Y., is increasing the capacity of its factory by placing in more new machinery. A larger number of hands are now employed on regular work than ever before in order to meet the demands from all parts of the East, West and even New Mexico. Alex. Churchward, who for the past year has acted as assistant electrician for the company, has been appointed general superintendent and electrician.

The Premier Electric company, 11 Whipple street, Brooklyn, N. Y., is the name of a new electrical manufacturing company which is preparing to place on the market a line of motors, batteries, miniature incandescent lamps and electrical novelties. M. R. Rodrigues, the company's manager, is well known through his connection with prominent electrical concerns of New York. E. F. Kelly, superintendent of the manufacturing department, was formerly connected with the Porter-Leavitt Electric Motor company of Providence, R. I.

The introduction of so many new styles of incandescent lamps has already had the effect of creating new applications of the electric light. J. L. Somoff of 1 Ann street, New York, reports the shipment of large quantities of his fancy incandescent lamps of low voltage for Christmas trees. He has now over forty original styles of miniature incandescent lamps which he is placing on the market. The colored lamps are particularly in demand, and his high efficiency lamps of two watts per candle requiring but 200 milliamperes of current, have acquired a wide popularity. Large orders for them have been received from Berlin, Paris, Bordeaux, London and Brussells.

Charles McLaughlin of the firm of J. H. Bunnell & Co. of New York, when asked for his opinion as to the outlook for the business in the electrical line for '92, stated that he considered that the prospects for the general trade were excellent. The majority of firms now in business were solid and substantial, and the tendency toward careful and conservative business was very bright. He also stated that the volume of business had steadily increased in all branches of the electrical trade since September 1st. This opinion coming from a member of a house having such a large domestic as well as foreign trade is very gratifying, and the years that Mr. McLaughlin has been the active manager of this concern place him in a position to judge intelligently of business in the future.

BUSINESS.

Julius Andrae, Milwaukee, is enlarging his workshop, putting in several pieces of new machinery. Mr. Andrae has done a very satisfactory business in electric supplies and appliances during the past year, and is looking for a marked increase for the current year.

The Electrical Engineering & Supply company, St. Paul and Chicago, has a large force of men engaged in installing the storage battery plant in Col. J. J. Hill's house at St. Paul, recently noticed in this paper. When completed it will be, it is said, the finest electric plant in a private residence in the world.

The Easton Electric company, Brooklyn, N. Y., recently sold to J. S. & G. F. Simpson of the same city a 600-light Easton incandescent dynamo and lamps. The plant includes a number of the Easton arc lamps, which are operated on the incandescent circuit. This is the sixth large plant which the Easton company has recently installed in Brooklyn. This fact is good evidence that the work of the company is appreciated at home.

The Chicago Electric Manufacturing company reports a marked increase in the demand for instrument work over the corresponding period of last year. This company is manufacturing voltmeters and ammeters in lots of one and two hundred at a time, employing constantly a large force of men. In addition to this work on fine instruments this company is engaged in general electrical repair work and the manufacture of a number of specialties under contract.

A rawhide belt 28 inches wide, 115 feet long, and weighing 500 pounds, has just been made by the Chicago Rawhide Manufacturing company for the American Cutlery company of Chicago. This company manufactures a rawhide pinion for use on electric street railways and during the past year a number of large rawhide belts have been sold to electric light and electric street railway people.

The Great Western Electric Supply company reports that it has been unable to meet the demand for K. K. wire which have been made upon it during the last six weeks. It hopes to catch up with its orders in the course of a week. The Great Western company has sold within the past week forty Sun arc lamps to one concern in Omaha and has booked in the same time several small orders aggregating about the same number. The use of arc lamps in connection with incandescent lighting systems is apparently on the increase.

The Equitable Engineering & Construction company, Drexel Building, Philadelphia, announces that on the 1st of January the company will go into liquidation. The concern's business for the past year has been a profitable one, but the active members of the company wish to get out of the construction business. S. Ashton Hand has accepted a position as superintendent of the Detroit Electrical Works, Detroit, Mich., and W. A. Stadelman wishes to devote his time for the present to his interests in Bristol, Tenn., which consist of the Bristol Belt Line railway, and the Bristol & East Tennessee railroad. Mr. Stadelman owns a controlling interest in both these roads. The Equitable company retires from business with every debt paid and a good balance to be distributed as a dividend to the stockholders.

The Huyett & Smith Manufacturing company, Detroit and Chicago, has just installed for the West Superior Electric Railway company a hot blast system for heating the shop and car house and for drying and cleaning the armatures. A current of hot air is taken directly under the cars at a temperature of 180° Fahrenheit, driving out all moisture from the armatures in a short time, making it a very easy matter to thoroughly clean the electrical apparatus. The first plant of this kind ever put in use was built by Huyett & Smith and installed about a year ago for the West Side road in Milwaukee by C. A. Lathrop, then representing the Detroit firm in the Northwest, but now its general western agent at 31 South Canal street, Chicago. Since the first application in Milwaukee several other roads in St. Louis, Minneapolis and in the East have adopted this system.

ELECTRICAL PATENTS.

Issued December 29th, 1891.

465,829. Fire or Other Alarm. Hugh M. Browne, Washington, D. C.

465,832. System of Synchronism for Telegraphy. Gilbert A. Cassagnes, Paris, France.

465,844. Electric Railway. Julius Emmner, Jr., Washington, D. C.

465,853. Electric Machine. Thomas H. Hicks, Detroit, Mich.

The third claim reads:

"In an electric machine, an armature provided with two separate circuits traversed by current impulses of opposite directions, said armature having in combination therewith separate current-collectors, substantially as set forth."

465,854. System of Electric Distribution. Thomas H. Hicks, Detroit, Mich.

465,865. Sliding Clamp for Electric Welding Apparatus. Hermann Lemp, Lynn, Mass.

465,886 Electric Railway. Henry S Pruyn, Hoosick Falls, N. Y.

465,888. Covered Electric Conductor. Thomas L. Reed, Providence, R. I.

Claim.—As a new article of manufacture, a wire for electrical purposes having a covering composed of braided strands and straight wire-strands not braided inclosed between the two sets of braided strands.

465,909. Door Bell. Frank M. Winters, Chicago, Ill.

465,949. Electric Cane. Alfred W. Roovers and Alexander H. Roovers, Brooklyn, N. Y.

465,958. Lightning Arrester. Alexander Wurts, Pittsburg, Pa.

465,961. Insulator. Giuseppe S. Albanese, Orange, N. J.

465 970. Armature Connection for Motors or Generators. Thomas A. Edison, Llewellyn Park, N. J.

Claim four is:

"The combination, with an armature, a commutator-cylinder, and commutator-brushes of several sections of resistance-conductor, and means for throwing all said sections into circuit in series as a brush leaves a segment."

465,971. Means for Transmitting Signals Electrically. Thomas A. Edison, Menlo Park, N. J.

465,973. Armature for Dynamos or Motors. Thomas A. Edison, Llewellyn Park, N. J.

465 981. Electrical Pyrotechnics. Pierre C. E. Champion, Paris, France.

465,983. Cut-out. Henry W. Fisher, Pittsburg, Pa.

465,989. Signal Transmitting Apparatus and System. Henry A. Chase, Boston, Mass.

Claim twenty-one is quoted.

"In a signaling system, the combination, with a box provided with a signal-transmitting mechanism, of an audible signal for said box, a motor mechanism for said audible signal, a frangible covering for said box, and a releasing device for the motor mechanism, controlled by the frangible covering and automatically operated thereby.

465,990. Signal Transmitting Mechanism. Henry A. Chase, Boston, Mass.

465,991. Electric Signaling Apparatus. Frederick W. Cole, Newton, Mass.

465 994. Alternating Current Dynamo. Thomas H. Hicks, Detroit, Mich.

This invention refers to new and useful improvements in dynamos, and it consists in the mode or manner of arranging, and connecting the field poles, and collector devices.

465,997. Electrical Switch. George B. Martratt, Troy, N. Y.

465,999. Brake for Electric Motors. Alton J. Shaw, Muskegon, Mich.

466,009. Motor Car. Thomas C. Oakman, Aurora, Ill.

466,011. Electric Pendulum Clock. Henry Phillips, New York, N. Y.

466,019. Time Indicator for Letter Boxes. Edwin W. Morton, White Plains, N. Y.

466,028. Governing Device for Electric Motors. William Baxter, Jr., Baltimore, Md.

466,037. Electrically Operated Elevator. Frank E. Herdman, Indianapolis, Ind.

Claim twenty reads:

"In combination, an elevating apparatus, a pivoted lever counterbalanced and connected to the elevating apparatus, said lever being counterbalanced to the desired load and adapted when said load is increased to swing on its pivot-point, and intermediate connection between said lever and the source of power, whereby when the lever swings on its pivot-point the mechanism is stopped."

466,052. Electric Plug Circuit Closer. James L. Kimball, Boston, Mass.

466,053. Electric Signaling Apparatus. Bernice J. Noyes, Boston, Mass.

466,058. Electric Game Register for Pool Tables. Carl A. Erikson, New Britain, Conn.

466,063. Electric Annunciator. Frank C. Colville, Oakland, Cal.

466,087. Temperature Regulating Device for Electrical Circuits. Edward Weston, Newark, N. J.

466,101. Electric Railway Switch. Max Kerstein, Boston, Mass.

466,131. Art of and Apparatus for Heating Metal Articles by Electricity. Edwin E. Angell, Somerville, Mass.

466,132. Electric Forge. Edwin E. Angell, Somerville, Mass.

Claim five reads:

"In an electric forge, the combination of two electrode-levers pivoted at opposite points and inclined toward each other, the inner ends of said levers being provided with conductive anti-friction rollers to receive between them a bar to be heated."

466,133. Electric Forge. Edwin E. Angell, Somerville, Mass.

Claim six is:

'In an electric forge, the combination of a work-holder having electrodes connected with one pole and an electrode-wheel connected with the other pole."

466,138. Secondary Battery Plate. Henry G. Morris and Pedro G. Salom, Philadelphia, Pa.

466,159. Annunciator. William C. Dillman, Brooklyn, N. Y.

466,177. Galvanic Battery. Samuel Miller, Buxton, England.

This battery consists of a case or vessel, a carbon element in the form of a cylinder or box embedded in pitch or similar substance and containing the depolarizing-liquid, a porous pot inclosed by the carbon box, and containing an acid solution, and a zinc element in said porous pot.

466,180. Electrically Driven Locomotive. Everard H. Morgan, Dover, England.

466 196. Electric Railway Trolley and Support. Wilbur A. Stevens, Kansas City, Mo.

466,212. Electric Car Brake. La Motte C. Atwood, St. Louis, Mo

466,244. Electric Switch. William J. Kelly, Boston, Mass.

466,245. Controlling Apparatus for Incandescent Lights. William J. Kelly, Boston, Mass.

466,250. Electric Conductor. Joseph W. Marsh, Pittsburg, Pa.

466,266. Electric Heating Tool. George W. Blanchard, Waterville, Mo.

Claim two is given:

"An electric heating device consisting of tongs, having insulated handles and means for connecting electric conductors to its jaws."

466,268. Electric Cable. William A. Conner and Joseph W. Marsh, Pittsburg, Pa.

This cable consists in having a series of conductors adapted to be used in pairs for metallic circuits, the two wires of a pair or circuit being separated from each other, a greater distance than the adjacent wires of adjoining circuits.

466,288. Lamp Socket. Jesse L. Hinds, Syracuse, N. Y.

466,290. Lamp Socket. Jesse L. Hinds, Syracuse, N. Y.

466 289. Lamp Socket. Jesse L. Hinds, Syracuse, N. Y.

466,306. Electric Fire Alarm System. Henry E. Jacobs, Milwaukee, Wis.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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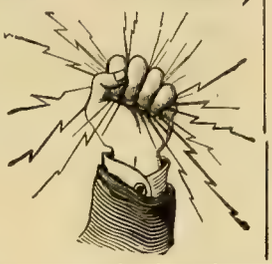

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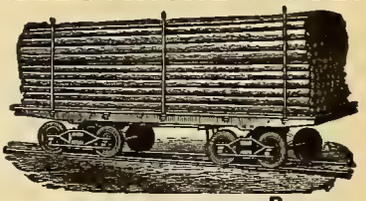

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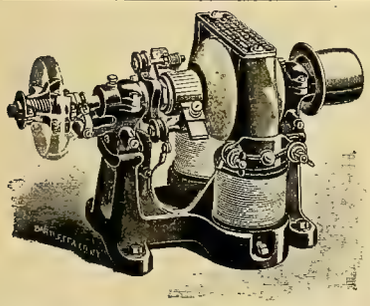

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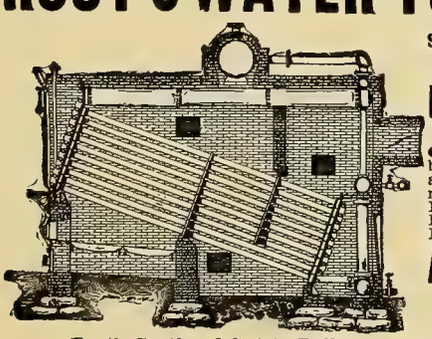

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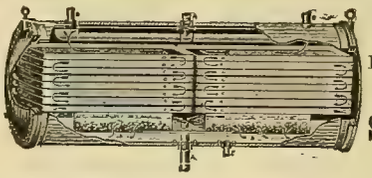

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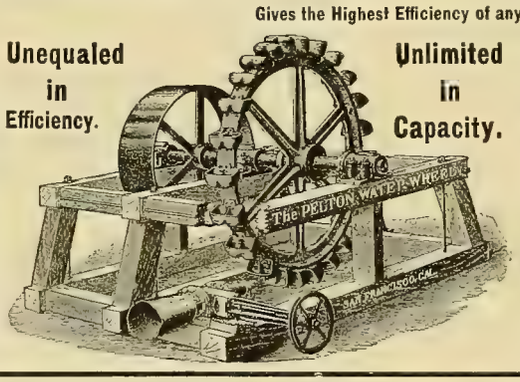

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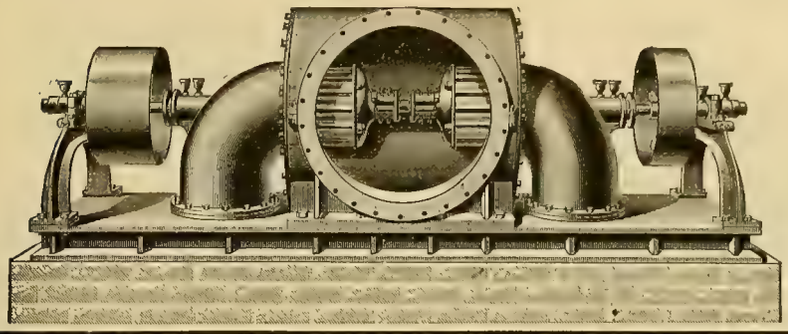

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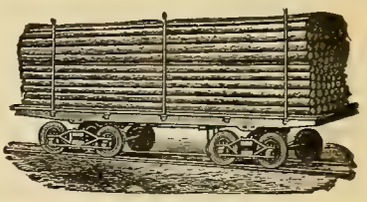

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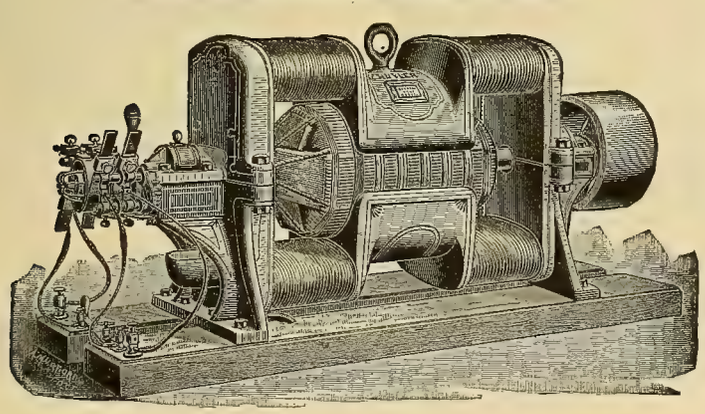

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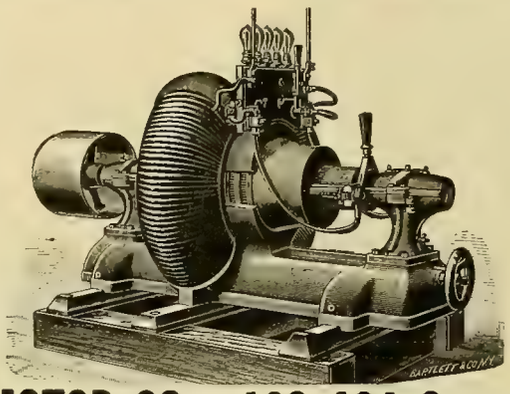

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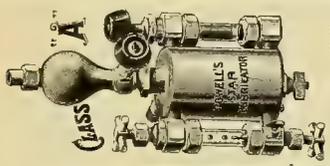

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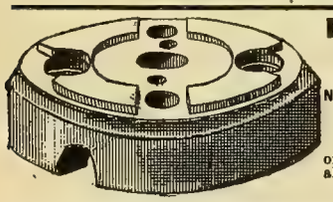

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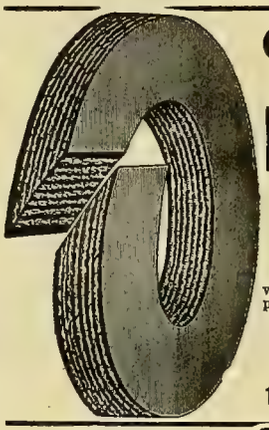

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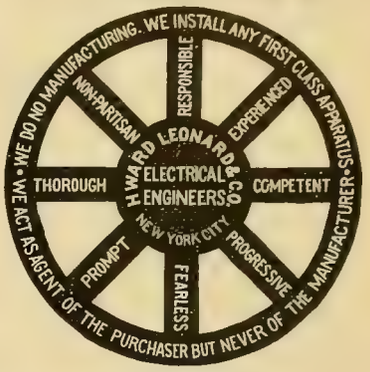

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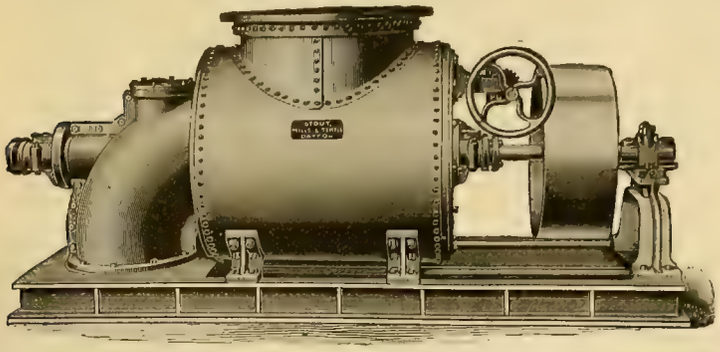

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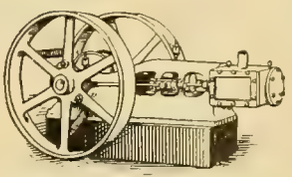

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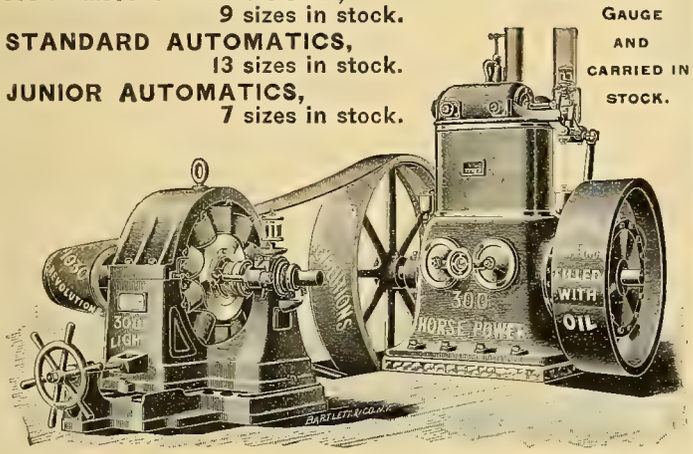

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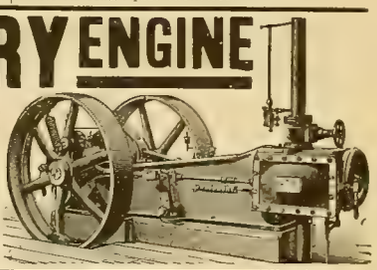

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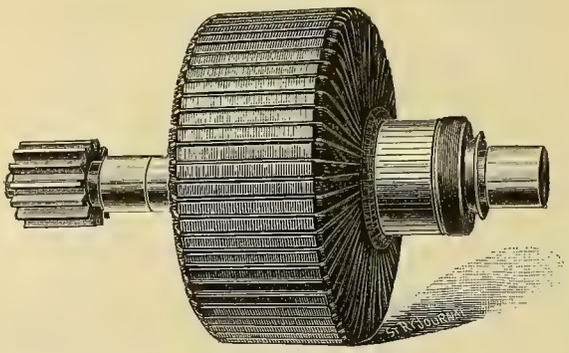

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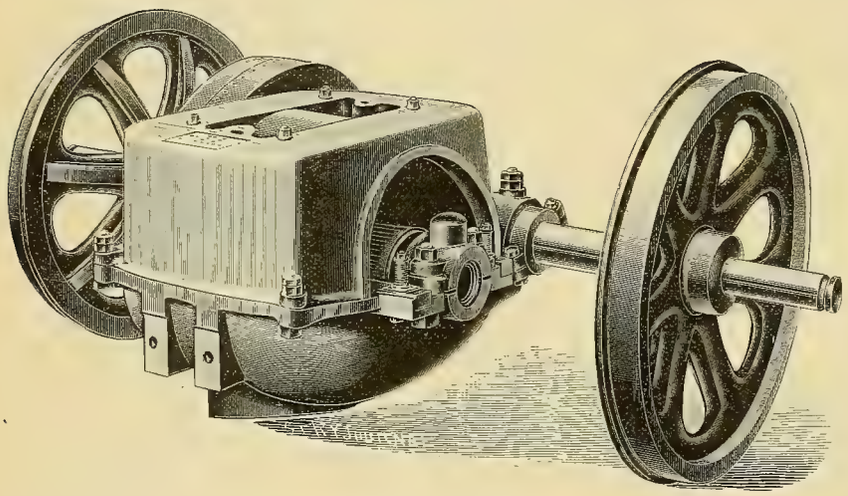

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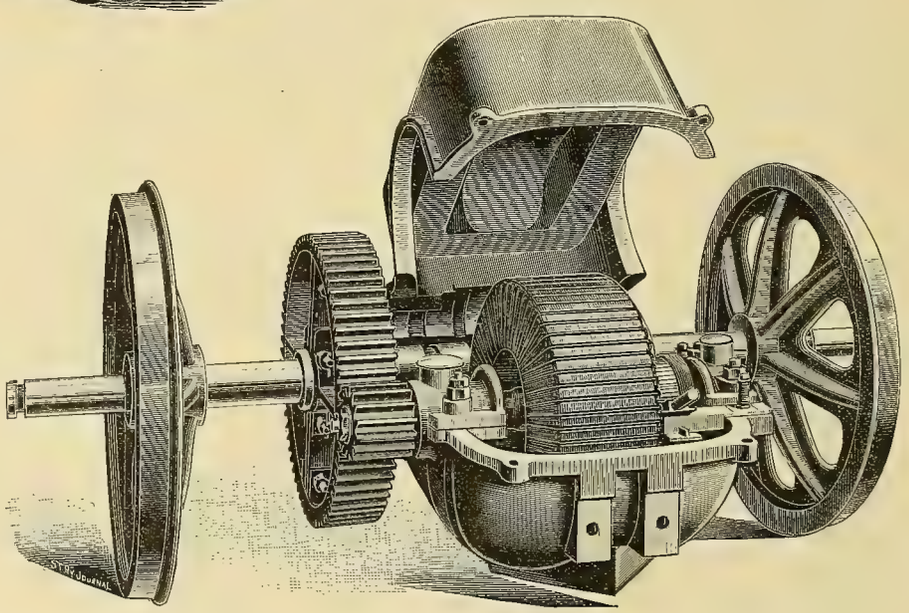

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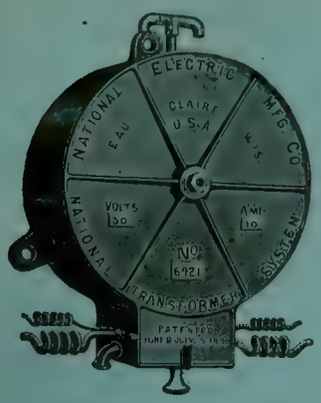

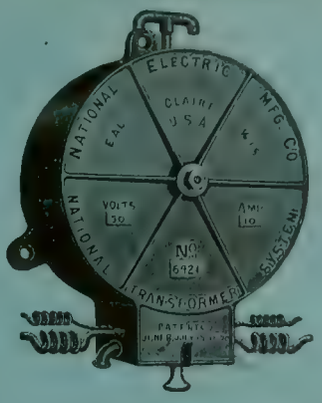

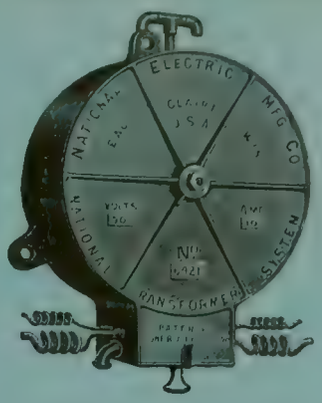

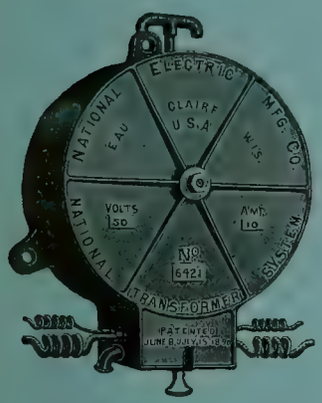

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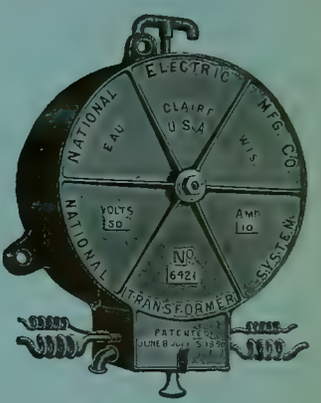

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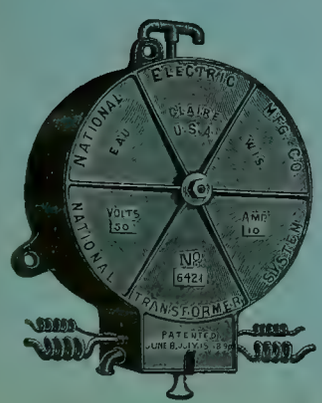

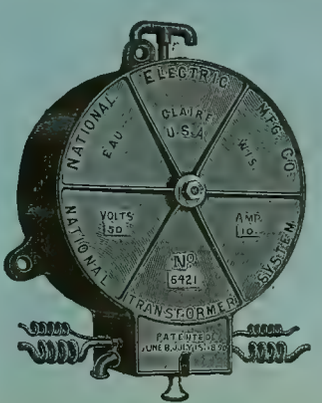

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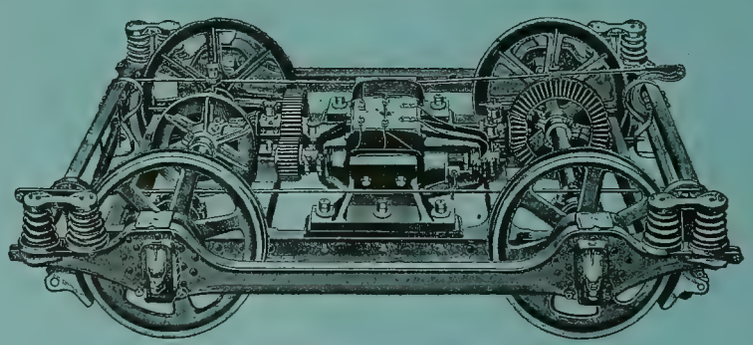

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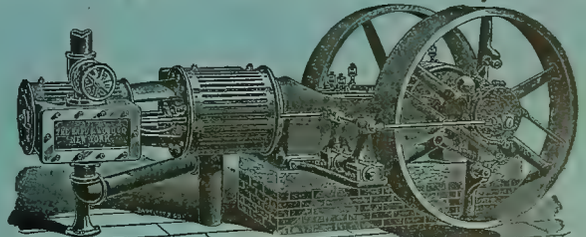

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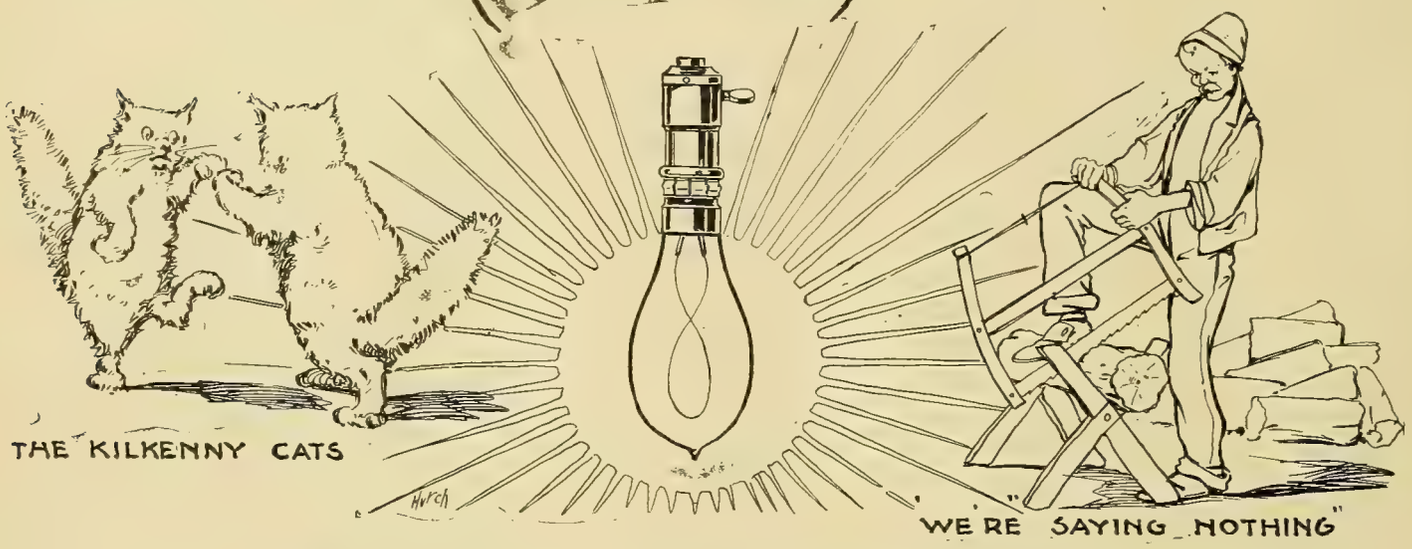

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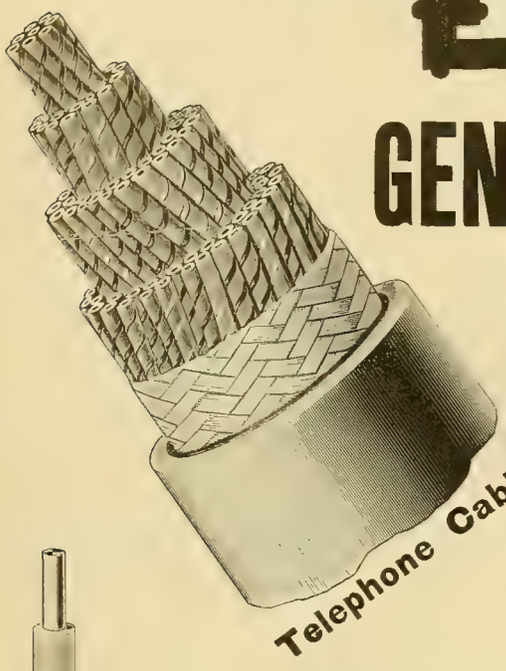

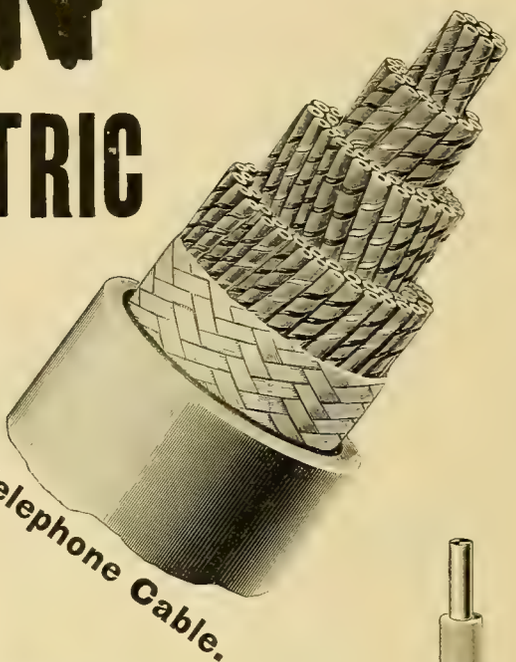

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E. M. W.

The Best Rubber Covered

WIRE

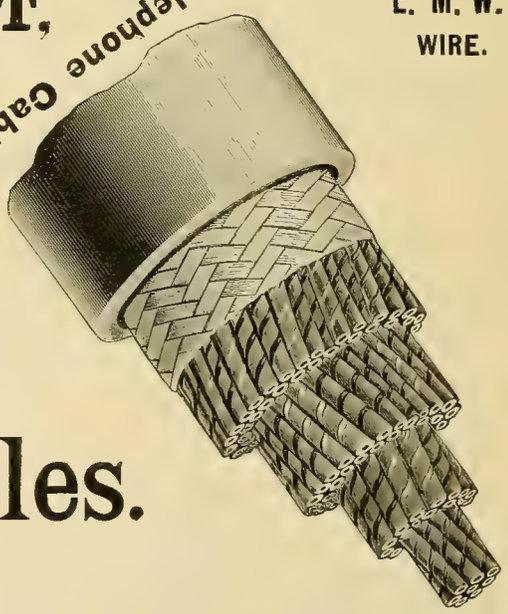
IN THE MARKET,

AND

ALL CLASSES OF

INSULATED

Wires AND Cables.



DISTRICT OFFICES:

CANADIAN: Edison Building, 77 Bay St., Toronto, Can.
CENTRAL: 173 and 175 Adams St., Chicago, Ill.
EASTERN: Edison Building, Broad St., New York.
NEW ENGLAND: 25 Otis Street, Boston, Mass.
PACIFIC COAST: Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTH WEST: Fleischner Building, Portland, Oregon.
ROCKY MOUNTAIN: Masonic Building, Denver, Colo.
SOUTHERN: Gould Building, Atlanta, Ga.
MEXICAN AND SOUTH AMERICAN DEPT.: Edison Building, Broad St., New York.
EUROPEAN OFFICE: 34 Victoria St., Westminster, London, S. W., England.

THE

WASHINGTON CARBON COMPANY'S

WEEKLY BULLETIN TO ITS FRIENDS.

Last week we stated that the ***Carbon Trust*** proposed to drive us out of the business by monopolizing the supply of raw material. ***To this end IT is bending all ITS energies.***

MORE ABOUT TRUST METHODS:

A representative of the ***Trust*** visited people who supply us with raw material and proposed the following:

"The Trust will buy raw material from YOU, if you will agree to charge outsiders twenty-five per cent. more than you charge the Trust."

This little scheme would have enabled the ***Trust*** to ***Advance the price of Carbons***

$2.00 PER THOUSAND,

but ***it failed.*** By ***"Outsiders" it*** meant ***The Washington Carbon Company. It is part of its creed that no one but the Trust has any right in the business.***

We are glad to be "outsiders." We propose to keep on being outsiders, for it pays, as our order books show.

We are very busy, but have time enough to keep an eye out for the ***Trust*** and have gathered much interesting matter, which we propose to deal out in weekly installments.

As we have arranged for an abundant supply of raw material, we are prepared to make contracts for carbons at fair prices for a term of years.

THE WASHINGTON CARBON COMPANY,

LOOK OUT FOR NEXT WEEK! Washington, Pennsylvania.

EDISON GENERAL ELECTRIC COMPANY.

Electric Generators and Motors.

— HIGHEST EFFICIENCY. — — PERFECT RESULTS. —

ELECTRIC MINING MACHINERY,

LOCOMOTIVES, DRILLS, CARS, Hoisting and Ventilating Apparatus.

Lamps, Wire, Cables.

All kinds of Accurate, Delicate and Reliable Measuring Instruments.

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ROCKY MOUNTAIN: Masonic Building, Denver, Colo.
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MEXICAN AND SOUTH AMERICAN DEPT., Edison Building, Broad St., New York.
EUROPEAN OFFICE; 34 Victoria St., Westminster, London, S W., England.

OUR GROWTH.

50,000

100,000

150,000

200,000

IN DAILY USE Jan. 1, 1892.

SOME REASONS FOR IT:

1. Increased Light at Decreased Cost.
2. With the sale of a 16 c. p. Lamp an **ACTUAL DELIVERY** of the **LIGHT.**
3. **ONE PRICE** to Central Stations for like Quantities.
4. Refusal to sacrifice **QUALITY** for Quantity and Price.
5. Avoidance of **MISLEADING** and unbusinesslike life Guarantees.
6. **ABSOLUTE FULFILLMENT OF ALL GUARANTEES.**
7. **A LARGER RETURN** to Consumers on **MONEY INVESTED** in **SUNBEAM LAMPS** than shown by any of our Competitors.

THE SUNBEAM INCANDESCENT LAMP COMPANY,

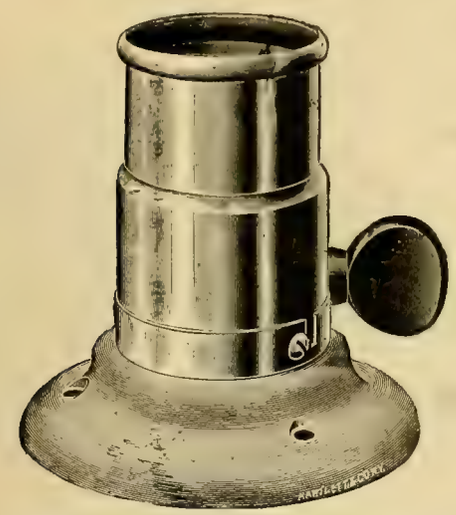
805 Chamber of Commerce Building, CHICAGO, Ill.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.



NEW PRICES.

WRITE FOR THEM.

LOWEST YET ON ALL LINES.

Star Electrix Co.,

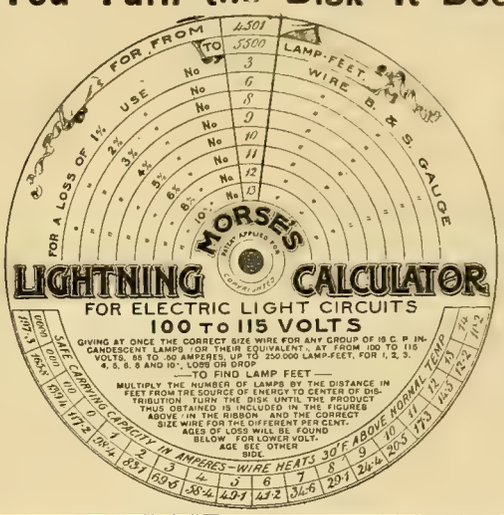
641 N. Broad St., PHILADELPHIA.

NOW THEN! FOR SALE CHEAP!!

Four 400 light, 240 ampere, Thomson-Houston Incandescent Dynamos, 110 volt.
Two 25 light, 2,000 candle power American Arc Light Dynamos.
One 50 light, 2,000 candle power Sperry Arc Dynamo.
700 Goose Necks, T.-H. Municipal Sockets, Shades, etc., complete.
45 miles No. 10 Wire, American Electric Co.'s make, used about nine months.
One 10 light Weston Arc Machine, with 8 double lamps, 2,000 candle power, A 1.

JOHN E. BEGGS MFG. & SUPPLY CO., 74 Cortlandt Street, NEW YORK.

You Turn the Disk—It Does the Rest!



Price 50 cents.

Quicker, easier and more reliable than charts or tables.

Enables any one to tell **instantly** the proper size wire to use for any Electric Light Circuit, with perfect accuracy. 100 to 115 volts, .65 to .50 ampere on one side: 50 to 60 volts, 1 ampere on the other. Every one interested in Electricity should have one. Cut two-thirds actual size. Sent prepaid on receipt of price.

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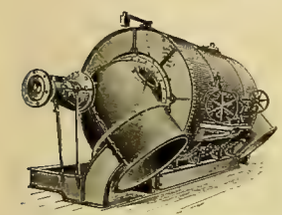
Manufactured by



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Specialties for Electric Light and Power.

Double the Power of most wheels. **High Speed and Even Speed. Perfectly controlled by Regulator. Belting** directly to dynamo. **Efficiency,** 90%. Holyoke Testing Flume. **Easy working gate.** Excellent workmanship, great durability. **Moderate Prices** and satisfaction guaranteed. 1,950 wheels sold in New England. One party has 87 of these wheels in use; another 6,800 H. P., another 7,400 H. P. etc., etc. Large numbers of wheels furnished for Electric Light and Electric Power Transmission, Street Railway, etc. Write for catalogue and estimates on proposed plants.

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Send For Complete Catalogue.

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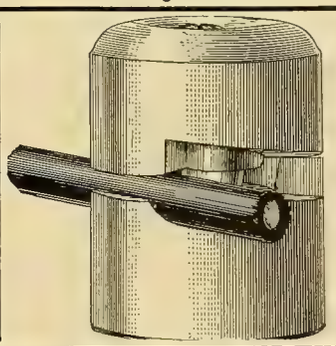
S. E. Cor. Fifth and Sycamore Sts., (Nevada Building,) CINCINNATI, O.



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MANUFACTURED BY THE

Security Insulator Co.

An Insulator that is easily and quickly adjusted, and will securely clamp the wire without injury to the Insulation, thus doing away entirely with tie wires, and effecting a large saving of time and labor in wiring. Wire from ⅛ to ⅜ of an inch may be used, thus allowing of a variation of ¼ of an inch in size of wire. Made of the best Vitrified and Non-Absorbent Porcelain.

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MOISTURE-PROOF
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THE RIES REGULATING SOCKET

FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

SOMETHING ENTIRELY NEW. Saves the Current, Regulates the Light. An Innovation in Electric Lighting. **SIMPLE, EFFICIENT, ECONOMICAL.**
INDORSED BY THE ELECTRICAL PRESS and prominent Electrical Engineers and Electricians.

NO RESISTANCE, OR ANY OTHER CURRENT-CONSUMING DEVICES USED.

The Price of our No. 1 Ries Regulating Socket (for lamps 16 to 25 C. P. 50 volts) is

$1.27½ { $3.00 EACH LESS 57 1-2 PER CENT. DISCOUNT, MAKING THE NET PRICE $1.27 1-2 EACH, When Ordered in Quantities. } **$1.27½**

For particulars write to
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Are Standard. Only One that is Guaranteed.

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Manufacturers of, and Dealers in, a line of General

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ALSO ELECTRIC AND COMBINATION FIXTURES AND GLASSWARE.

Rubber Covered Weather-Proof Wires and Lamp Cords.

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It will pay you to get our prices and new catalogue.

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BRAND'S STEEL WIRE TRACK BROOMS,
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BURTON ELECTRIC HEATERS

—AND—

ELECTRIC RAILWAY SUPPLIES

OF EVERY SORT—
FOR ANY SYSTEM.

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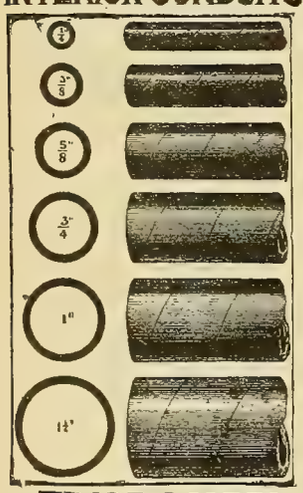

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The Solution of the Problem of Safe Guarding
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Wherever and for whatsoever purpose employed, is to be found in the
CONDUIT SYSTEM.
INTERIOR AND UNDERGROUND
CONDUITS
MANUFACTURED BY
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WORKS: { 527 to 531 W. 34th St., 526 to 528 W. 35th St.,
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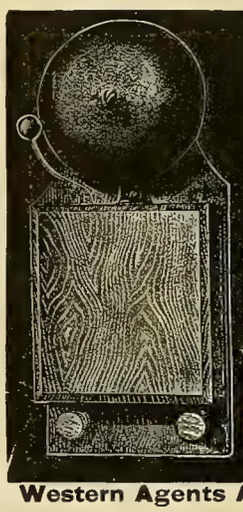

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BELLS
ARE THE BEST.
Polished Case, Nickel Plated Trimmings, Heavy Magnets, Quick Stroke, Clear Ring.

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LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This System Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

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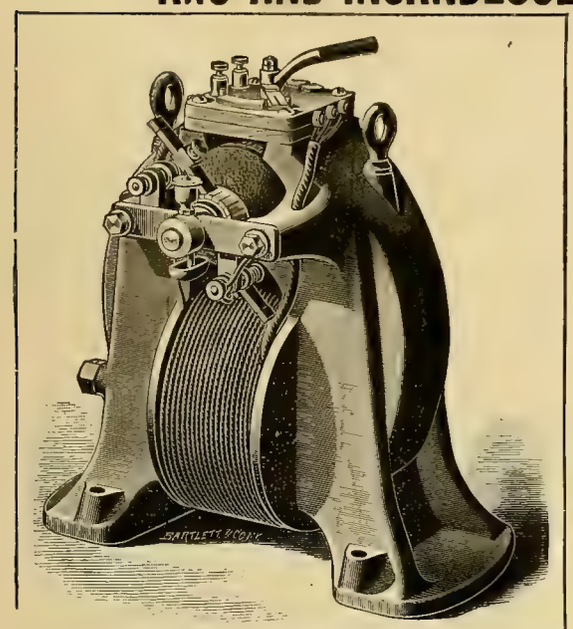
ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



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Automatic Dynamos.—Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

MOTORS and GENERATORS

Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

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NEW YORK, 510-534 West 23d Street.

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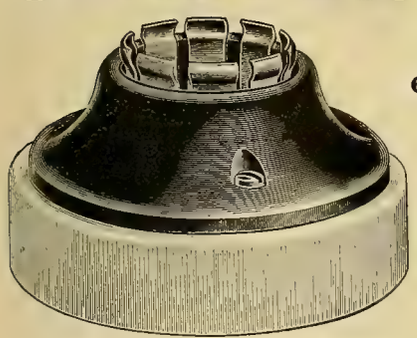


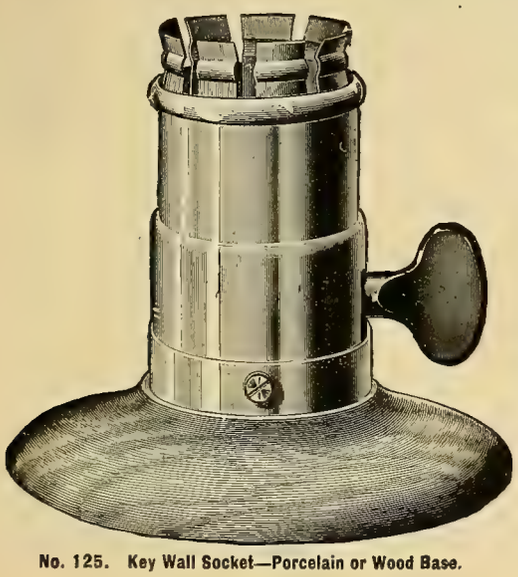
No. 135. All Porcelain Keyless Wall Socket.

INCANDESCENT LAMPS.

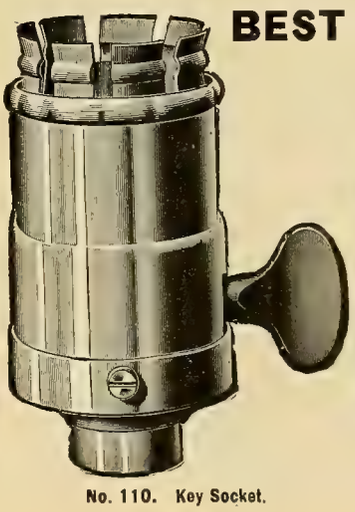
Orders Executed Correctly and Promptly.

SOCKETS.

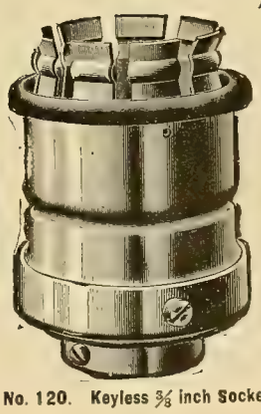
BEST AND CHEAPEST.



No. 125. Key Wall Socket—Porcelain or Wood Base.



No. 110. Key Socket.



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ALSO—

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MANUFACTURED BY

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Secure bid from us for Electrical Apparatus or Construction before deciding. Railways, Lighting, Transmission of Power, Wiring, etc.

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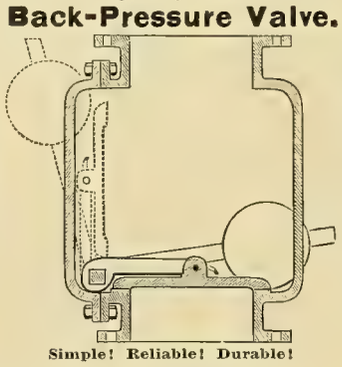
Straight-Way Noiseless

Back-Pressure Valve.



Simple! Reliable! Durable!

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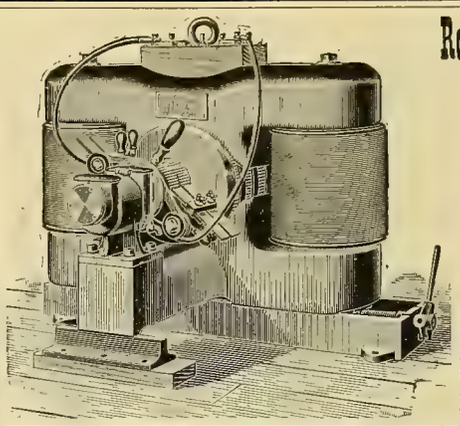

Rockford Electric Mfg. Co.,

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Manufacturers of

MOTORS,

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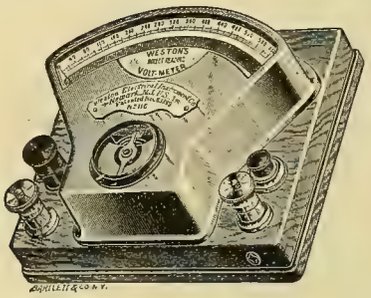
Incandescent Dynamos and Generators

(MAYO SYSTEM).

Specially adapted to Isolated Plants. Absolutely self-regulating and reliable. The Motors are the most efficient now in the market. Agents wanted in unoccupied territory.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

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JAS. SCHAWEL & CO., 29 JOHN ST., NEW YORK.

Importers and Melters. Sheet and Wire in any Gauge. Scrap Purchased.

H. T. PAISTE,

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See our full page advertisement in issue Sept. 12, for illustrations, prices, etc.

MICA.

For all Electric Insulating Purposes East India Mica is the best on the market.

I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

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SOLID BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

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CEDAR, OCTAGONAL PINE AND STEEL.

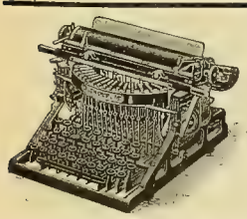
If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.



The "DENSMORE,"

The World's Greatest Typewriter,

Should be examined before purchasing any other.

MANY IMPROVEMENTS. HIGHEST STANDARD.

Invented, owned and controlled by men having had fifteen years' experience on type-bar machines.

Simplicity, Strength, Durability, High Speed, Easy Action, Permanent Alignment. Most convenient. Two interchangeable carriages. Site 1 throughout.

STANDARD KEY-BOARD, with shift carriage for capitals. Call or send for catalogue.

"A perfect machine. Am delighted with it. A pleasure to run it."—CHAS. D. KELLY, Stenographer West Shore R. R., New York.

We will appoint a reliable dealer in all cities as soon as possible, and in the meantime will ship machines on approval to parties having a good commercial rating.

DENSMORE TYPEWRITER CO., 202 Broadway, New York.

—THE—

UNION HARDWARE CO.,

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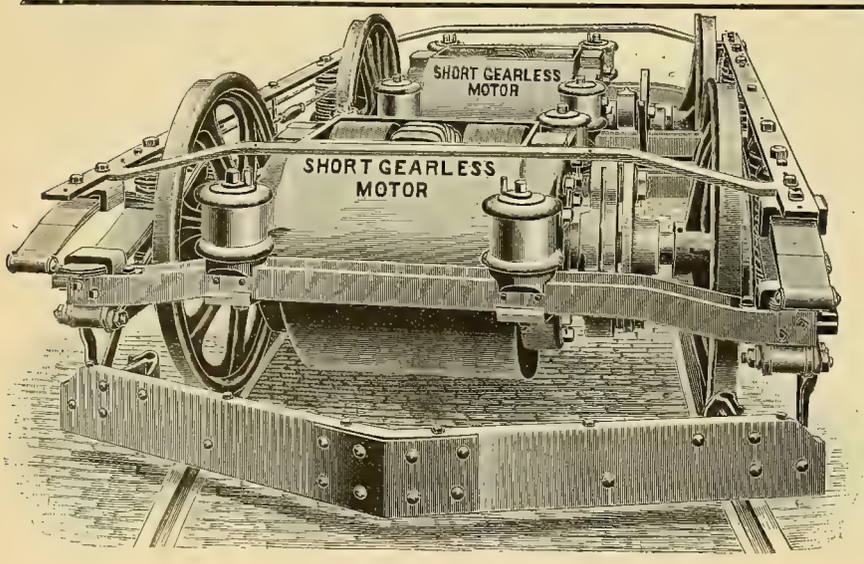
SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.



The Northwest will soon have three more fine street railway plants, installed by

THE SHORT ELECTRIC RAILWAY CO.

OF CLEVELAND, OHIO.

All three roads—Minneapolis Street Railway Co., Minneapolis, Minn.; Consolidated Street Railway Co., Grand Rapids, Mich.; Harvey Transit Co., Harvey, Ill.; will be equipped with

Short 20 H. P. Gearless Motors.

Western Electrician.

EVERY SATURDAY.

Vol. X. CHICAGO, JANUARY 16, 1892. No. 3

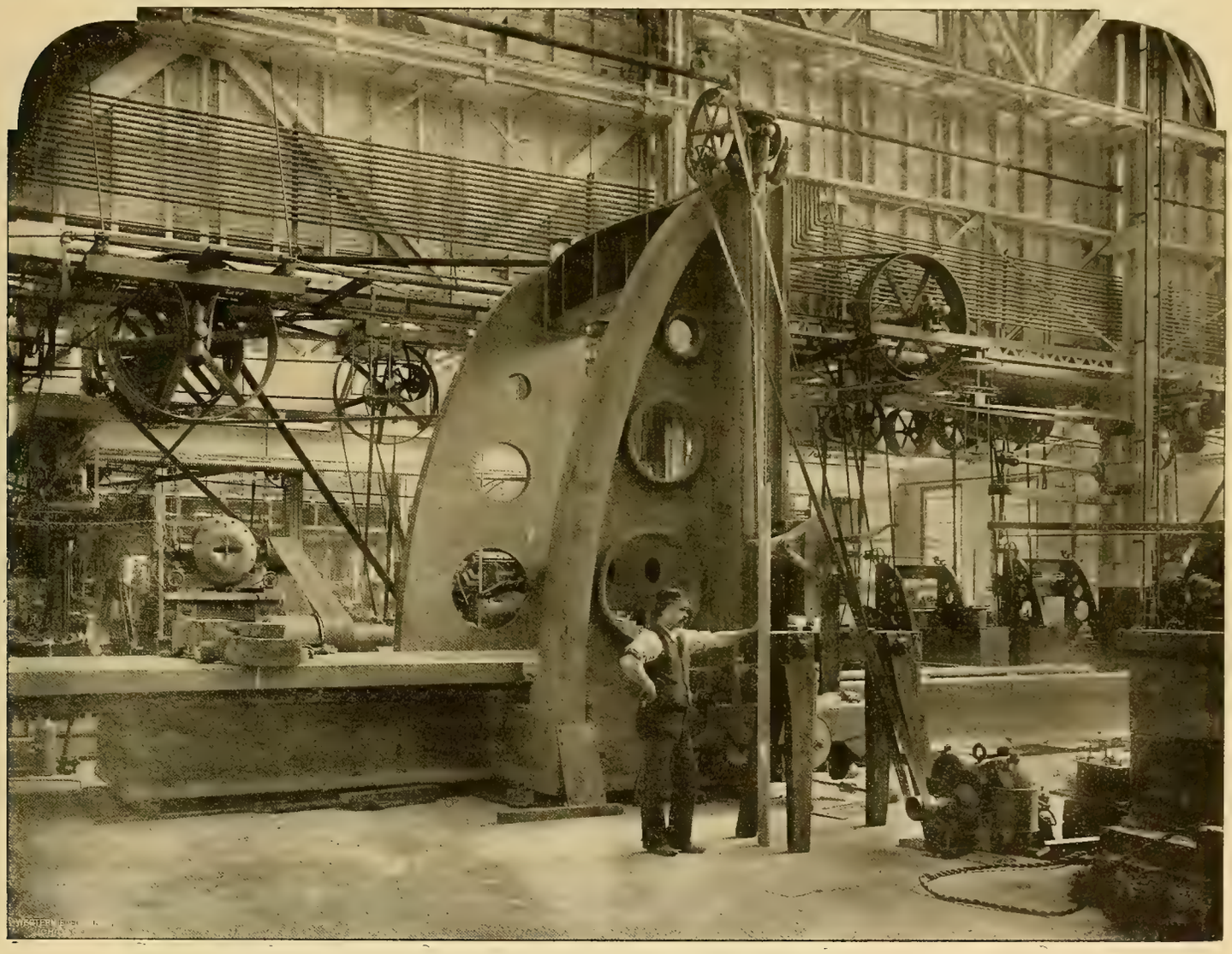
Electric Motors for Moving Heavy Machinery in Philadelphia.

The peculiar adaptability of the electric motor under circumstances where it is impracticable to resort to steam or other well-known sources of power, is now very generally appreciated by mechanical engineers. The portability of these electric machines of the ordinary stationary type, and the ease with which they may be applied where power is required only temporarily, are, however, two features, which, while apparently understood, are as yet only taken advantage of in cases where the power needed is comparatively small. Some manufacturers, although perhaps well had been ordered by the Edison company for its factory. This huge machine, at the time the photograph was taken, was very nearly completed. Several machinists were engaged in putting on the finishing touches, and by the aid of the electric motors these men were enabled to fit and adjust the parts to the greatest nicety without moving the machine from its first position in the erecting shop. The parts were fitted in one by one, and when for instance to get a bearing it was necessary to put any particular piece in motion, an electric motor was resorted to for power. The motors in such a case as this are of course mounted on only rough stands—in fact, they are set up is a motor which drives an Evans variable speed friction cone gearing. The Evans gearing and its motor are employed when it is necessary to have a machine run at a speed which may be regulated with great accuracy

Current for the power circuit is furnished by an 80,000 watt Edison generator. This dynamo is compound wound and is used exclusively for power purposes. It is driven from the shop line shaft.

A glimpse of the generator may be obtained by a close inspection of the illustration. It is just behind the planer to the right of the Wenstrom motor.

The great cranes in the Sellers works, with which the



ELECTRIC MOTORS FOR MOVING HEAVY MACHINERY IN PHILADELPHIA.

posted, are not fully cognizant of the extent to which the more modern method is being introduced, and for this reason, if for no other, the accompanying cut will be of interest. Perhaps it may not be venturing too far to make the assertion that no better illustration than the one presented can be had of the growing tendency among the best informed machine builders to avail themselves of electrical methods of power transmission in their shops.

While in Philadelphia recently a representative of the WESTERN ELECTRICIAN visited the machine works of Wm. Sellers & Co., and through the courtesy of Coleman Sellers, Jr., the engineer of the firm, was enabled to obtain information relative to the manner in which electric motors are employed to advantage in building heavy machine tools.

In the illustration is shown an immense planer which with no regard to looks, and in any manner that they will run satisfactorily and aid the workmen.

About the Wm. Sellers & Co. factory there may be found at present five electric motors which are employed in miscellaneous work. These machines are of the Sprague and Wenstrom stationary types, and range in size from five to thirty horse power. The motors attached to the Edison company's planer are a 30 horse power Wenstrom and a 5 horse power Sprague. Current for the various motors is obtained through flexible cables from the shop power circuit. The cables are mounted on reels and sockets are provided in the circuit at short intervals so that a motor or motors may be run at any point in the shop that may be desired.

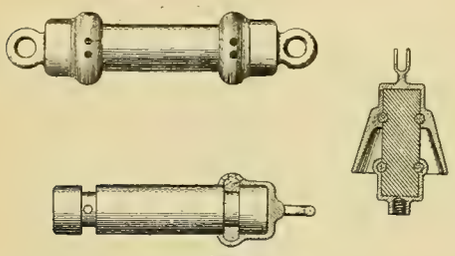
In addition to the stationary motors which are trucked about and used in testing the different machine tools, there reader is already familiar, are driven by the motors, takin current from the same circuit as the other motors. The crane motors are, respectively, one 15 horse power Sprague, one 15 horse power Bilberg, and one 40 horse power Wenstrom. There is also a 30 horse power Wenstrom driving a line shaft. The motors were sold to Wm. Sellers & Co. by the Equitable Engineering & Construction company of Philadelphia, and were installed under the supervision of Chief Engineer W. A. Stadelman of the last named company.

Wm. Sellers & Co. are firm believers in the great future of the electric motor. They consider an electric system as having many advantages, especially for factories covering large areas. "Where the plant is like Baldwin's, for instance, or for that matter like a great many others," said one of the mechanical engineers of the Sellers works,

"what an admirable plan it would be to generate all the power at one point and distribute it about as we do in our works. Thus you would do away with all the small steam engines you see distributed about. Our idea would be to drive, say, a line shaft in each shop. Of course, it would not, as a rule, pay to equip all tools, or even the majority of them, with motors. In many cases the best plan, I think, would be to subdivide the power to the extent of one motor in each shop with a few extra machines to be trucked about and used as we do now. You can see for yourself how useful the extra motors would be. If you've ever worked in a machine shop and seen the big engine running at night driving the long line shaft, with a few men working overtime in the erecting shop, the flexibility and adaptability of an electric system strikes you forcibly. This is our general idea, but, of course, it must be understood that in almost every plant the methods of doing work are peculiar to that particular factory. Consequently, the plan of distribution would, as a rule, have to be varied to suit circumstances."

Andrews' Insulators.

The body of these insulators consists of a rod or block of wood or other insulating material, having at each end a groove which preferably, though not necessarily, extends



ANDREWS' INSULATORS.

entirely around the block. Fitting over the ends of the block are metal caps, having eyes to which wires may be connected. Each sleeve or cap is provided with a groove corresponding in position to the depression in the block, that is, the grooves are so placed on the block and on the cap, respectively, that when the parts are put together the grooves register with each other. Each cap is provided with one or more holes, which extend through the body to the groove.

In making the insulator the caps are slipped onto the plug of insulating material and melted type-metal is poured through the holes into the space formed by the grooves. When the metal cools, the caps and body will be rigidly secured together by the metal rings which are partly embedded in the caps and partly in the body and extend into the holes. By actual test an insulator, constructed by the inventor, W. S. Andrews, of New York, as above described, in which the body was one inch and a half in diameter and in which the metal rings were about three-eighths of an inch square, broke only at a strain of four housand pounds.

Rowell's Extensible Conductors for Railway Crossings.

It is no unusual thing nowadays to hear of squabbles between steam and electric street railway companies over the question of crossing lines. Hardly a month passes but one reads in the daily papers that such a fight is in progress. Injunction after injunction is served to prevent the stringing of the wires across the tracks, and frequently the controversy is not all carried on in the courts. The lawyers, of course, are satisfied to settle such disputes by strictly legal methods, but the mechanical or electrical engineer seeks for other and easier means through which the same end can be attained. It was, therefore, with the object of overcoming such a difficulty that B. C. Rowell of Boston devised the arrangement shown in Fig. 1. The rigging might be called an extensible conductor. The details are more clearly presented in Figs. 2 and 3. From Figs. 1 and 2 it will be seen that there is an extensible section of conductor which slides in a sheath set just above the trolley wire proper. On the end of this extensible section there is a latch mechanism, as indicated in Fig. 3. Fig. 2 shows Mr. Rowell's method of returning the bridging conductor after the car has crossed the track.

FIG. 1. ROWELL'S EXTENSIBLE CONDUCTORS FOR RAILWAY CROSSINGS.

The operation of the arrangement will now be understood. As the car runs over the crossing the trolley wheel catches against the latch, as represented by the dotted lines in Fig. 3, and draws out the extensible conductor until its upper trigger strikes the stationary tripping shoe on the opposite end of the trolley wire. The shoe is constructed of a flaring shape, wide at the outer end and diminishing in width toward the wire to serve as a guide to direct the trolley wheel to the conductor. The blow the upper trigger receives from the shoe releases the lower trigger, and consequently disconnects the trolley wheel, leaving the extensible conductor free to be drawn back into the sheath by the weight shown in Fig. 2. The free end of the extensible rod is counterbalanced, as indicated, by means of a cord running over a pulley, attached to a supporting span wire. The ends of the cord are fastened in eyes at the respective ends of the extensible rod, the eye on the back end of the rod running in a slot in the socket.

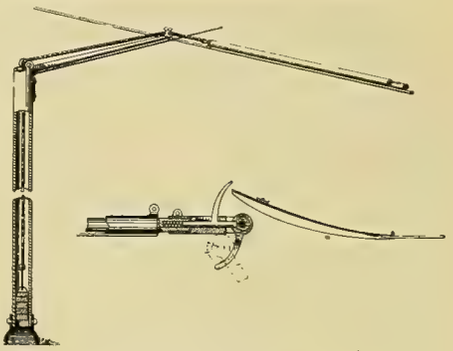
Electricity at the World's Fair.

One of the most interesting spots in the World's Fair to the members of the electrical fraternity, and to many others as well, will be the great central station at Machinery Hall, where all the dynamos employed in furnishing light and transmitting power for the entire exposition will be installed. The portion of the building set aside for the electrical plant is indicated on the accompanying floor plan of the vast building, with the annex, designed for the heavy machinery of the World's Fair. This space will be about 700 feet long and 110 feet wide, or about 77,000 square feet. The space for the engines to drive the generators is also shown, as well as the boiler house. In this central station it is expected that electric power to the extent of 22,000 horse power will be developed from dynamos of the principal manufacturers of the world.

The bids for constructing the electrical conduits at the World's Fair, illustrated and described in the WESTERN ELECTRICIAN of November 28th, were opened on Tuesday. The name of the successful bidder will soon be announced.

Specifications for a considerable portion of the lighting contracts are about completed, and they will soon be sent to all the manufacturers of generating machinery in this country and Europe.

The cold, snowy weather of last week interfered considerably with the work on the electricity building.



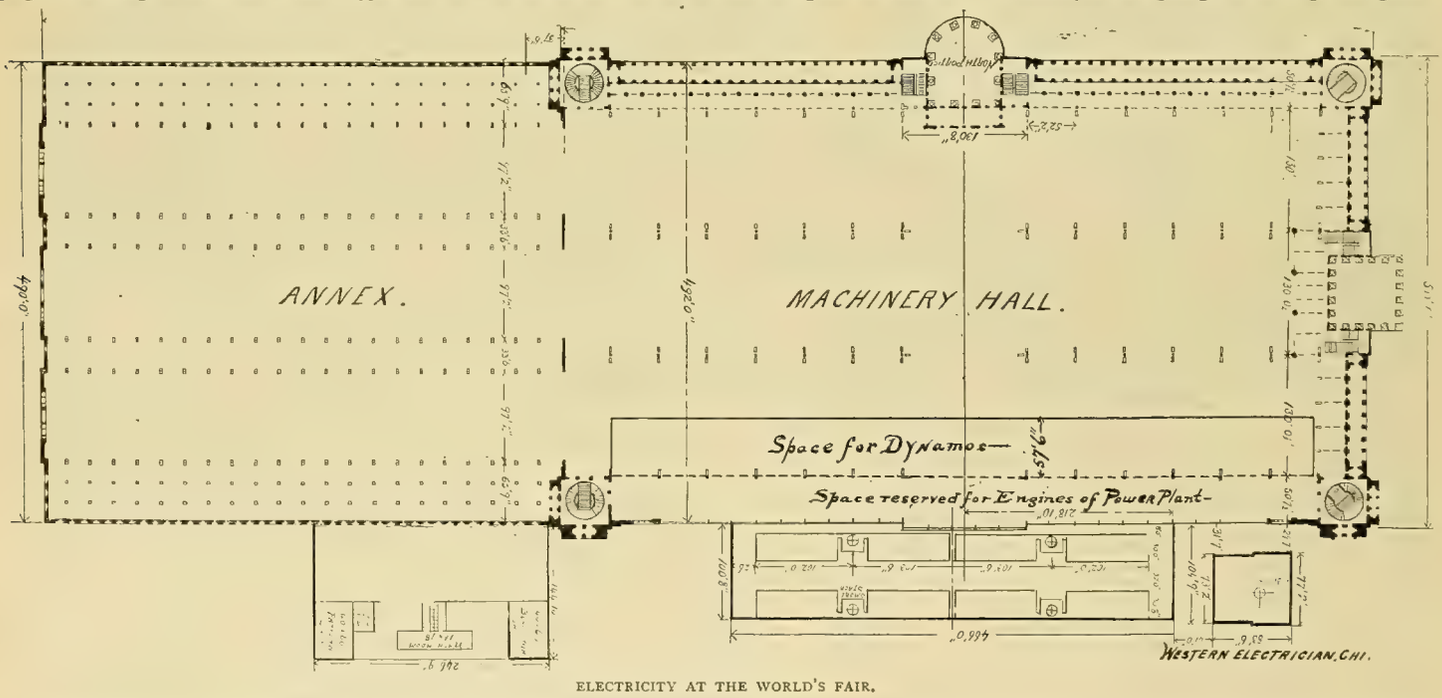
FIGS. 2 AND 3. ROWELL'S EXTENSIBLE CONDUCTORS FOR RAILWAY CROSSINGS.

The electricity building has been insured for $97,000 as it stands now.

The official report of the progress made in World's Fair work for 1891 contains this paragraph:

Plans adopted for lighting the buildings and grounds provide for 138,218 electric lamps, of which 6,766 are to be arc lamps of 2,000 candle power each, and 131,452 incandescent 16 candle power each. The electric lighting will cost something like $1,500,000, and will be ten temes as extensive as was employed at the Paris exposition. The light and motive plant at the exposition, it is estimated, will require 26,000 horse power, of which 22,000 will be required for the electric plant.

In the same report the cost of the electricity building is placed at $401,000. This is considerably larger than the amount called for by all the contracts that have been let,



ELECTRICITY AT THE WORLD'S FAIR.

but it is probably intended to include all the interior and exterior decorations and finishing.

E. E. Higgins, general manager of the Short Electric Railway company of Cleveland, and Alexander Kempt, western agent of the Brush Electric company, called on Secretary Hornsby of the department of electricity recently and suggested that the exposition management might secure without cost the five miles of the proposed intramural railway in Jackson Park. They thought that the Westinghouse, Short, Thomson-Houston, Edison, and

BRIDGEPORT'S ELECTRIC ROAD.

Rae systems could be applied, each to a mile of road, as an advertisement. All, it was thought, that these companies would ask, would be that electric powers to run the cars be supplied. The trouble with the suggestion is that it would be difficult to devise an arrangement whereby all the systems could be fully and equitably exploited on one track.

In speaking of the international electrical congress to be held in connection with the World's Fair the London *Electrician* says: "By the summer of '93 there will be several matters connected with nomenclature, units and definition, awaiting imprimatur; and what soil more appropriate than that of America on which to formally admit the names of Franklin and Henry into the electrical temple of fame? The Chicago exhibition will have been justified, if it be the occasion of the holding of a truly representative international electrical congress, which confines itself to its proper work and avoids farcical discussions in half a dozen tongues on subjects outside its jurisdiction."

Bridgeport's Electric Road.

Bridgeport, Conn., has electric cars at last. The line was started December 15th, and although many more people stood on the sidewalk and looked on than were carried by them, the smooth running of the system demonstrated the fact that the trolley system can be safely and cheaply applied to Bridgeport's needs. Two cars were run on the opening day, and they continued until after the holidays,

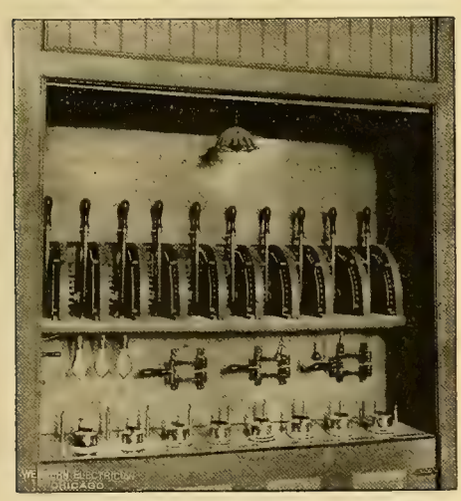


FIG. 2. DAVIDSON THEATER LIGHTING PLANT, MILWAUKEE.

entertaining the crush of humanity about the corner of Main street and Fairfield avenue. The residents of Bridgeport would be better pleased, though, if the cars were larger, and besides this there is more or less dissatisfaction because the only depot is at present located in the window of Read's modern drygoods house at Main street and Fairfield avenue, as is shown in the illustration. The road tunnels through a cliff, makes a circuit and reappears, running through a pretty little hamlet, back to the depot. Read's window may do a good work and set the Bridgeport people thinking. This year it surpasses all previous efforts. The little model, which has excited a great deal of attention, was arranged by the New England Electrical company. The car does not appear in the cut owing to the fact that the camera used in taking the picture did not operate instantaneously, and the car was going around at the rate of ten times per minute. The car measured 9 inches in length, 4½ inches wide, and 5 inches high, and was finished like a Broadway car. It was equipped with a motor and everything complete, having miniature lights, etc. The tiny incandescent lamps used in the display were from J. L. Somoff, New York.

Davidson Theater Lighting Plant, Milwaukee.

One of the finest places of amusement in the West is the new Davidson Theater on Third street, near Grand avenue, Milwaukee. It will seat over 2,000 people and is fitted up in luxurious style. The building, which is fireproof, was designed by Burnham & Root of Chicago, and is distinguished by a lavish use of marble and other fine

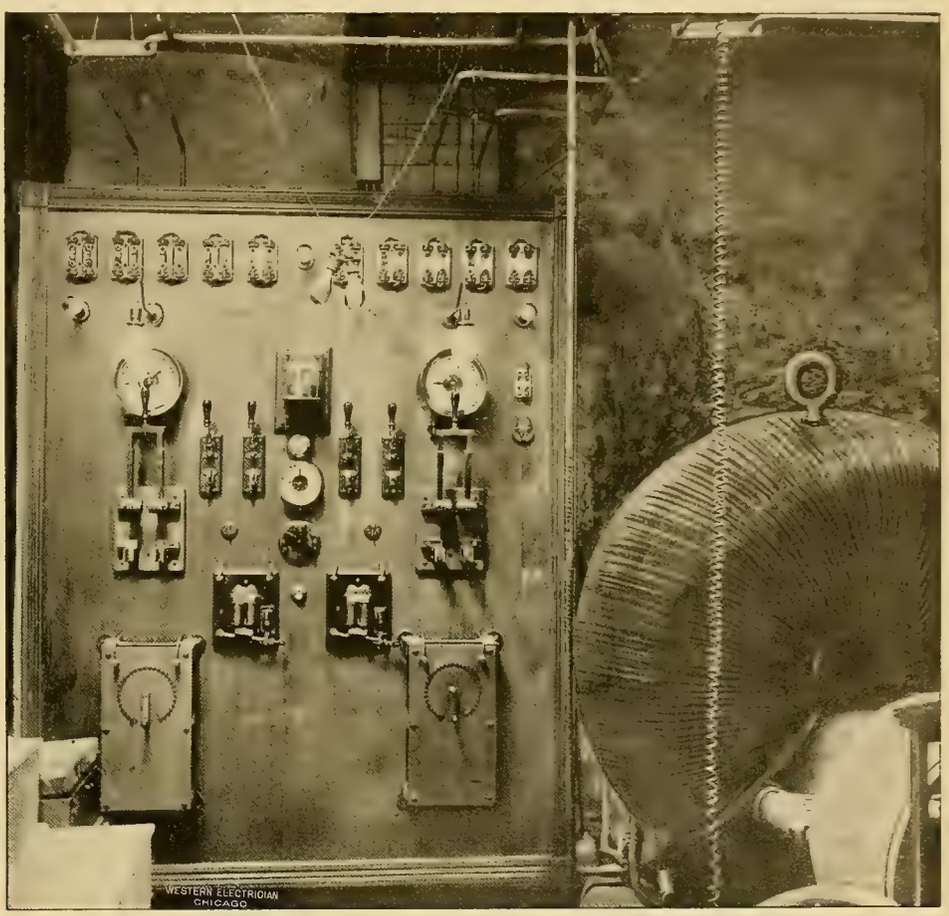


FIG. 1. DAVIDSON THEATER LIGHTING PLANT, MILWAUKEE.

building stones. The portico, of white marble, with polished granite columns and beautifully designed mosaic pavement and ceiling, is very imposing. Its walls are lined with marble of different colors. The interior of the house is no less elegant in design. The decorations are described as of a modernized renaissance order, the blended colors of the rainbow, with shades of red, green and yellow predominating, being employed. The whole effect is very rich and pleasing. Fine carpets and chairs upholstered in grayish pink enhance the sumptuous appearance of the auditorium. There are twelve boxes, and an iron drop curtain separates the stage from the front portion of the theater. The ventilating and heating appliances are of the most modern and effective design.

Of course in so fine a theater only electricity was employed for lighting, and much care and attention was bestowed on the plant, which is illustrated in the accompanying cuts. The dynamos, two in number, are of the Mather company's manufacture, and are installed in the basement They are 800-light compound wound machines driven by a Reynolds-Corliss engine, built by E. P. Allis & Co., and rated at 175 horse power. One of the dynamos and the dynamo room switch board are shown in Fig. 1. The engine also supplies power for the complicated ventilating apparatus. The switch-board is wired in multiple, and is equipped with a complete outfit of switches and measuring instruments. The dynamos are belted to countershafting, and Allis friction clutches are used.

About 850 16 candle power Perkins lamps are distributed about the auditorium and foyer, while 450 are needed to light the stage The ceiling lights in the audience room are arranged in 18 clusters of 16 lights each. The effect is handsome and brilliant. Three light brackets are plentifully used on the exterior gallery mouldings, while single lamps are scattered everywhere. The footlights consist of three rows of lamps—one white, one red and one green. The stage switch-board is shown in Fig. 2. It is of the Mather Electric company's patent, and by its use the lights in the auditorium and on the stage can be regulated in any way desired. For instance, all the footlights can be dimmed, or any row of them, and one color can be substituted for another instantaneously. The border lights and the lamps in the body of the house can be cut in and out in any necessary combination, simply by turning the handles, as the switches are interchangeable. This switch-board, with the necessary resistance coils, is located in a fire-proof room under the stage, and all the cut-outs are also placed in this room. The switch board has given complete satisfaction, and the lights can be regulated to a nicety.

Beside the theater, the building contains a 40-room hotel, and this is lighted from the theater plant, 500 lamps being necessary. This includes two stores and a Turkish bath establishment. The entire electrical equipment was furnished by the Chicago office of the Mather Electric company.

Chicago Electric Club.

The Chicago Electric Club will devote its meeting next Monday evening to a discussion of the outlook for the organization with a view of adopting some measures that will insure permanent security. At present the club is on a good financial basis, and it is the wish of the managers to secure for it a permanent arrangement that will protect the club for all time. A large attendance is anticipated at Monday evening's meeting.

American Institute of Electrical Engineers.

The sixty-third meeting of the American Institute of Electrical Engineers will be held at 12 West Thirty-first street, New York, Tuesday evening, January 19th. A paper will be read by Chas. P Steinmetz of Yonkers, N. Y., on the "Law of Hysteresis"

Munsie-Coles Underground Conduit for Electric Railways.

An underground conduit system for electric railways which is somewhat complicated but said to be very efficient, is shown in the accompanying illustrations. It is known as the Munsie-Coles system. In Fig. 1 the idea is shown as applied to a double track street railway. The main conductor is placed in what is called a blind conduit between the tracks, as shown at *g* in Fig. 1. Each track is provided with a shallow conduit *c*, better shown in Fig. 2, which is provided with a slot opening in the manner of a

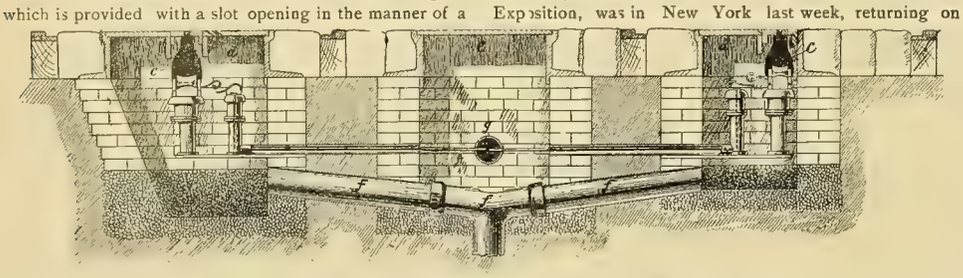
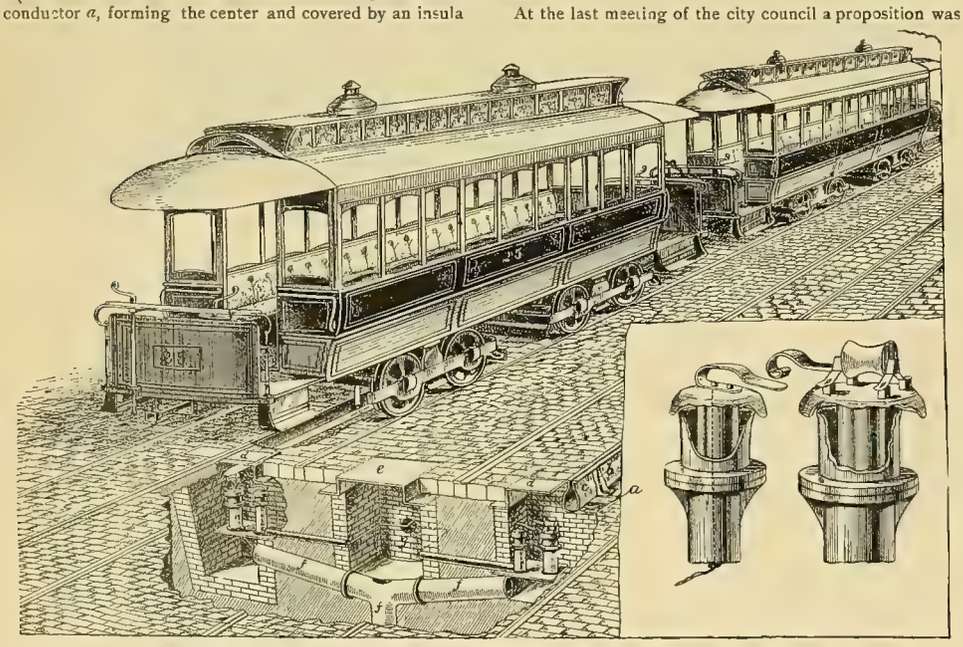


FIG. 2. MUNSIE-COLES UNDERGROUND CONDUIT FOR ELECTRIC RAILWAYS.

cable road. The track conduits are provided at suitable intervals with hand-holes *d*, which are placed directly opposite the man-holes *e*, the latter being over the main conductor. In these hand holes are placed two contact posts, one directly under the slot. To the inner of these posts loops from the main conductor are led through insulating ducts and connected with the contact point or spring on the top of the post, as shown in Fig. 2. The post directly under the slot supports a friction roller or circuit closing device, which is operated by means of a traveling closing bar or trolley suspended from the car in such a manner that in passing the friction roller is pressed down, making a spring connection with the contact point, thus becoming a portion of the circuit leading to the motors on the car axles. The traveling closing bar is of sufficient length to reach from one friction roller to the next, and therefore the distance between the hand holes is regulated to suit the length of the trolley. The trolley is long and flexible, but is, of course, rigidly attached to the car by proper supports.

The hand holes and man holes are provided with suitable drain pipes which are connected at intervals with the sewer. A special insulating device is employed to prevent the contact points on the inner posts from leaking, as these are the only exposed points in the circuit. The details of this device and the manner of making the spring contact with the friction roller are shown more fully in Fig. 3. The hanger or supporting arm of the contact bar shown in cross section in Fig. 4, is so constructed as to prevent the conductor from coming into contact with the slot rails. As will be seen, the shank is composed of a conductor *a*, forming the center and covered by an insulating material *b*, which is inclosed in a metallic shield *c*, which protects the insulation from wear on the slot rails. A glass cup *d* is fitted to the conductor, having a triple perforated cover designed to inclose an absorbent to protect the conductor from moisture.



FIGS 1 AND 3. MUNSIE-COLES UNDERGROUND CONDUIT FOR ELECTRIC RAILWAYS.

The method of attaching a trolley hanger to the truck is shown in Fig. 5 and consists of a hollow ball *a*, firmly attached to the truck to which the hanger proper *e* is attached by means of metallic fingers *b*, which grip the ball with sufficient hold to support the weight of a contact bar, but so arranged that in case the car should become derailed they will spring loose from the rigid ball, and prevent injury to the contact bar and connections. The cuts are reproduced from the *Street Railway Journal*.

Prof. Barrett to Remain in Chicago.

Prof. J. P. Barrett, city electrician of Chicago and chief of the department of electricity of the World's Columbian Exposition, was in New York last week, returning on Sunday, and there seems to be but little doubt that at that time or before that he was offered the position of superintendent of the new police telegraph system that is to be installed in the seaboard metropolis, at a larger salary than he now receives from the city of Chicago. Prof. Barrett modestly declines to talk about the matter farther than to say that he intends to stay in Chicago, which, he thinks, is "the greatest city on earth." The city electrician is one of the best known figures among the electrical fraternity in Chicago and his friends here will be delighted at his decision. The compliment is a flattering one, but it is well deserved. Prof. Barrett's practical achievements in the line of inventing and perfecting the municipal fire alarm and police patrol systems are well known, and Chicago's eminence in this direction, due very largely to his efforts, has been widely copied by other cities. By next June Prof. Barrett will have completed a term of 30 years' continuous service for the city of Chicago and at that time he means to retire from the employment of the city which he has served so well, undisturbed by administrative changes. The World's Fair will then absorb his entire attention, and after that is over he will devote himself to his private business interests.

Rapid Transit Outlook in Detroit.

The people of Detroit have long been clamoring for rapid transit, but thus far the street railway officials and the municipal authorities have been unable to agree on the terms upon which rapid transit methods shall be introduced.

At the last meeting of the city council a proposition was introduced by which the company controlling all the present street railway lines agreed to substitute electric motors for horses. At present there is a dispute over the term of duration of the company's franchise, the city officials claiming that it will expire after another year. If this view should prevail the company of course would not introduce improved methods unless it received some guaranty that the franchise would be extended for a long term.

In its communication to the city council the street railway company says:

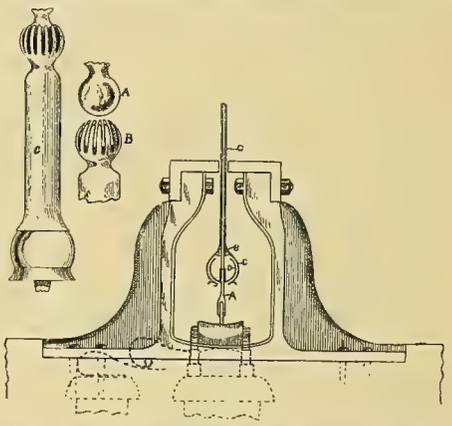
On October 1, 1891, we purchased the property from the former owners, and since that time there has been a complete and entire change in the ownership and control. The new owners of this property purchased with the intent of equipping the entire system with a rapid transit plant at an early day, commencing with the present year. Having this purpose in view, the company caused three members of its executive committee to investigate thoroughly the mechanical questions connected with rapid transit. They visited the cities of Boston, Salem, Schenectady, Pittsburg, Buffalo, Syracuse Rochester, Cleveland and Toledo. Plans were prepared, and these plans brought the company face to face with a financial problem of large proportions

It will cost upward of $2,000 000 to equip the lines of the company with such a rapid transit plant as Detroit should have and as the company is willing to put in. Ordinarily there would be no difficulty in obtaining even this large amount of money, but, on account of the persistent attacks which have been made upon the property rights of the company, it has become impossible to borrow the necessary funds; capitalists decline to loan to a street railway company whose right to continue business is attacked by the city officials.

Rapid transit is not possible until the question of the right to use the streets is settled, and only two ways of settling it seem to be open. These are either litigation or recognition of the rights of the company.

Litigation involves expense and delay. If there is any way in which an adjudication suitable to such vast interests can be intelligently and satisfactorily obtained in a brief time, it is unknown to us. Certainly we, who have made so large an investment in a property worth several millions, must exhaust every possible defense known to the law to defend our rights and interests.

It is safe to say that, unless terminated sooner by a decision favorable to the company, no conclusion in the litigation can be reached in less than six or seven years from the commencement, thus consuming over one-third of the time which is in controversy. It is not to be expected that any decision destroying the value of this great property will be acquiesced in so long as the contest can be reasonably continued In the meantime, rapid transit is impossible. In the midst of litigation, money cannot be raised.



FIGS 4 AND 5. MUNSIE COLES UNDERGROUND CONDUIT FOR ELECTRIC RAILWAYS.

This company is ready and willing to proceed at once with the work of equipping the lines of the railway with a rapid transit plant. It will do so as soon as the city reconsiders its proposed attack on the right of the company to operate its lines under the existing ordinances, and as soon as the city removes the present distrust by recognizing that those ordinances confer rights which are valid until the expiration of the time provided therein.

The proposition was not acted upon by the old council, and it will probably be some time before the new council will reach a decision. In the meantime the city is without rapid transit. The newspapers of the city call attention to the fact that it would be unwise for the city to continue litigation if all the substantial benefits could be obtained by compromise and agreement. "Suppose the litigation completed, and the case decided in the city's favor," says the *Detroit Free Press*, "we would still be without rapid transit with the need increased very greatly by the lapse of time. Is it not quite within the limits of possibilities that the city would have then to make just as much concession to some company as it will have to make to the Citizens' company to secure it now? If so, why not deal with the Citizens' company now, and secure rapid transit on the most favorable terms possible—provided, of course, that the company proposes favorable terms. What they seem to propose is to give us rapid transit on an abandonment by the city of the claim that their charter expires next year. They are undoubtedly in a situation to do this, and to do it more quickly than any new company can. Can the city do any better, assuming that the offer means prompt and satisfactory rapid transit?"

The street railway between St. Joseph and Benton Harbor, Mich., will use the electric system.

Edison Dental Outfit.

In view of the many calls for motors to run dental lathes and dental engines, together with the demand for different speeds and reversing devices, the central district of the Edison General Electric company is introducing a special

FIG 2. EDISON DENTAL OUTFIT.

outfit for such work. In the construction of this combination the wants of dentists, as learned from their inquiries, have been the sole guide, and in presenting this apparatus to the trade the Edison company feels confident that it has embodied every requisite.

The equipment consists essentially of a 1½ horse power Edison slow speed motor, specially constructed for five speeds. The variation of the speed is secured by the winding of the fields of the motor, and not through a cumbersome rheostat. The control of the armature (in the case of the motor without special switch attached) is through a lever button on the face board of the motor. In reference to the switches there is a choice of two, namely, a foot and a hand switch. In the foot switch the controlling lever is operated by a spring treadle so peculiarly arranged that within an arc of six inches, not only five speeds are obtained, but the same speeds are to be had in a reverse direction, with the advantage also of almost instantly stopping the motor if desired. The hand switch is about five inches square by one inch thick, and can be fastened in any location convenient for the hand. The same advantages enumerated for the foot switch are embodied in the hand switch.

In regard to the application of the rigging, the motor may be placed in the laboratory over the dental lathe, Fig. 1, and from this position belted to the suspension engine in the operating room by the means of ceiling pulleys. The controlling switch at the operating chair is connected with the motor by a flexible conducting cord. By this arrangement the lathe in the laboratory and the suspension engine in the operating room are both supplied with power from the same source with like conveniences for each.

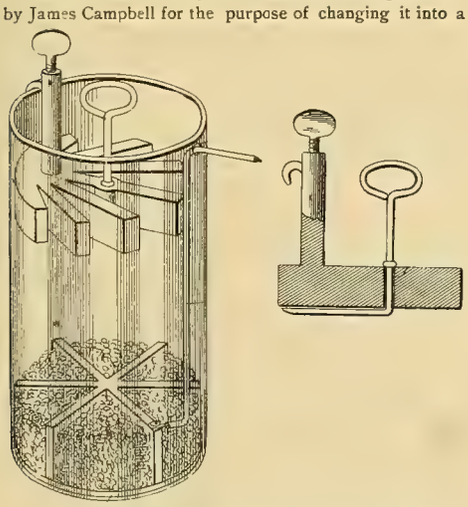
The motor and switch, shown more clearly in Fig. 2, are applicable to any style of dental engine, whether suspension, bracket or the ordinary foot style.

This outfit was designed by Agent E. R. Harding of the central district of the Edison company.

Big Power Station for St Louis.

The Teuscher distillery in St. Louis has been purchased by James Campbell for the purpose of changing it into a great electric station, for operating the Benton and Bellefontaine railroad and for other purposes. The property embraces 305x160 feet of ground and is improved with two substantial four-story buildings and one one-story building, all resting upon bed rock foundations. In an interview Mr Campbell said that it was his original intention to build a large plant with power to run all the electric railways in St. Louis, and to sell power as well to all other electric companies and to every company that wishes to use power.

In response to a remark about existing street railway power plants, Mr. Campbell is reported to have said: "Yes, but the expenses of operating a combined plant would be reduced. Coal could be obtained with greater facility, and the saving in cost of labor would be enormous. There are the St. Louis and Suburban, Lindell, Union Depot, Market street and South Sixth street lines, with as many power houses. The Benton and Bellefontaine, Northern Central, Cass avenue and Union lines are to be changed to electric, calling for four more plants, which are unnecessary, as there is no limitation for the transmission of power, save the ability to erect poles and string wires."



DELANEY'S IMPROVEMENT IN GRAVITY BATTERIES.

Delaney's Improvement in Gravity Batteries.

After an ordinary blue stone battery has been in use for some time, as a rule stalactite formations may be found on the bottom of the zinc that tend to short circuit the battery locally and seriously impair its efficiency. With the ordinary battery it is necessary either to lift the zinc from the cell and remove these formations or to endeavor to dislodge them by inserting an instrument beneath the zinc while in the cell; but by the latter plan the zincs can only be partially cleaned, even when considerable trouble is taken. The improvement in the present instance consists merely of a sweep suitably located, as shown, with reference to the bottom of the zinc, so that it may be swung across the bottom to dislodge any formation. The sweep is mounted in a bearing in the zinc itself, and it consists of a horizontal arm that lies close against the under side of the zinc, with a handle at the top, by means of which it may be made to sweep the under face of the zinc. In the gravity battery, as usually constructed, there is also a tendency for the wire attached to the copper plate at the bottom of the jar to lift the plate. This may occur during the handling of the wires, and through accidental contact with them in attending to other cells. When the copper plate is lifted from the bottom of the cell, the crystals of sulphate of copper become lodged under the plate, and in this way the distance between the copper and zinc elements of the battery is changed, producing a variation in the resistance and action of the cell, and in a group of cells there might, therefore, be produced a wide difference in the efficiency of the individual cells. The manner in which this difficulty is overcome is so clearly indicated that further explanation is unnecessary.

Public Lighting in Buffalo.

Mayor Bishop of Buffalo discusses the [illegible] in his annual message to the city council. On this subject he says: "The report of the lamp inspector shows that there were in use on Dec. 31, 1891, on lighting streets and public grounds of the city 1,842 gas lamps and 1,055 electric lights, an increase during the year of 300 gas lamps and 203 electric lights. No reduction in the price of gas or electric lights was made during the past year, and, assuming that no extension of the lamp district will be made during this year, the expense for lighting the streets and public grounds will reach the large sum of $344,000, an increase in five years of $88,721."

Continuing on the same subject, the mayor says:

I am of the opinion that the appropriation for lighting for the current fiscal year will be exhausted by payments for the lights now in use, and I would recommend that no further extension of the lamp district be made before June 30th, 1892. I believe that your honorable body should give most careful attention to the whole subject of street lighting. The problem cannot be solved by infrequent and temporary refusals to extend the lighted districts. It is a matter of general belief that the cost of lighting has in the past, been very excessive, and is now much more than it should be. The city advertises for proposals for lighting, but there is no competition. The several gas light and electric light corporations have divided the city into districts and apportioned the districts among them-

FIG. 1. EDISON DENTAL OUTFIT.

selves, and after careful consultation they submit uniform bids, and the city pays whatever price they choose to ask. The city has given to these corporations without charge valuable privileges, and the business of the electric light companies is almost entirely confined to lighting the streets and public grounds. This being the fact I believe they, in return, should furnish light to the city at a price as low as is paid by any other city having equal advantages with ours as to fuel and labor. I would recommend that your honorable body at once ascertain the cost of lighting in other cities, and that before new contracts are executed for another year the city insist upon the price being reduced until no more is paid by our city than by the most favored cities.

I would further recommend that your honorable body, together with the board of public works, investigate the whole subject of municipal lighting, and ascertain, if possible, its true cost, and determine whether the city cannot establish the necessary plants, and light the streets and public grounds with greater economy than can be secured in any other way.

A municipal ordinance has been introduced in Boston prohibiting a speed of electric cars of more than seven miles an hour, unless the car be provided with proper fenders.

The outlook for electric railways in England at present seems to be bright. The Brush company is reported to have some very important and valuable contracts on hand, among which is the application of electric traction to the Liverpool Overhead Railway and the South Staffordshire Tramway company.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE work of removing the last of the poles and overhead wires from the streets of New York in the condemned district will soon be completed. The electric companies have agreed to have the poles down within a certain time, and they are using every means to do so. This will remove all the overhead wires from the down-town district.

IT is not often that one hears of a 30 horse power electric motor of the stationary type being trucked about in machine works to be employed temporarily to aid workmen. Such a machine, however, and other motors almost as large, are doing good service in one of Philadelphia's largest manufactories. Applications like these are becoming more numerous, but still there are a large number of machine and tool builders who do not thoroughly understand to what varied uses the stationary electric motor can be put. The ordinary form of motor has been referred to as the "stationary type," but it is needless to point out that its present general design and diminutiveness as compared with its power, make it a machine in which the characteristic of portability is pre-eminent. The machine builder who is desirous of acquainting himself with more modern methods of distribution could spend a day with profit in the establishment whose practice forms the subject of an interesting article on another page.

HERETOFORE the lawyers have had the fight all to themselves when the question in dispute related to the crossing of a railway line by the overhead trolley system, but now the inventor appears on the scene with an overhead bridging device which extends across the other road only at the time when the car passes over. While some question might be raised as to the practicability of this extensible conductor as described in another column, the idea embodied is suggestive of a way out of one of those numerous small, but, nevertheless, most exasperating difficulties which beset the path of builders of the overhead system.

CHICAGO is to be congratulated on the decision of Prof. J. P. Barrett, city electrician, who says that he will stay in Chicago, although he had a handsome offer to go to New York to take charge of the new police telegraph system in that city. At least everybody supposes that Mr. Barrett was thus honored, although he modestly refuses to confirm the report. At any rate, he announces that he will stay in this city, which will be good news to his friends who have heard the rumor of his possible removal. The city electrician has probably done more than any other man to bring municipal fire and police alarm telegraphs to their present state of efficiency, and the city of Chicago has shown its appreciation of his work by retaining his services for nearly thirty years, despite the mutations of politics.

IF any one has the mistaken idea that the introduction of the overhead electric street railway system into one of the large cities of the eastern states is an easy matter, his attention should be directed to Brooklyn, N. Y. There is witnessed the spectacle of an over-conservative mayor, or perhaps a cunning politician, evidently convinced of the wisdom of the proposed method, yet retiring from office and leaving his successor to pass upon a most important resolution providing for the substitution of electricity for animal power in the Brooklyn surface roads. What is to be the end of it all is hard to say just at present, but one thing is brought forcibly to mind by this particular controversy. It must be evident to many that the large cities are finding it harder and harder as time goes on, to discover a system of propulsion that equals the overhead electric.

AN important controversy between the Gold & Stock Telegraph company and the Stock Exchange in New York city has been terminated by the telegraph company agreeing to the terms of the Stock Exchange. The Western Union company, which owns the Gold & Stock company appealed to the courts, but found that it would be impossible to secure quotations regularly without accepting the terms finally agreed upon. It is seldom that a business controversy between two corporations affects the financial interests of the country as did that just terminated, but the general interest manifested in the dispute and its financial bearing goes to show the change that has been effected in business methods through the introduction of electricity. To-day there are very few branches which are not in a measure at least depending upon electricity.

IN the discussion of Prof. Barrett's paper recently read before the Chicago Electric club, an interesting point was brought out relating to possible tests of the storage battery at the coming World's Exposition. It was remarked that any test extending only during the time the Fair was in progress would be lacking in value owing to the fact that the accumulator had reached that stage in its development when a time test of years is required before conclusions of value to capitalists could be reached. This is a pertinent fact, but a six months' trial with apparatus cared for as it should be, would do much toward educating those who want the accumulator system of traction. Many through adverse criticism and ignorance, perhaps, have obtained but the vaguest idea as to what electricity can do, even with those systems longest in use. The six months' test, then, will be of more value than might at first thought be supposed.

THE Rapid Transit commissioners of New York city last week listened to the protest of the Madison avenue property owners, represented by a committee of which Charles A. Dana was chairman. It was asserted by the committee that the East Side would not be benefited by the so-called east side route, and that no other route in the city could be selected where so much damage would be done to the property owners—men of moderate means who had built up their homes along the avenue. The commissioners were not prepared to say whether they could modify the proposed route so as to conform to the wishes of the committee, and after an exchange of views the committee withdrew. It is hardly to be expected that the route will be changed, as it is believed that the opposition to the commissioners' plans comes from the "L" road officials. Mr. Dana, for instance, is opposed to anything that will interfere with the monopoly which the "L" road now enjoys, and nothing short of total abandonment of the underground project will satisfy him.

BROOKLYN'S new mayor entered upon the duties of his new office the first of the year and one of his earliest acts was the vetoing of a resolution passed by the aldermen December 21st, which provided for the introduction of the trolley system in street railways. It was well known that the new mayor was opposed to improved methods of rapid transit, as he had while a private citizen bitterly opposed electric companies that were endeavoring to introduce their systems but it was thought that the favorable report of the railroad commission might have modified his views somewhat. It is expected, however, that despite the mayor's opposition the city of Brooklyn will have electric cars, as a large majority of the aldermen favor the plan and it is believed the resolution will be passed over the mayor's veto. Within a year it is hoped there will be completed an efficient and extensive electric railway system, and then all opposition to the improved method must necessarily be abandoned

NOW that the people at large are beginning to understand that although electricity is a mysterious something, its force or power to produce results can, nevertheless, be measured just the same as that of any other agent, a number of municipalities buying their electric light on the contract system are beginning to display what might be termed a landable curiosity as to whether the street lamps employed were giving the candle power claimed. For instance it was only last week that a New Jersey common council committee handed in an expert report in which it was stated that tests of the lamps in that particular town showed that the light furnished was far from being up to candle power. All this tends to show that a demand exists for a thoroughly reliable portable photometer. A number of such instruments have been devised, and one of the latest attempts at the production of a photometer that shall be accurate as well as portable is described in this issue. But there is still room for improvement. The use of an electric lamp in the instrument is a valuable feature, giving as it does a practically constant light and precluding any error which might arise from a flickering lamp or candle flame. A study of the device referred to above will give a number of useful points to those working on a similar line.

SEVERAL gentlemen composing a committee of taxpayers that is now wrestling with the rapid transit problem in Chicago have had the kindness to agree to ask the aldermen to consent to the construction of electric railways in this city, operated by means of overhead conductors. Lest the joy of that portion of the community favoring electric traction should be excessive, however, the committee coolly proposes that the arrangement shall not be permanent, but that it last only until some better method of transportation can be found. For a city so poorly provided with street railway facilities as Chicago, this is very good indeed. The cable can kill and maim passengers by the score, and the antiquated, slow and dirty horse cars may still drag their tiresome way, but the superior electric cars are only to be suffered as a temporary expedient, simply for the sentimental reason that the poles and wires "do not look well" in the streets. This objection may apply to the principal business thoroughfares, but in practical Chicago it should not be allowed to stand for a moment, so far as the outlying streets are concerned, in face of the record of the cable and horse cars. The condition tacked on to the offer—that the overhead trolley system be used until something better is devised—is not attached in a spirit friendly to electric traction, but the electric railway men will undoubtedly be perfectly willing to take the taxpayers at their word and install their systems "until something better is provided." The present indications are that that would mean a long lease of life. Once let a double track electric railway, with center pole construction, be established in such a street as Indiana avenue, and there would be no doubt as to its retention and its force as an exemplar.

National Electric Light Association Convention at Buffalo.

The arrangements for the Buffalo convention of the National Electric Light association next month are now well under way, and the outlook for a pleasant and profitable meeting is promising. President Huntley has taken personal supervision of the preparations, and he will be earnestly supported by the representatives of the local electrical interests. It is hardly possible that there will be much of an exhibition of electrical devices, if indeed there is any display at all, as it has been generally agreed that the Montreal exhibition was about all that could be expected for one year at least. There seems to be a growing sentiment among the members to discontinue much of the display heretofore considered an essential part of a successful meeting and place the association on an equal footing with organizations of a like nature; in a word, to give more attention to business, and less to entertainment and display.

At the last meeting a large part of the time was occupied in sight-seeing, attending receptions and entertainments of all kinds, and at times it was almost impossible to get the delegates together for the discussion of subjects they had met to consider. The Montreal meeting will be remembered as one of the most enjoyable in the history of the association, yet there was so much attention given to entertainment that the more serious business of the convention was slighted. It is expected that the Buffalo meeting will mark the beginning of a new order. President Huntley in arranging the programme for the convention will see to it that the business of the association be first transacted, and that the entertainment will occupy a subordinate part in the arrangements. It is not to be considered, however, that the entertainment of delegates will be overlooked, but that the conventions will hereafter be conducted more like business meetings than general holidays.

President Huntley's suggestion a year ago that the summer meeting be discontinued is growing in favor. It is his idea that by reducing the cost of membership and dues, and holding one meeting each year, the prosperity of the association will be assured.

"Our object should be to place the association on a good business basis," said President Huntley last week. "Cut down the cost, hold one meeting a year, and make that a big success. It costs too much money under the present arrangement, especially since the plan of holding elaborate displays was adopted. I am in favor of adjourning to Chicago in 1893 and then we can have the greatest meeting of electrical interests the world ever saw, and our exhibition will consist of the electrical display at the World's Fair. I think this plan will be received with favor by the entire electrical fraternity."

President Huntley has communicated his views to a number of representatives of the electrical interests, and in every case they have been received with favor.

The headquarters of the association during the convention will be at the Iroquois hotel, Main and Eagle streets. The meetings will be held in the Buffalo Library building, which is about a block from the Iroquois hotel, facing on La Fayette square.

Lighting the "Mecca Flats."

One of the largest flat buildings in Chicago is that known as the "Mecca Flats," which fronts on State, Thirty-fourth and Dearborn streets, and which is now nearly completed. This structure comprises about 600 rooms, and will be lighted by 2,600 incandescent lamps. Current will be obtained from an isolated plant, which will consist of two 45 kilowatt compound wound Edison dynamos driven by two engines of 75 horse power each. The building will be wired on the loop system. The Chicago Edison company has secured the contract for the entire electrical equipment. Work on the installation has already been begun.

Gossip about Sir William Thomson.

Apropos of the recent honor shown Sir William Thomson, the London correspondent of the *Sun* writes: The greatest surprise in Queen Victoria's New Year's honors is the peerage for Sir William Thomson. His researches into electrical science have made for Sir William a world-wide name. Many of the electrical wonders which we marvel at now were foretold by him twenty years ago. Recently when Mr. Balfour delivered his rectoral address at the Glasgow university he was the guest of Sir William, and doubtless the conferment of a peerage is due to Balfour's initiation. Sir William is a genial, homely Scotchman. He is above all suspicion. No amount of money could buy from him a favorable opinion for an unworthy object. He is slightly lame, and walks with the aid of a thick oaken stick. He dresses more for comfort than show, and his care of the bawbees is frequently illustrated by his contentions with London cabmen. He has a knack of gauging how far he can ride for a shilling to a mathematical nicety.

Chicago's Rapid Transit Agitation.

The committee of Chicago taxpayers that is considering the question of rapid transit appears to have an unconquerable prejudice to overhead electric lines. It has graciously decided, however, to ask the city council to permit the construction of electric roads with overhead wires. These roads, the committee announces, will not be permanent, however, but will simply be used "until some better method of solving the street transportation problem can be found." This isn't very flattering, but if the condition were strictly carried out the electric railway people might be willing to comply with it.

At the last meeting of the committee Alexander Clark presented the proposals of the Chicago & Evanston Electric Railway company, recently described in this paper, and this and lines based on similar systems meeting with the approval of the meeting, it was resolved that a committee be appointed to petition the next meeting of the city council, asking that the objections to the overhead wires be waived for a sufficient time to give the citizens temporary relief by means of the electric roads. Mr. Clark stated that at least $1,500,000 had been sunk in conduits by various cities, in each of which the overhead wires are now in use.

Mr. Givins proposed a plan of his own for the transportation of visitors to the World's Fair. Drawings of the proposal were submitted. It contemplates the construction by all the steam railroads running south of a four-track electric road on Sixtieth street, to run from Leavitt street in Englewood east to the fair grounds. These tracks would cross those of several lines of railways, the farthest west being the Panhandle at Leavitt street, over which eleven roads run trains. Stations would be at each intersection, and the people could take any of the railways from the heart of the city with a transfer to the electric road for the World's Fair. The latter would thus be reached by all south-bound roads which would, therefore, it is anticipated be willing to unite in the construction of the electric line.

A Record of Misfortunes.

By a strange conicidence the office of the Electrical Supply company, Chicago, was visited by a series on misfortunes a short time ago It began on Saturday, January 2d, when G. G. Carter sustained the loss of all his household effects by fire. On Sunday the little daughter of Wells Goodhue manager of the house goods department, died. Monday proved to be even more disastrous. D. E Goe, the advertising manager, received a telegram announcing the death of his father, while news reached the office that Miss Ida M. Berentson, Mr. Terry's stenographer and an unusually bright and gifted young lady, had succumbed to pneumonia. The sad list was completed by receipt of the intelligence that the mother of Carl Klussman had just died. All the gentlemen named are well known to the electrical fraternity, and they have the sincere sympathy of their friends.

Flour Mills to be Operated by Electricity at St. Paul.

Kingsland Smith, a practical miller of St. Paul, announces that he has been engaged during the last year in experimenting with electricity for flour mills, and he has at last, he believes, devised a system by which it can be economically employed.

Speaking of the proposed change in the method of operating, Mr. Smith said: "I have become thoroughly convinced of its cheapness and entire practicability." There is not, he says, a mill in existence run by electric power, and its introduction into mills will be a step in advance equal to the introduction of rolls in 1880. Mr. Smith says: "I have not definitely decided on how or where I shall get this power, but am figuring on a plan which, if it is carried out as I think it can be, will revolutionize the question of cheap power in St. Paul." It is proposed to utilize 80 horse power at the beginning.

Electric Companies Interested.

A terrific boiler explosion took place in the new Springer building on Canal street, Chicago, on January 8th. Five men were killed and one injured. It is said that the boilers were so defective that the city inspector had refused to issue a certificate. A number of electrical manufacturing concerns had shops in the building, including the Chicago Motor company, the Standard Electric company, George Cutter, J. K Pumpelly, the Sperry Electric company, the Great Western Electrical Supply company and the Electrical Expert company. None of these suffered any damage, however, save the stoppage of the power.

Electric Lighting in Chicago.

At the meeting of the Chicago aldermanic committee on gas, oil and electric light last week action on the matter of lighting the Fifth and Sixth wards with electric lights was deferred. This was done in order that the electric light companies might have an opportunity to hand in estimates. Alderman Burke introduced an order in the council some time ago directing the city electrician to prepare estimates as to the cost per lamp. It was claimed that it would be cheaper than gas, and some of the aldermen voted with electric companies in reference to lighting the territory. The Arc Light & Power company submitted a proposition to put in a plant and furnish light for 55 cents a lamp, providing it was given a seven year contract, or that the city, should it wish to discontinue the arrangement prior to that time, would buy the plant. It was claimed the plant would cost $191,692. A representative of the Chicago Illumination company appeared before the committee and asked an opportunity to submit a proposition. The ordinance of the Archer Electric Light company asking the right to erect a plant and run wires in the territory bounded by Wentworth avenue on the east, Thirty-ninth street on the south, the South Branch and the canal on the west, and Thirty-first street on the north, was read. It was decided to defer the whole matter for one week.

Electric Propulsion for Canal Boats.

Discussing the project of an overhead trolley system for the propulsion of boats on the Erie canal, the Rochester *Post-Express* says:

It has been suggested that boats on our canals should have electricity for a motive power; and it seems to us that the suggestion is an admirable one.

If the Erie canal is to remain in its present condition, it is plain that electricity is the proper motive power for the boats that use it. The old-fashioned method of drawing boats by horse power is slow, inconvenient, costly, and incapable of further development. Many attempts have been made to introduce steam propulsion, but none of them have been more than moderately successful. The Belgian cable system is clumsy; and it offers no advantages that would compensate for the cost of its introduction. Canal navigation, therefore, has been practically without improvement for years Modern methods have hardly touched it. In applying electric power lies the true key to the problem which the state once put before the inventors of the country and for the solution of which it offered a liberal reward.

It would be an easy task to construct a trolley system along each bank of the canal and supply ample power to boats. Horses or mules would be liberated from the cruelest kind of labor in many instances; in others the space taken up by steam engines would be utilized for freight.

The only difficulty, so far as we can see, would be in regard to the furnishing of power. Should the state build and operate the plant, or should it grant a concession to a private company to furnish electric power for canal traction at rates advantageous to the boatmen?

The importance of the Erie canal must be fully appreciated in order to account for the lively interest manifested thoughout the state in this discussion. Ex-Assemblyman Hickman of Buffalo contributes the following in a communication on the subject to the Buffalo *Express*:

With an "up" wire and a "down" wire, boats could be moved easily and cheaply. The room necessary for an electric motor is small and no fuel-room is required. The weight of the motor is also small, comparatively speaking. One boat could tow another, and the cost of transportation be so reduced, that even with low freights, boatmen could live. I believe this would be profitable with the present method of generating electricity, but if the Niagara Falls power scheme should prove a success there would be a splendid return on the investment.

Proposed Hawaiian Cable.

In alluding to the proposed cable from the Pacific coast of the United States to the Hawaiian Islands, the New York *Sun* says:

As to the proposed landing places, the one favored by the Tuscarora, on the American side, will probably be in Monterey Bay, a little south of San Francisco. A preliminary trip was made from that point outward for 800 miles, and then the Albatross returned to San Francisco for coal before completing her survey to Honolulu. Near the Hawaiian Islands the bottom proved very uneven, as was expected; but the place chosen as the best for landing a cable was only a few miles from Honolulu.

The work thus done by the Tuscarora is preliminary only, and would presumably be supplemented by a more detailed set of soundings should any commercial company take up the cable enterprise. Yet what has already been determined must form a valuable aid to any such company. Should none of the routes yet surveyed be satisfactory, it would be possible to start elsewhere, between Monterey and San Diego, or, indeed, from any point north of San Francisco, where, however, the distance would be greater. The American project has the advantage over the British in this matter of distance, but the latter might find a more favorable ocean bottom.

A cable to Honolulu would naturally contemplate ultimate extension either to New Zealand and Australia or to

China and Japan. The latter would doubtless be the American choice, and then the surveys of the Albatross would need to be supplemented by others extending across the Pacific. Admiral Belknap, on the Asiatic side, found, in his former surveys, a valley east of Japan, apparently stretching all the way to Kamchatka, and exceeding in depth 4,643 fathoms, at which depth his sounding wire broke. But perhaps this prodigious gully could be avoided by going farther south. The last Congress refused to pay a subsidy to a company which proposed to lay a wire between San Francisco and Honolulu. The Senate had voted $3,000,000, but the House refused to concur even with an amendment that Hawaii should pay one-fourth of it. Still, for preliminary surveys consent was readily obtained, so that perhaps a continuation of the work of the Albatross may be authorized at the present session.

Dow's Adjustment for Incandescednt Lamps.

The little device illustrated in the cut presented herewith is an invention of Willard E. Dow of Boston. It is so simple in construction that a glance suffices to show for

DOW'S ADJUSTMENT FOR INCANDESCENT LAMPS.

what purpose it was designed. As will be readily seen it may be made as ornamental as desired. The case inclosing the spring and the extra cord is made of metal with either a gilt, nickel or bronze finish. The adjustment works on the same principle as a spring window blind, and the lamp is raised or lowered after the same fashion. This little fixture is manufactured by the Dow Adjustable Light company of Boston.

A Portable Photometer for Measuring Street Lights and Illumination.

In a paper read before the Engineers' club of Philadelphia Carl Hering described a portable photometer that he devised for actual use in measuring the candle power of the lights of an electric light company in a Pennsylvania town. The conditions required the construction of a portable photometer which would work equally well in all kinds of wind and weather. It had to be light and small, so as not to attract attention, in order that the electric light company should not know that the lights were being measured, and take unfair advantage of the opportunity to run up the lights. It was furthermore necessary that the results should be quite reliable, as the matter might have to go before the courts.

After several trials Mr. Hering finally constructed a satisfactory instrument by the use of an electric light supplied by a portable accumulator. The lamp used was a small four-volt incandescent lamp of about one candle power, requiring a current of slightly less than an ampere. The accumulators consisted of two cells placed in a wooden box having a shoulder-strap, enabling it to be carried by the operator at his side. The weight of it complete was about twenty pounds. The cells were sealed with lids before the acid was added, and the whole was covered with a thick layer of powdered carbonate of soda, so that if any acid did come out through the vent tubes, it would be decomposed and then evaporate. As the voltage of an accumulator will become less and less as it is being discharged it would change the candle power of the light very materially. To get over this, the accumulators were chosen of such a capacity that the amount of current used in one set of tests was only about one-fiftieth of its capacity; the fall in potential for such a small discharge may be taken as negligible. Furthermore, as the light was turned on for only about half a minute at a time, with intervals of rest of five or ten minutes, the cells had time to recuperate. The cells were discharged slightly before the test, in order to bring them down to their normal and constant voltage. Comparisons of this light with a standard during different parts of the evening showed it to be quite reliable and constant.

The photometer itself consisted of a light wooden tube of square cross-section, 4 inches to a side, about 3 feet long and open at both ends. The adjoining cut shows a view of it with one side removed to show the inside. The usual screen *S*, with a grease spot, and mirrors *M M'*, was placed near the right-hand end, and a square opening left in the side of the of the tube opposite to it to look through. The tube was blackened inside and outside with a paint made by mixing much lampblack with a little very dilute shellac; this paint, in drying, leaves no gloss. It was supported by two projecting handles *H H*, the right hand one being nearly under the center of gravity, so that the whole could readily be supported by the right hand alone. The small electric lamp *L* was secured to a block capable of being slid along inside of the tube by means of a projecting rod *R*, having a scale attached as shown, which indicated the distance of the lamp *L* from the screen *S*. This rod, with a lamp, could be securely clamped at any desired distance from the screen by a thumb nut *N*. A 15-feet tape in a spring case *T*, without pawl and ratchet, was attached on the bottom near the left handle. A small switch, not shown, for turning the electric light on and off was also secured near the left handle.

To use the photometer it must first be standardized. This is done in any convenient room which can be darkened. The instrument is laid on a table with a standard Hefner-Alteneck lamp, which is placed at a fixed and known distance opposite the right hand end of the photometer tube. The small electric light is then turned on, and moved forward or back, until the grease spot seen in the mirror *M* on the right hand side of the screen *S* disappears altogether. The left hand side (toward the small electric light) was not considered at all. This adjustment, therefore, admits of considerable precision, as there is no difficulty in making the grease spot disappear on either one side or the other; the difficulty is in making it nearly disappear to the same extent on both sides, and it is here that the large personal error enters in ordinary photometric work in which no two operators will set it alike. After making this adjustment the electric lamp is firmly secured in that position, and the photometer is ready for use.

To use it in measuring street lamps, or any other source of light, the right hand end is pointed toward the light in either a horizontal, a vertical or an inclined direction; the small electric light is then turned on, and the whole tube moved toward or away from the light to be measured until the spot of light again disappears on the mirror *M'* to the right of the screen *S*. By measuring the distance between the screen and the light to be measured, and knowing the calibrated value, the candle power of the light is readily calculated from well-known laws. The distance from the screen to the large light is measured by means of the spring tape *T*, which passes directly under the screen, and may be easily read by the operator. The small switch placed near the left hand handle, not shown in the figure, enables the current for the small lamp to be turned on and off readily, so as not to burn it longer than just enough for the test.

In Mr. Hering's measurements the lights to be measured were from 10 to 25 candle power, and it was thought that from 4 to 6 feet of tape was a convenient distance, being an average of about 1½ inches per candle. This would require, as a unit of illumination of the screen, a little less than one-foot candle. For convenience in making calculations the standard was placed at 14⅛ inches (= 1.20) from the screen in the calibration. This gave such a unit that the square of the distances in tens of inches is double the candle power of the light to be measured, a calculation which is readily made mentally, approximately at least. A difference of one candle power in the unknown light would therefore require a movement of the photometer of about 1½ inches; a fraction of a candle may therefore readily be detected; hence the photometer was quite sensitive for this class of work. The end of the tape was held up to the center of the lamp by an assistant with the aid of a pole. The spring case of the tape kept it stretched so that the tape was virtually a fixed rule or scale over which the whole photometer was moved. The right hand end of the tube must be long enough to shield the screen from the light of other light or of the moon.

This form of photometer has the further advantage that

PORTABLE PHOTOMETER FOR MEASURING STREET LIGHTS AND ILLUMINATION.

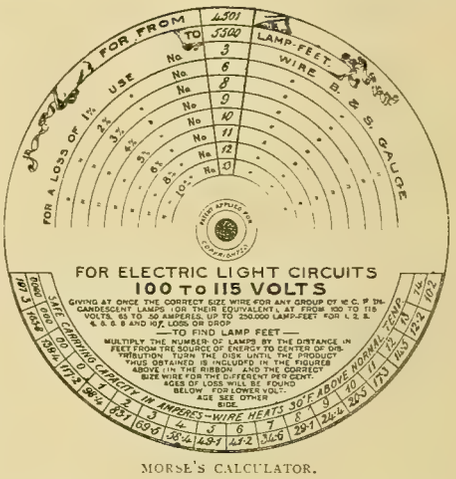
it can be used to measure "illumination" as distinguished from the candle power of a light.

To use this photometer for such measurements, the right hand end of the tube is made in such a way that it can be taken off, so that the grease spot screen forms the end of the tube. The photometer is calibrated, as before, but instead of securing the rod containing the little lamp, its position should be read on the scale shown in the figure, the zero of this scale being such that the reading gives the distance of the small light from the screen. Being thus calibrated, it is ready for use. To use it, as, for instance, to measure the illumination on a desk produced by day light, the photometer is placed vertically, so that the screen is on a level with the desk, and the electric light is moved in its position until the grease spot disappears. From the reading of this position, and that of the calibration, the illumination in foot candles is readily calculated. From this the number and position of electric or gas lights necessary to reproduce such an illumination may then readily be calculated.

Morse's Calculator.

This device will be of interest to those engaged in electric wiring on account of its extreme simplicity, and the readiness with which, through its use, all ordinary problems of house wiring may be solved. The calculator is more easily consulted than a chart or table, as there are no intersecting lines to follow, or columns to confuse. The readings are direct, plain, and absolutely correct. It is sometimes desirable, also, to ascertain the proper size of wire to use for circuits in places where it is inconvenient to spread out a chart or consult a table, but this calculator may be consulted any where during the progress of work as well as in the office. It can be carried in the pocket and gives instantly the information desired. The calculations are for fifty to sixty volts, one ampere on one side and for 100 to 115 volts, .65 to .50 ampere on the other, with a range of from 0 to 250,000 lamp feet, with from one to ten per cent. loss or drop. This meets the requirements of all ordinary installations.

By referring to the cut the operation of the device will be readily understood. Suppose the problem is to install fifty 16-candle power, 110 volt incandescent lamps, with a loss of five per cent. at a distance of 100 feet from the dynamo. It will only be necessary to multiply the number of lamps (50) by the distance in feet (100) and the result is



MORSE'S CALCULATOR.

5 000 lamp feet. The calculator, as it stands in the illustration, reads: "For from 4,501 to 5 500 lamp feet, etc." Five thousand is therefore included in these figures, and by noting the figures opposite the five per cent. mark, it will be seen that No. 10 wire, B & S gauge, is the proper wire to use.

The Morse calculator has been placed on the market by Edward Lasell, Kansas City, Mo.

Gov. Flower on Electrical Executions.

One of the suggestions in Gov. Flower's message to the New York legislature was for the repeal of the provision of the law regarding electrical executions by which newspapers are prohibited from publishing accounts of the executions. On this subject he says:

"The adoption of so novel a method for inflicting the death penalty as electricity naturally excited world-wide attention and aroused both popular and scientific interest. There was in the beginning some question of its success. The public curiosity to know the actual results of the experiment was intense. It did not spring from morbidity, but from wholesome interest. The feeling was general that so radical and important a departure from existing methods should be carefully studied and the facts relating thereto truthfully stated. There is a popular aversion to secret methods of performing public duties. I, therefore, recommend its repeal. I have no sympathy with that morbid taste which yearns for revolting details of human suffering and misfortune and would make heroes out of criminals, but I recognize a legitimate public interest in the adoption and trial of this new method of execution, and I would not shut out from the people the opportunity, under proper restriction, of securing the most unbiased information regarding its operation.

"Other legislation has also been suggested to facilitate the operation of the statute providing for electrical executions. The infliction of death by electricity requires expert supervision and perfect appliances. These, it has been thought, are not always easily attained in the state prisons. Besides, the cost of establishing and maintaining the necessary apparatus in each prison is considerable, and should be avoided if practicable. I would respectfully invite your attention, therefore, to the recommendation of the superintendent of prisons, that the statute be amended so as to provide for but one plant in a building especially constructed for the purpose and containing the necessary rooms and apparatus, under charge of a competent and trustworthy electrician. My own opinion is that, should it be deemed advisable to adopt this suggestion, the plant should be connected with one of the largest and most accessible prisons, rather than established separately. This would be more practicable and more economical."

Electrical Exhibits at the Columbian Exposition.[1]

By John P. Barrett.

Electricity, as an adjunct to industrial procedure, has ceased to be empirical. Its practicability, economy and the conveniences of its employment are settled and incontrovertible facts. Its conduct under fixed conditions is no longer problematical. The laws which rule its action are as inviolable as those of the exact sciences, as constant as those of nature, of which they are a part.

In making plans, therefore, for an exposition of electrical development, the practical side of the question must be ever uppermost. The chief aim must be to demonstrate beyond cavil that as a factor in the affairs of this workaday age electricity cannot but be taken into great account. This, the chief feature, however, would fail of its force were we to neglect to demonstrate at the same time the immense strides that have been made since electricity emerged from a state of mystery and became one of the essentials of civilization and progress.

Following out this preliminary reasoning, I think it necessary to treat practical electricity in classes according to the importance and relationship of its application.

The question of railway and other processes for transporting passengers and freight is the most vital economical issue of the present day. Steam, either by locomotive or cable, has been the only feasible motive power up to within a short time. The manifold objections to it, however, have increased the activity of inventors and the possibilities of rich reward have been a stimulus to the energy of electrical workers. Electricity, in some branches of this service, is already a success, and is fast displacing other motive power. The next few years—possibly the next few months—will probably see the whole question finally settled by some new element or the further development of one or the other of the existing electrical systems. It will be part of our duty, therefore to give every facility to exhibitors to make displays of new systems and to exploit old, along new lines and under new circumstances. In order to do this it is contemplated to set aside a parcel of ground at some point of the exposition on which to build trial tracks, which may be equipped for the different systems. We should make it possible for every system to be demonstrated, so that not only the electrical people may judge of the respective merits but that the visiting capitalists and possible customers may have ready facilities for becoming interested in the subject itself or in any of the various inventions or systems on exhibition. It is to be hoped that in this class of work the electrical people will submit something which shall decide the question of transportation wholly in favor of electricity—as is already in part done—whether it be by means of overhead, conduit or accumulator systems. I have only to say that the public at large, and those who are interested in the question from a financial standpoint have high anticipations in this direction, and there is a disposition to wait for developments.

Electric lighting, arc and incandescent, has already arrived at the point of a practical success. For illuminating purposes electricity is accepted and stands without competition. The development in this direction will be as thoroughly demonstrated at the Columbian Exposition as it is possible to conceive of. All the various systems of lighting and of the transmission of power will be placed in practical operation for service. Nearly, if not quite, 25,000 horse power will be applied to electrical transmission at various parts of the grounds and buildings. It is contemplated to engage each company undertaking work, to wire and equip the territory allotted, furnish its own lamps, materials and supplies, so that each company's system of construction and operation will stand entirely alone, to show its special merit or to receive condemnation for failure. In this work it is contemplated to bring into friendly but brisk business competition the companies and systems of this country and Europe. The question of the saving of energy by the perfection of machinery and insulation will be closely calculated, and the various systems will be thoroughly tested by efficient juries, on the awards, of which more hereafter. Artistic lighting of theaters, hotels, residences and streets will be given an impetus, placed as these features will be in competition with art in every other conceivable dress. The brisk, practical business methods of the electrical people of this country have left little time to art and aestheticism up to the present time, while the people of Europe have, on the contrary, led art and electricity hand in hand The Columbian Exposition may have some surprises in store for visitors in this behalf, and will undoubtedly be a source of much pleasure and instruction.

The transmission of power from sources at points along available water courses, or in the immediate vicinity of fuel for steam, and remote from the desired point of application, has been given much attention of late, and much newspaper comment has been made upon alleged successful inventions. This has seemed to me surprising, coming from electrical journals at least, since all of us in this country ought to be aware of the fact that long distance transmission has long been an accepted application of electricity in the mines of the West and Southwest, and has done much toward revolutionizing the process of mining. At many points in the West far removed from fuel for steam, and at long distances from water power, mines are being successfully operated that could not have been so where fuel was to be delivered at the mine instead of the developed power ready for application. Some new things have come into practice in this field of electrical work, in Europe of late, and at the Columbian Exposition we will see an increased interest in this work of transmission. There is in contemplation, moreover, a project to make a most instructive object lesson by placing in practical operation an electric plant operated by a water wheel, with wiring and terminals for application at an artificial mine some distance away. The many applications of the electric current, of various quantities and qualities, in mining and milling work, will come under this head, and I am assured of some new and valuable contributions in the way of machinery.

In the whole field of electrical invention, moreover, there are promised models of invention setting out new principles, and numberless contrivances will be a part of the exhibit to testify to the large measure of usefulness of electricity in the various directions of its application. It is hoped also that the exhibits will be object lessons to the general public, and that they will inculcate the fact that there are legitimate uses of electricity, and that on the other hand there are applications which closely border upon the fraudulent, and which are mere catchpennies and brought forward wholly because of the mystery and hocus pocus that surround them. I feel it a part of the duty of the department of electricity to unreservedly oppose the presence of these things and by discountenancing them, have an effect in a degree to rob them of their harmful influence. People must come to understand that electricity is not a mysterious force, uncertain in its operation and liable to all sorts of eccentric deviation from the desired course. Until this understanding has been reached, the electrical people will suffer more or less from frauds practiced by the unscrupulous and will meet with obstructions in the shape of legal injunctions to prevent the laying of electric roads and lines of wire for transmission, and the actual dangers of electricity will be magnified many fold by those interested in restricting its use.

The remaining feature of the electrical exhibit, but not by any means the least for being mentioned last, is that part which will create object lessons on electrical progress—the historical exhibit. It would be impossible to fully appreciate the greatness of the progress made and the magnitude of the work of making commercial electricity what it is to-day, without the presence at any exposition of the first crude machinery, the initial appliances by which the electrical current was made a useful force. It is contemplated to have some of the original models, and where this is found impossible, to have reproductions of the models of the apparatus of Morse, Franklin, Henry and many others of our own country and those of Ohm, Ampere, Gauss, Siemens and many others of Europe. The department is in correspondence at the present time with those people or governments that have control of musuems or institutions of learning where any of this historical apparatus may be, and we earnestly hope to have a full exhibit of these priceless treasures.

It is not contemplated by the national authorities of the Columbian Exposition to offer awards which would have so great an intrinsic value as to attract exhibitors but it is contemplated to make the standard of excellence so high that the bare acceptance of an exhibit by a department will be a lasting and distinguished honor. In the electrical department the space available for exposition purposes will be so small, as compared with the demand, that the greatest judgment will have to be brought into play to decide what exhibits are worthy of a place, and what will have to give way. It will be impossible to accept all. Therefore, the presence of an exhibit in the electrical building will be a testimonial of its unusual merit. The awarding committees have determined to have full and exhaustive tests made of all machinery in competitive exhibition, by the juries of the different departments, and to publish these tests and the jury findings, at the close of the exposition, under the authority of the national commission.

I regret that it is impossible at this time to present figures and definite information as to the prospects and scope of the department. It is yet sixteen months before the opening of the exposition, and while an amount of space in the department building has already been applied for in excess of the total amount available, yet we have heard from fewer than one-half of the probable applicants for space. A delicate task is before the department therefore, and it will not be advisable to discuss the question in detail for some months to come, when I hope to have heard from all the electrical people. I will then be in a position to discuss the matter more fully, and more in detail in a paper which I shall ask to present.

Discussion.

President Sunny: One of the statements in Chief Barrett's paper attracted my special attention. He stated that a trial track would be built for the purpose of showing what can be done in the way of electric traction. I hardly think that the electrical fraternity will be satisfied with a trial track of 500 or 1,000 feet in length. Nothing less than a railway equipped with electric motors and extending over all parts of the exposition grounds will satisfy them. I do not think many changes from the present style of electrical apparatus will be required to equip an electrical elevated railway for the fair, such as has been generally decided upon to do the work It will be a great disappointment, I am sure, to the electrical world if anything but an electrical railway is used upon the grounds, and in that case this track that is referred to in Prof. Barrett's paper, will hardly be sufficient.

There is another significant statement in the paper that it will hardly be possible to accommodate all the applicants for space, and that it is going to be in itself an honor to any firm or corporation to have space allotted to them in the building. When we take into consideration that there is a building 350 feet wide and 700 feet long, with a gallery all around, providing an enormous number of square feet of floor space, which can be devoted entirely to the electrical exhibit, and compare that with the small space that was given to the electrical exhibit in 1876 at the Centennial Exposition, the growth of the industry will seem not only marvelous but almost beyond the comprehension of any of us.

Geo. Cutter: I agree with the chairman that a proper display of electrical street railway apparatus demands something more than a model track. Prof. Barrett's endeavor to make [illegible] electricity for [illegible] We ought to [illegible] will be [illegible] would be possible [illegible] same feeling [illegible] transmission of power.

I presume that some people will be interested in seeing a little waterfall with a little [illegible] dynamo, and a little [illegible] something else and we want [illegible] 1893. We want Prof. Barrett to [illegible] we appreciate his efforts to [illegible] electricity, we must insist upon the largest possible display of such applications of this great science.

Chas. L. Cutler: I believe that we can rely upon Prof Barrett to get all for us that is possible. In the matter of a trial track, if it is possible to get an opportunity to display to the fullest extent all of the appliances of electricity, we will have it. I think we should eliminate all that smacks of the quack doctor and the medicine man; all bogus schemes from this great display. There are too many people who are trading on the term "electricity."

The Chairman: The possibility of equipping the railway at the fair with storage batteries is mentioned in the paper, and in view of that fact I would ask Mr. Pumpelly to favor us with his views on this subject.

J. K. Pumpelly: For the last six years the trials of storage batteries for traction have so nearly approached failure that they might be called by those not understanding the conditions, and by those having lost money, questionable schemes The nearest point to practical traction that we know of in the West was at Dubuque. There were from six to nine cars equipped, and to a certain extent they did good business and did it economically, comparatively speaking, that is, as compared with horses. There is no use in talking about anything of the kind being economical, however, when compared with the trolley wire, where it can be used But this happened to be where they could not use the trolley wire and they determined to have storage batteries. The system did good work for six months, and then litigation and failure. It was a failure that could have been prophecied on account of the friction between the men. Now it is taken for granted all over this country, especially by capitalists who have lost money and have had their fingers burned that that is enough. "It failed there. We gave it a good trial, and we had better decide that it won't do for that kind of work," is their conclusion.

Now, if a battery can be made that will possess sufficient durability, and that will not cost over ten per cent. per year on the first investment, then where the trolley wire cannot be introduced—where the franchise will not allow it, or where it is impracticable for some other reason—the storage battery would be measurably successful. Or where, for instance, in the case of a road coming in here within a certain distance of the court house with a trolley wire, I think it would be very practicable to switch in a truck with a battery that would do the work around the loop and return to the trolley again. In that case if they wanted to introduce electricity in the city here, and they would not allow an overhead wire or a conduit wire, then the storage battery could be utilized if it could be made durable, and I think it could be made durable It could be made to do the work for one or two years, and not cost over 10 per cent. to make it do the work for three years. That is a point about which I have talked with Mr. Barrett and it is a point that I should like to see proved at the Columbian Fair, but it will not be. There is no test which a battery can be put to for the six months of the fair that would satisfy a capitalist or an investor beyond what has already been demonstrated.

Fred De Land: Mr. Pumpelly refers to the breaking down of the positive plates at Dubuque. When the new cars were started a second class engine from the scrap pile was belted to the generator used for charging the batteries. This engine would often have to be taken apart, and it would not govern. Again, the trays containing the charged cells were dropped from the tables on two or three occasions, which added nothing to the life of the positive plates. There are other reasons for believing that the storage battery has not been given all the show it was entitled to in Dubuque.

C. G. Armstrong: Long distance transmission of power for use at the exposition has been a pet hobby of mine for some time, but Niagara is 500 miles away, and that is too far for anything but a mere experiment. But at Marseilles on the Illinois river, 80 miles from here, there is a waterfall that would furnish from 1,500 to 2,000 horse power that is running to waste. I have made some figures for a plant to generate current and bring it here for any use that might be desired during the six months of the exposition, and after the exposition is closed the current could be utilized It seems to me that a project of that kind would be a good thing both as a matter of experiment and profit. The current can be obtained cheaply. If they can transmit it 115 miles in Europe, we can transmit it 80 miles here, and we will show an advancement by transmitting 1,500 to 2,000 horse power instead of 100 or 200. The town is on the canal, and the right of way can be easily procured from the canal commissioners, so that removes a number of serious difficulties. Professor Barrett would then have either an experimental road, or he could have one for actual use, as the president has suggested

The Chairman: I am inclined to think that if we drop down to 80 miles we will be falling short of what they did in Germany. I do not know that anything short of Niagara Falls would be satisfactory on the coming occasion. We may, however, have to come down from our high horse and take the 80 miles.

Thos. G. Grier: I would like to ask Mr. Armstrong just exactly what the method of transmis-

1. Read before the Chicago Electric club, Jan. 4, 1892.

sion is, and what voltage he would use. Probably my question is a little in advance of the time, as I understand that at a meeting in the near future we are going to discuss this question of power transmission, and the direct current versus multiphase or alternating current. But at the same time I think a few preliminary remarks in regard to the method of transmitting this power would be in order.

MR. ARMSTRONG: About 20 000 volts will be used and the alternating current, multiphase or otherwise, as deemed best. There is plenty of power, and there would be no objection to a loss of 20 per cent. or 25 per cent. in the transmission. We could even lose 33 per cent. and not care much about it, because the water doesn't cost anything.

THE CHAIRMAN: We have with us this evening General Barney of New York, and Mr. Keller of Boston. General Barney will favor us with a few remarks.

GENERAL BARNEY: I supposed that the railroad at the World's Fair would be an electric road, and I was rather surprised at the suggestion that it was yet undecided. I think it would be a mistake if any other form of motive power were used, and entirely unworthy of the enlightened management, of which, if I am correctly informed, your president is a member.

THE CHAIRMAN: In answer to General Barney I would say that it is the expectation to equip this railway with electricity. It is to be an elevated structure, according to the present arrangement, but later on I think it may be decided to make it a surface road, so that it will cover the ground more efficiently than such an elevated structure possibly could do. An elevated structure, it seems to me, must necessarily be an obstruction to the view, and one object that the managers of the fair have in view is to preserve a general harmony in the architectural designs of the buildings, and make the whole thing pleasing to the eye. Now if an elevated structure is erected upon the grounds in such a way as to accommodate the masses—and the distance from building to building is very great indeed—it seems to me that the front elevation of the buildings will be almost wholly obscured by the elevated structure. To obviate that difficulty the elevated structure must be placed on the outside limits of the ground, so that it will be a long distance from the structure to any particular building, except, perhaps, in a few instances. The specifications for the equipping of the elevated structure require electricity, and I have no doubt that electricity will be used, so that this trial track that Professor Barrett alludes to in his paper will perhaps not be used, or only be used for very small purposes indeed.

MR. KELLER: I know of a storage battery road that is running in Massachusetts in the central part of the state, from a little town called Milton to Hopedale, five miles distant, and I am told that the grades are about five per cent. They have been running this road for something more than a year. Some of the best people in Massachusetts are interested in the road, and they assure me that it is a success, and that they are running it as economically as they could by any other electric system.

I and others have just got a right to build two miles and a half of electric road in the town where I live, a city near Boston, and we propose to operate that road with the storage battery; that is, we are going to lay the track, and the gentlemen who have the electric apparatus, and who are now operating the road from Milton to Hopedale, propose to put on cars and operate them for a certain length of time that we may agree upon, nothing less than a year, however, and show us the results, and we will have an expert there all the time ourselves. If it is satisfactory to us we will take the cars. If not, they will take the cars off, and we will use the trolley system. We propose to make our arrangements for an overhead system in case the storage battery proves a failure. But in the grant that was given us by the city it was understood, and it so states, that we shall first try the storage battery system.

THE CHAIRMAN: Mr. Keller, can you outline what the possible development of the telephone is to be between now and the opening of the fair? That was a thing that came out first in 1876 at the Centennial at Philadelphia. It was the electrical exhibit of that time, and it would, no doubt, be interesting to all to know what the developments will be in that direction.

MR. KELLER: I can only say that we have a line now completed and working from New York to Cleveland by way of Pittsburg, and we hope by 1893 to have a line to Chicago. We have a line working very successfully indeed from Boston to New York and Buffalo, and all intermediate points. Our subscribers are using the service daily, and doing a great deal of business between New York and Boston. The New England Telephone & Telegraph company has lines of about 200 miles, with metallic circuits, operating through Massachusetts and Vermont, and I do not believe that we have, out of about 400 trunk lines and connecting exchanges in the territory I have mentioned, more than twenty that are single lines to day. They are all metallic circuits. Our trunk lines are all metallic circuits. We have in the city of Boston, at this time, probably a thousand metallic circuit subscribers. We have three offices in Boston. We began taking metallic circuit subscribers about a year ago, and we are receiving them now at a rate of about 75 to 100 a month. Our rates are somewhat higher, but the people are glad to pay the advance In fact the applications are away ahead, and we have all we can do, and it is equally so with all of our larger exchanges throughout our entire territory, with the exception of Maine. On our large exchanges the subscribers are coming in as fast as we can take care of them, and out of about 101 exchanges we have about 40 metallic circuit switch-boards.

THE CHAIRMAN: I have wondered how generally the long distance telephone would be used by the public between Chicago and the East, on account of the price that you would necessarily have to charge for a conversation. The only thing we have now is the telegraph, and considering the cost of the metallic circuit and assuming that it would take fifteen minutes to carry on an ordinary conversation, with six or seven minutes to make the connection, it would cost about $60. In that time the telegraph people could transmit 120 messages at 50 cents apiece.

MR. KELLER: To make connections between the subscriber in Boston and the subscriber in New York does not take over 35 to 40 seconds unless the wires are cut up in sections and used locally. Those of our subscribers who use the long distance wires a great deal have a special set of instruments for that use alone, and then they have their local instruments. Our statistics in Boston show that the average time consumed in conversation over our long lines, which are about 200 miles, as they are made up, is a little less than 4 minutes to each conversation. The rate between New York and Boston is $2 for five minutes' conversation. If you have business transactions on hand that you wish to discuss you can talk more words in five minutes than you can send over the telegraph wires at 25 cents for ten words. It would cost you probably about $4 to send the same number of words by telegraph. You can easily talk 100 words a minute. We have got 40 circuits, I think, between New York and Boston, and those circuits are kept busy all the time during the busy hours of the day. We haven't circuits enough there.

MR. CUTTER: I would like to say something more about Mr. Armstrong's long distance power-transmission scheme. Here we have 1,500 to 2,000 horse power within 80 miles of Chicago, and it seems that there are people who stand ready to furnish the money to carry the scheme through, and it seems to me that we should as electricians, heartily approve of some such scheme. If there are any serious objections to it I would like to hear them.

W. J. BUCKLEY: I object to Mr. Cutter's proposition on the ground that the distance is not great enough; 80 miles is not enough. We have got to do something better than was done by our German cousins. I think we ought to go up in Northern Wisconsin two or three hundred miles, or even go to Niagara, if we have to.

There is one thing in Prof. Barrett's paper that impressed me, and that was his extreme modesty; usually he is not a bit bashful about proposing to do a great deal more than he outlines in that paper. Now the idea that he is going to give us an experimental track scarcely meets our expectations. Of course, there are a number of other motors, such as steam and vapor, gasoline, naphtha, and others whose champions would like an opportunity to show their results, and I believe we ought to suggest to Prof. Barrett that he give this experimental track to these people, and let us insist as a body that we have far larger ideas as to what we can do; that we want the exposition people to give us a steam plant of 30,000 horse power, to run all the lights and furnish the power required on the exposition grounds.

MR. ARMSTRONG: I would say in reply to Mr. Buckley that while transmitting power 500 miles would be a great undertaking, it is, after all, only a matter of figures. If we transmit 1,500 or 2,000 horse power any considerable distance, we will be doing something more than was ever done before. But it is very easy to figure that we could carry it out the other way by narrowing down the current and stretching it out longer. I think it will give the impression that we seek to convey, that we have done something that has never been done before, and at the same time, it is not exactly visionary. It is something that is really practicable after all, because 1,500 or 2,000 horse power would be worth from $60,000 to $80,000 a year after the fair is over; that is something that is worth considering, as well as the idea of showing people what we can do. It is not a mere plaything. We are putting it up to use for business, and I think it is a feasible plan.

G. E. DORMAN: I approve of Mr. Armstrong's scheme as a first step toward getting Niagara, and I propose that a high pressure continuous current be used. From our experience in continuous high potential currents it is perfectly feasible to transmit a continuous current of any potential whatever up to a million volts.

With regard to foreign exhibits there is one, which as an Englishman, I feel it my duty to refer to, and that is the original Faraday apparatus, which is in the laboratories of the Royal Institution of London, and without which the historical exhibit of dynamical electricity would not be complete. I refer to that apparatus by which it was discovered that electricity could be produced from motion.

MR. CUTTER: I would suggest the adoption of a resolution to the effect that it is the opinion of the Chicago Electric club that some scheme for very long distance power transmission—the longest practicable—should be adopted for the World's Fair, it being understood that it is not the indorsement of any particular scheme or commercial enterprise.

THE CHAIRMAN: I think you will all agree with that general proposition, that this club is in favor of some such grand undertaking in connection with this Columbian Exposition,

The motion was adopted unanimously.

In describing the electric cars of Boston, a correspondent of the *Guardian* of Manchester, England, says: "Over its path of greensward the car goes humming on its way, and the grass is touched by no devastating clinker, no desecrating hoof. It is needless to say that the Boston car is essentially a summer vehicle. The Bostonians have inclement seasons to provide against, and we might easily adopt their system of keeping a mixed rolling stock always in running order. The closed car is a long, lofty and luxurious bogie carriage, with a lounge on either side. It will seat forty people, and give standing room to fully fifty more. For comfort in tramway traveling it is, when not overcrowded, unsurpassed. But he who would taste something of the joys of a strong bird in its flight, swooping onward upon outstretched motionless pinions, should be upon a Boston car when it is 'doing' its mile in 200 seconds on the old broad Cambridge road."

Polyphasal Generators.

Dr. Pupin's paper on "Polyphasal Generators" read before the American Institute of Electrical Engineers which was presented in the WESTERN ELECTRICIAN, Dec. 26, 1891, provoked an interesting discussion, of which the following is a synopsis:

CHAS. P. STEINMETZ: It would be perhaps more advisable to use a shape of the electromotive force similar to Fig. 7, than the shape in Fig. 8; because, as you see, in Fig. 8, the curve has a sharp corner. If we could produce waves of electromotive force that have sharp corners, it could hardly be expected that we could derive from them a current, which, after being sent through step-down transformers, over lines of considerable electrostatic capacity and again through step down transformers into a motor of high self-induction, would still have retained this sharp cornered shape.

Then with regard to the equations of the currents x, y, z, the complex harmonic of the electromotive force produces a current, which is a complex harmonic too, and it is identically the same complex harmonic as long as the circuit has no self-induction and no capacity, or, what amounts to the same, as long as self-induction and capacity have a certain ratio with each other. But as soon as the circuit has self-induction the complex harmonic of current differs from the complex harmonic of electromotive force.

Mr. Steinmetz then went into a long discussion of alternate current motors, upon which he had obtained data from the makers. In closing his remarks he presented the following conclusions:

1. It is possible to produce rotary magnetism of constant strength and constant velocity of rotation by means of true sine-waves.

2. It is hopeless to try to produce rotary magnetism of constant strength and velocity by means of a particular shape of the wave of electromotive force, because in a circuit of considerable, and variable self-induction the shape of the current wave will differ in a considerable and variable degree from the shape of the electromotive force wave for any shape of the electromotive force but the true harmonic or sine-wave.

3. Hence it is more advisable, not to build the generators so, that they will produce that shape of electromotive force which in a particular type of rotary motors will give magnetism of constant strength and velocity, but to build motors that will give magnetism of constant strength and velocity from true harmonic or sine waves, as the only waves which can be transformed, transmitted through inductive and other circuits without changing their shape, to build the rotary motors for sine waves, as the possibility has been shown by Ferraris, and as already in the oldest Tesla motors it evidently has been the aim of the designer.

PROF. ELIHU THOMSON: I remember long ago putting in a patent specification a machine connected so that it had not the three segment commutator, but three rings, and it was rejected at the patent office on the ground that it was not an invention to put three rings on a three coil armature any more than it was for any alternating current. But times have changed since then. It seems to me some light would be thrown on the matter of this discussion by a few simple considerations. We will take the three coil in its simple form, as shown in the figure in the paper. Now let us lead off a wire / which would be a neutral wire. If we wrap that wire around a magnetic core the effect should of course be the same or it should act the same as though these three wires, a, b, c, were wrapped around the magnetic core. So that if any fluctuations of magnetism were set up in this core by wrapping this neutral wire around the magnetic core, the same effect would be produced by wrapping these three wires around the magnetic core. That would show that no fluctuation might be expected in such a system. But there is another question that comes in just here. If we look into the manner of generating; if we take our armature and put on three coils and have a magnetic field which magnetizes this armature core with a constant number of lines, a number of lines which does not change during the rotation, it is evident then that whatever actions occur in these coils will be accompanied by no fluctuations of magnetism. You cannot generate in a system of coils any difference of condition which is not expressed by the magnetic field in which it is generated. If the magnetic field is constant, than we have constancy of magnetism in the core; that is, we have no fluctuations. Now it would seem to me, that putting another armature in connection with these corresponding terminals and having a magnetic field for it of constant strength, we would have a rotating field produced in this second armature which would result in the rotation of the armature itself; that is, the tendency to rotate the field would turn the coils backward and this would seem to indicate that under certain conditions we can, with the ordinary arrangements, produce exactly what we want, steady rotative effect without magnetic fluctuations, which would go to bear out the Ferraris idea. Now how far the production of a rotating magnetic field in the presence of a short circuited armature may modify these conditions I have not investigated. It does seem to me, however, that in such case the remarks of Mr. Steinmetz are quite true, that we will have a large self-induction on a light load in such a motor and therefore a waste current, a leakage current corresponding to the leakage current in the transformer. Just how much it will be, will of course depend on the general design and the proportions and of course on the frequency of the alternations. I think the system demands that the frequencies shall be much less than we are accustomed to use in transformers for lighting. That the system will have a considerable application I have not the slightest doubt. It will have a large application. Whether the best form of it is not to place two corresponding armatures in fields, or use synchronizing machines is a question. I should say, reasoning at the start, that this is probably the chief merit of the system. We have the possibility of getting rid of commutation on high potential transmission of power by making corresponding machines and running corresponding armatures in fields that are excited. Of course there is a great

desire to get a motor which shall enable us to get rid of this constant excitation, and which will give us the power of starting under load. The generator reversed and used as a motor, demands that in starting the generator shall also start, that the two machines shall come up together. I have indeed taken one Thomson-Houston arc machine and put on three rings and simply delivered the current by three rings to the armature of another machine, and it would start and run up to speed having no load on it, at least no large load. It would get into synchronous rotation when the power delivered is, after exciting the field fully, considerable. I have constructed some small machines which are almost exactly like Fig. 10. There are six coils on the armature and a field excited separately. The field, by the way, rotates, and the angle covered by the field poles is about what is covered there, Fig. 10. I have no indication at all of anything wrong with these machines. They work, we think, perfectly, and so far as the heat generated in the armature goes, it is remarkably small. It is no greater, from actual experiment, than one would expect from an ordinary machine with a commutator. In fact it is probably less. Probably more fluctuation is introduced into the magnetism by the commutation than there would be in this case by the simple use of three coils without commutation. I would say further that I have never had much confidence in some of the reasoning of Mr. Dobrowolski in relation to this matter. I have always thought that he was a little out in his argument He has attempted to show how by using three phased currents he could get polyphasal currents from them, by winding the armature in a different way. It strikes me as nothing more than spreading that coil over a certain angle of the armature surface. This, of course, would prevent sudden, sharp jumps in the field, and might be useful, and undoubtedly is useful in the perfection of a motor working upon a closed circuit armature. These matters of discussion would undoubtedly be best settled by a simple experimentation on the basis of what I indicated a little while ago. It may be that the very fact of the differences of composition of the wave may make a very great difference in the effect. We may not be called upon to reason upon fluctuations of magnetism due to sine curves when those sine curve currents are put in different angular positions

I would say that there is another matter which probably ought to be taken into consideration; that is, that a mass of iron does not always change its magnetism when you think it ought to. It may hold up by its own inherent property of disregarding reversal; by hysteresis. This would tend in fact to hold the magnetism up rather than to allow it to suffer fluctuation. We know that in a closed circuit transformer it is necessary to put energy into the iron to cause it to drop its magnetism. It would tend to remain magnetized if we cut off the current at any portion of a wave, at least up to a certain point, and this would tend to help us out in this very matter of getting rid of fluctuations of magnetism, which, of course, would be a serious loss of energy in the case of large bodies of iron, the magnetism of which should be allowed to go up and down through large ranges. There is another matter, too, that comes in here; it is whether we get in the motor or in the machine a motion that is equal velocity—that is whether it is, an even pull all the way around, the sum of the magnetic lines being the same, or whether it is a jerky motion—a motion of difference of velocity. Of course it will naturally be seen at once that unless we get a perfectly uniform flow our efficiency could not be as high in the case of a fluctuating movement of the lines and the lines which hesitate and then move forward and then hesitate again, and then move forward, that would be only efficient in case the armature was negligible which, of course, could not be the case.

C. S Bradley: It is difficult to test the efficiency of the different armatures. But I have always had an idea that the closed coil armature was exactly adapted to the carrying out of the three phase, because the currents can pass in more directions. There are more subdivisions than there are in the open circuit; with three open coils the position of each would determine its phase. But if it were completely closed and taken out at three points, there is a chance for two wires to operate and leave the third one nil, and the current has a chance to pass clear around the armature; that is, it will pass 120 degrees on one side and 240 degrees on the other side, making a multiple arc circuit. In other words the closed coil armature carries out the plan of Dobrowolsky, and does exactly what he is trying to do by placing on the extra coils without the extra coil.

Prof. Thomson: I think that matter is made clear by considering the movement of the armature with respect to the lines. It does not seem to me to make very much difference what the coil is, providing the two armatures are connected similarly. The movement of lines in one will be reproduced in the other, provided of course that the order of the connections and the symmetry of the apparatus are preserved.

Mr. Bradley: I tested machines running that way. They were direct current machines changed to the three ring type. I first ran them as direct current machines, and then put three rings on each one, connected them up, and ran them together. I found the machines ran so near alike that I could not detect the difference.

Prof. Thomson: It might interest the members for me to say that at one time, I think it was about 1882, I happened to have a three coil arc machine that had three rings on the shaft, and I discussed with my assistant, Mr. Rice, this matter of connecting on three rings on two machines and we found that the machines would work well as a means of transmitting power. But we had not facilities for building such apparatus in any quantity.

A. E. Kennelly: We are face to face with a condition in the art of electrical distribution which is not only somewhat novel, but is also very intricate, and consequently any assistance, even of the most elementary description, which will enable us to fathom the mysteries of this difficult system of distribution should be only too gladly welcomed, I think, at the hands of this institution We have presented to us in this paper a mathematical disquisition on the very simplest and most elementary type of the three phase generator in which it is assumed that there is no armature reaction, no hysteresis, and no eddy currents. Under these conditions, just as in the corresponding ideal transformer with constant coefficients which has been called by some one the "phantom" transformer, that we all aspire so much after, but so very seldom see—the fundamental operations of this particular machine are readily capable of being analyzed by the skill that has been presented in this paper. I think that we should be content to take one subject at a time, to consider that we have arrived at a position where modifications which will certainly present themselves by disturbing influences, will ultimately resolve themselves into this fundamental type, as they are lessened and removed. This is the starting point, so to speak, from which the various roads branch from the theoretical machine to the practical machine. I think, therefore, that while the paper gives us what may be called almost a little discovery in its way in practical mathematics, that it should be treated for its own value on the side of a mathematical essay, and not brought into the question of practical and everyday machines. We have the very remarkable fact that although the electromotive force which is capable of being produced by a complex condition of magnetic fields can be a uniform one and while the currents which are set up by the electromotive force cannot possibly be the prototype of the electromotive force, graphically, when there is any self-induction in the circuit, yet that under the influence of mutual induction, that prototype may be restored. That is a beautiful conception, even though it may not have a very direct bearing on the practical side of the question. It seems to me that the practical issue of the question is not whether we can produce artificially and with considerable care a constant rotary magnetic field or a constant rotary electromotive force. By theory we can produce any continuous curve; and any periodic wave can be established as the resultant of a number of simple harmonic waves. It only is a question of how many compounds we want. Sometimes we should want an infinite number. But however interesting that may be from the theoretical point of view, the next step in this difficult pathway which has been outlined here to night is not how to produce perfection, but how far differences from perfection will affect the practical result; not how necessary it may be to have a perfectly continuous field, but how far the fluctuations which will almost inevitably present themselves will affect the efficiency and efficacy of these particular machines. At the same time while we have to remember that the paper is a theoretical disquisition, it is also the first step toward practice, because theory follows ever slowly in the steps of practice, and it is in the direction of such theory that we have to hope for the ultimate apprehension of all the difficulties before us.

Dr. Pupin: The method which I have employed, as Mr. Kennelly remarked, is to go step by step from the ideal to the more and more practical, and see what the real difficulties are. The authorities on theoretical electrical engineering invariably consider the simple sine waves whenever they discuss the subject of periodically varying electric currents. Nobody has ever taken up the problem of complex harmonic waves. We really do not know what a complex harmonic wave will do. There are no quantitative relations. I think that I have shown in this paper what a complex harmonic current wave will do in a particular case. Mr. Steinmetz has pointed out that a combination of two simple sine waves can produce the same thing which I claim for the complex wave. But the correctness of his statement requires the employment of a homogeneous magnetic medium in which his two coils are to act.

The remark of Prof. Thomson with reference to the machine which he put on the blackboard, three coils rotating in a uniform field, has been answered in the very beginning of my paper They will produce a constant rotary field although the producing field, the exciting field, is constant. The relation of the coils with respect to the exciting fields is continually varying, and the electromotive force produced in each one of those is a simple sine wave. As long as we have simple sine waves and three phases, there will be a maximum variation of fourteen per cent. no matter what you may do. Now wind the three wires on a piece of iron. The neutral wires will produce no magnetization. The three wires, if they are wound around the same coils in the same way, will also produce no magnetization. So I do not think that the experiments suggested by Prof. Thomson could give us any record of any fluctuations in the rotary field.

Electrical Department at Cornell.

Prof. R. C. Carpenter contributed an article on the "Technical Schools of America" to a recent member of *Cassier's Magazine*. Discussing the Sibley college laboratories of the Cornell University, he refers to the electrical equipment as follows:

"The laboratory of electrical engineering is well equipped with dynamos and electric motors of all the principal manufacturers of this country, donated for this purpose to Dr. Thurston in order to provide for the practical education of electrical engineers.

"The investigations that have been made in this laboratory in the past under the direction of Prof. W. A. Anthony, and in more recent times by Profs. Nichols, Ryan and Mohler, have made the laboratory famous and well known to every electrician in the country.

"The course of instruction is in charge of the department of physics, and requires, first, a sufficient amount of practice to render the student familiar with electrical measurement and electrical apparatus; second, the actual work with this apparatus, and the making of efficiency tests of the various electrical machines; and third, research and investigation of matters of importance to electrical engineers.

"All students in the course of electrical engineering devote eight to twelve hours per day during the last two years of the college course to this work."

CORRESPONDENCE.

New York Notes.

New York, January 9. The mayor's annual message to the common council was submitted January 4th. Mayor Grant thinks that the decrease in fatal accidents resulting from overhead wires, despite the great increase of electrical business, is an evidence of the wisdom of the efforts made by the administration to place the wires under ground. In substantiation of these views the following interesting statistics are given in the message: "One fatal accident, in which death was caused by a fall from a telegraph pole, is the record of the year. In 1889 five deaths from actual electric shock were reported. There has also been a noticeable improvement, especially in the lighting service, from the use of the subways. The year's work under the Board of Electrical Control comprises the removal of 5,224 poles and 7,152¼ miles of wire and the construction of 114 miles of subway. The capacity of this subway work is as follows: Forty-seven miles for electric light service, 721 miles for telephone and telegraph service, and 121 miles for Edison light service. There are now in use in the city 1,420 miles of subways, divided as follows: Electric light subways, 578 miles; telephone and telegraph subways, 721 miles, and Edison subways, 121 miles. There are at present 59 alternating and 84 arc circuits, making a total of 143 high tension circuits in use in the subways, with 528 miles of electric light conductors. There are 29,666 miles of telegraph and telephone wires and 383 miles of Edison conductors."

These reports, Mayor Grant thinks, are conclusive evidence that from an electrical standpoint the operation of the subways is a success.

While writing of the message mention must also be made of the fact that his honor recommends the establishment of a municipal telegraph exchange to connect the departments and other points between which communication is necessary and desirable. This service is now performed by several independent and inadequate systems, each department having its own, without uniformity of plan or of efficiency. All the departments, he thinks should be connected by wire with a central station controlled by the city government, in which the city's operator could connect any two wires called for, as in the telephone exchanges. Each office should be provided with either a dial telegraph, a ticker, or other instrument, which would transmit the messages as rapidly as if they were written. The expense would be very light, as the city owns privileges in the use of the subways.

He adds further that the advantages of a single system by which any official could reach any point would greatly facilitate the transaction of the business of the city and add to the efficiency of those departments whose duties involve the protection of life and property. The points to be connected might well include the police and fire department buildings, the public offices and the hospitals. It might be found desirable also to throw open these facilities to the public to the extent of permitting theaters and other places of public resort to be connected with police and fire headquarters at a charge which would pay the expense of the service, and yet be much lower than similar service now costs.

The Pennsylvania Railroad company, with its usual quickness to appreciate a good thing, will employ electromotive power on one of its projected lines The line referred to extends between Jersey City and Newark. B. M. and J. T. Shanley have the contract to build the line, and work will have been started by the time this letter reaches its destination. The construction will be begun at points between the Passaic and Hackensack rivers, on each side of the plank road, and the road-beds will run through the meadows in the direction of both cities. The road will join the Market street and Irvington line in Newark to the Jersey City and Bergen electric road, and will pass through four and one-half miles of open country upon which there is hardly a house, and no solid ground to build upon. The maximum of speed will be attained in crossing the meadows. The distance from the ferry to Irvington is twelve miles, five miles of which is through crowded parts of Newark and Jersey City, and the rest is territory in which high speed will be admissible. The Pennsylvania Railroad company owns the Jersey City and Bergen railroad.

At the meeting of the gas commission on Monday some of the contracts for lighting the streets for the year were awarded. The electric light companies that offered to supply the same lamps they lit last year at the same rates had

their contracts renewed. The average price paid is about 40 cents per lamp per night. No awards were made on those of the electric light bids which were higher than the prices paid in 1891. These were laid over for future action.

An injunction has been secured for Martin A. Frank from Justice Andrews of the Supreme Court, restraining the Edison Electric Light company and the Edison General Electric company from declaring a dividend of 80 per cent., payable in collateral trust debentures of the Edison Electric Light company, and from paying the same.

Proceedings have been begun for the voluntary dissolution of the West Coast Telephone company and the Telephone Construction company. Orders to show cause why these companies should not be dissolved were granted Monday by Justice Barrett in the Supreme Court, and were made returnable April 6th.

The electric light companies have had a hard time, indeed, but it seems that the city authorities are determined, and the poles must go. The lighting companies have had to agree that the poles and wires which the Board of Electrical Control ordered to be taken down within ninety days from October 12th be removed before the middle of this month, and at their own expense, too. The district in which the removals are to be made is the one in which the high tension wires are most dangerous and objectionable. The poles on Broadway from the Battery to Fulton street, are to be removed by Sunday, and those on Broadway from Fulton street to Houston street are to be taken down with in ten days.

The Brooklyn street railway people have, doubtless, the sympathy of most of the electrical fraternity. For weeks they have been working to get permission from the board of aldermen to adopt the trolley system on their lines, and just as they are about to succeed, a new mayor comes in and with a caution that is, of course, very natural, wants to think awhile. The result is his veto, and with him, at least, the work will have to be begun again. Mayor Boody says in his veto:

First—While it may be shown that the proposed method for propelling street cars is in successful operation in certain cities of the country, it cannot be said that any city of the size of the city of Brooklyn has felt justified in adopting that system.

Second—The resolutions grant important privileges which impose new conditions on our citizens, but for which the city receives no equivalent.

Third—It is claimed that the proposed system is dangerous to life. While it is true that we are called upon to yield many of our personal conveniences for the public good, no citizen in the time of peace can be justly asked to hazard the loss of life or limb. No amount of material benefit can compensate for the loss of one life.

Without further discussing the subject at this time, I am clearly of the opinion that it is my duty to return the resolutions for the further consideration of your honorable body.

It is reported, however, that Mayor Boody made the remark that "if the companies can prove to me that the trolley is not fatal to animal or human life, I might approve it."

As the mayor has always been opposed to the trolley as dangerous to life and injurious to property, and he appeared before the state railroad commission and argued against the substitution of the trolley on the Seventh avenue road, some believe that his veto is merely an act of consistency.

It is reported that there is to be a consolidation of central New Jersey electric lighting companies, and the large corporation will absorb all the companies with the object of monopolizing the lighting of the towns lying between Plainfield and Elizabeth. It is said that the Elizabeth Electric Light company has already been bought out by the corporation, and also that an alliance with the Plainfield company will soon be consummated. The project is strongly opposed in Westfield, as the townspeople had about completed arrangements to have a plant of their own.

The controversy between the ticker people and the Stock Exchange came to an end on Friday. The Western Union company, which owns the Gold Stock ticker, had to surrender to the exchange. One hundred dollars a day payable daily at the close of business, was the price asked by the Stock Exchange for the privilege of obtaining quotations, and the Gold Stock Telegraph company agreed to pay this price. In addition to this, the Stock Exchange reserves the right to scrutinize the list of customers of the Gold and Stock company, to see that the bucket shops are not among the number. The agreement is revocable at one day's notice, at the pleasure of the Stock Exchange. Although the ticker people call the present settlement a temporary arrangement it is believed that the matter is permanently settled for all time. While the Stock Exchange insists on its right to revise the list of subscribers to the ticker service, it is considered that this also will probably be largely a formal right.

There seems to be no danger that the Consolidated Exchange will be cut out of the service. It will be enough for the Stock Exchange to know that it has the unquestioned right to do so, but since nothing is clearer than that the Consolidated can get the quotations in some way, there seems little danger that this source of information will be shut off. W. F. O.

San Francisco, Cal.

SAN FRANCISCO, January 5.—On New Years eve the trouble that has been pending between the Order of Railway Telegraphers and the Southern Pacific company for the past six or eight months was amicably settled by the signing of an agreement between Acting Grand Chief Ramsey, representing the order, and General Manager A. N. Towne of the company. An examination of the terms of the agreement show it to be a virtual victory for the order. First and above all the objectionable affidavit which the company required all operators to make, to the effect that they had not or would not join the order, was annulled by the company, and recalled. "The Southern Pacific company," continues the agreement, "will henceforth have no objection whatever to its operators becoming members of the Order of Railway Telegraphers and those seeking employment who are members of said order will not be discriminated against on this account." The company also agrees to the re-employment of the striking telegraphers as nearly as practicable in their former positions, some to resume work at once and the remainder within the next fifteen or twenty days. The other vexed question as to the student telegraphers was settled by the following clause:

That in so far as the Southern Pacific company is concerned the student regulation contained in the ritual of the Order of Railway Telegraphers heretofore enforced, requiring members of the Order of Railway Telegraphers to first have the sanction of the grand chief telegrapher, attested to by the grand secretary under the seal of the Grand Division, before accepting students in their offices, shall be inoperative and shall have no force or effect, but in lieu thereof, whenever officials of the railroad company place students in the offices of the Southern Pacific company the members of the order will be permitted to notify the grand chief telegrapher, giving the date a student may be placed in his office, the student's name and the name and title of the official of the company who placed him there.

Mr. Ramsey will use his best endeavors to keep in this district of the Order of Railway Telegraphers officials who are not obnoxious to the railroad officers, and who will use their best efforts to work in harmony with railroad officials.

After the agreement had been signed Mr. Towne telegraphed instructions to all division superintendents of the system to advise all operators at once by wire of the amicable adjustment of the difficulty, epitomizing the terms of the agreement. New Years day was marked by two events of importance to the Order of Railway Telegraphers. The order gave up the rooms on Eighth street, Oakland, and which were occupied as headquarters during the strike; the sign, "O. R. T." was taken from the door, and thus the last vestige of the recent trouble was removed. Event No. 2 was, perhaps, of greater significanee. The Southern Pacific company, with uncharacteristic generosity, placed a special car at the disposal of Acting Grand Chief Ramsey and party, and took them down to Monterey—'California's Favorite Winter Resort"—where they were dined, wined and entertained as the guests of the great corporation. Thus ends a struggle which at one time threatened to extend all over the country, and even to rival the Western Union strike. S.

Milwaukee, Wis.

MILWAUKEE, January 9.—It was a happy New Year, indeed, for the people who live along Walnut street and National avenue. On that day the operation of the longest line of electric railway in Milwaukee was successfully commenced. The line extends from the western end of Walnut street down to Third street, thence to Sycamore, thence to West Water, thence to Reed street, thence to National avenue, and thence to the Soldiers' Home. The National avenue line had been in operation for several weeks. At 10 o'clock on the forenoon of New Year day a car left the corner of Reed street and National avenue to make the trip over the rest of the line. George Kuemmerlein, one of the old employes of the Milwaukee City railway, was at the motor; Manager Hommel was at his side, and Manager Lynn of the Cream City division operated the signal bell from the rear platform. Inside were Vice-president Coyne and other officers of the Villard company, as well as a number of city officials. The car was gaily decorated with flags and bunting, and received an ovation all along the line. There were cheers and waving handkerchiefs everywhere. At a meat market a woman waved a string of bologna sausage about two yards long and another woman swung a dressed goose over her head. These incidents convinced Manager Hommel that the electric car was welcome to the fat of the land. But a different kind of a greeting was experienced when Fond du Lac avenue was reached. Some wag had circulated a report that the Villard syndicate was going to take possession of that thoroughfare by running a storage battery car right over the street and when the electric car reached that crossing on its way up Walnut street it was found that a barricade across Fond du Lac avenue had been erected and that people armed with clubs, brooms, barrel staves and the like were standing around ready to defend the crossing. The car continued up Walnut street, returned, and then made a trial trip out on Third street. Everything worked satisfactorily, notwithstanding the fact that work had been pushed night and day for some time in order to allow cars to run on New Year day. At noon electric cars began running regularly on the Walnut street and National avenue line. A few days later the Third street line, extending from National avenue to Williamsburg, a distance of more than three miles, had been put into operation. Later still electric cars began running from the Union depot along Third street to Chestnut street and thence west to the city limits on the latter thoroughfare. Horse cars will run until spring on the Broadway branch of the Chestnut street line. No electric cars will run on West Water street between Sycamore street and State street. The horse and electric cars only use the same tracks at the south end of West Water street and a few blocks at the north end of Reed street. The Washington, State and Eighth streets and the Greenfield avenue lines are the only branches of the old Milwaukee City railway that remain to be equipped with electricity, and work upon them will be commenced in the spring. At the same time work will be resumed on the Bay View line and begun on the Forest Home branch of the old Cream City railway. Some of the proposed extensions will also be pushed in the spring, and by midsummer Milwaukee will have a complete network of electric lines in operation.

Together the single tracks of the Cream City and Milwaukee City systems amounted to seventy-five miles, of which forty-five miles have already been rebuilt and made ready for operation by electricity. The electric lines have given great satisfaction to the public and their owners. The service shows a wonderful improvement and it is hardly probable that the expense of operation is as great as before. On the Farwell avenue line, where thirteen cars were formerly used, twelve only are used now, but they run four minutes apart, whereas the horse cars used to run five minutes apart, and the line has been extended since the introduction of electricity.

The Milwaukee & Whitefish Bay railroad, which was purchased some time ago by the Villard syndicate, has been formally turned over to Manager Lynn of the Cream City division. The city terminus of the line is now at North avenue. It runs along Farwell avenue, Bradford street and Glen avenue. There is little doubt that the Farwell avenue line will be extended next year along those thoroughfares, so as to tap Lakeside Park, in which case connection with the dummy line will be made about a mile farther north. The dummy line will undoubtedly do an enormous business next summer. The completion of the down town electric lines and the North avenue line will give people in all parts of the city rapid transit to Whitefish Bay, and probably at reduced cost.

The Milwaukee & Wauwatosa Rapid Transit company has taken possession of the Wauwatosa electric light plant, which it bought a few weeks ago. The Rapid Transit line will be in operation by May 1st. It is said that trains will arrive and depart every fifteen minutes and that the distance between the city and Wauwatosa will be made in half an hour.

Judge Johnson of the Circuit Court has ordered Barbara Donaldson to submit to a physical examination in her suit against the West Side Railway company. She was injured in a street car and demands $20,000 damages. She is a teacher of of drawing and painting, and is now at Kansas City.

Mary Hardy has begun suit against the Milwaukee Street Railway company to secure $20,000 damages. She was injured in alighting from a Farwell avenue car and claims that the company and its employes were to blame for the accident.

Chief Engineer Meyer of the Villard system whose resignation took effect on January 1st was presented with a gold watch by his associates.

A break in the river connections stopped the Farwell avenue and Walnut street and National avenue cars on West Water Sycamore and Third streets for half an hour last Saturday.

The cases of Philip Stock and Fred Zantke against the Milwaukee City Railroad company have been discontinued.

An accident to the machinery at the power house necessitated the running of horse cars on the Becker line for a few hours last Sunday.

The injunction proceedings instituted by the Milwaukee

Light & Power company against the city have been quashed by Judge Johnson and the contract between the city and the Badger company, by which the latter is to furnish arc lights for four years at $110 per lamp per year, has been signed. Judge Johnson decided all of the disputed points except the last one in favor of the Milwaukee Power & Lighting company and until the last moment it looked as though the city and the Badger company had been defeated. He overruled the city's claims that the issuance of the writ was premature, and that the parties who secured the writ were not sufficiently interested. The city charter he held, allowed the city to buy the royalty on a patented article, but does not authorize the making of a contract with a patentee. Competition in street lighting, the court held, was impossible, and the gas company's case was cited in support of this position. It was held that the electric lights were not an improvement and did not come within the charter provision which requires that all contracts shall be let to the lowest bidder. He pronounced the opinion of ex-City Attorney R. N. Austin that the bids must be advertised for an error. It was a service that the electric light company rendered the city, and the common council, which passed the resolution authorizing a contract with the Badger company, although the latter had made no bid in response to the advertisement, had a right to determine by what kind of light the city was to be illuminated. The court quoted President Harrison's opinion that the competitive bid system for public work is not the best system. It generally meant cheap work, and not good work. Attorney Rose, in behalf of the Milwaukee Power & Lighting company immediately asked the court to grant a stay of proceedings, but City Attorney W. H. Austin objected. The city, he said, had no electric light contract, and might be left in darkness. It was also paying the old rate of $112.50, while the new rate would be $110. Judge Johnson promptly refused to grant a stay of proceedings. The lighting of the city could not be stopped, he said, and the Milwaukee Power & Lighting company had no lamps hung over the city, and could not do the lighting if it had a chance. Attorney Rose said he would appeal to the Supreme court, but afterward changed his mind.

The Villard people are aiming to replace the present 12-foot and 14 foot cars with 16-foot and 18-foot cars. Sample cars have been ordered from half a dozen firms. From the J. M. Jones' Sons company of Troy, N. Y., a fine large open car has been ordered. It has eight wheels and can seat fifty people. From a Minneapolis firm three cars have been ordered, and one of them has arrived. It is elegant and comfortable and 18 feet 7 inches long. The Stephenson company of New York, the Ellis Car company of Amesbury, Mass., and the J. G. Brill company of Philadelphia have been given orders for extra cars. C.

PERSONAL.

W. L. Adams has been elected secretary and treasurer of the Electric Merchandise company, Chicago, in place of Mr. England, who resigned recently.

Herbert H. Eustis, president of the Eastern Electric Cable company, Boston, was in Chicago last week. Mr. Eustis made a flying trip, remaining in the city only one day.

NEW INCORPORATIONS.

S. D. Warfield company, Baltimore, Md.; capital stock, $100,000; to manufacture machines and electrical apparatus.

Pneumatic Transit company, Camden, N. J.; capital stock, $500,000; operating and using pneumatic and electrical inventions.

Cortland & Homer Electric company, Cortland, N. Y.; capital stock, $50,000; the manufacture and use of electricity for light, heat and power.

Edison Sault Electric company, Sault Ste. Marie, Mich.; capital stock, $57,000; to supply electric lights; H. W. Oren, Sault Ste. Marie, Mich.

Roland T. Oakes, Holyoke, Mass.; capital stock, $8,000; general electrical work, also dealing in electrical supplies and other merchandise.

National Storage Battery company, Troy, N. Y.; capital stock, $5,000; the manufacture and sale of storage batteries and other electrical appliances.

Charleston Electric Light company, Charleston, Mo.; capital stock, $6,000; to establish and maintain an electric light plant; J. J. Russell, Charleston, Mo.

Edison Electric Illuminating company of Coney Island, Coney, Island, N. Y., capital stock, $50,000; to manufacture and use electricity for light, heat and power.

Lancaster & New Holland Electric Railway company, Lancaster, Pa.; capital stock, $150,000; operating an electric railway; B Frank Eshleman, Lancaster, Pa.

The Suburban Electric company, Elizabeth, N. J.; capital stock, $300,000; to buy, sell and deal in gas, steam and electricity, etc.; F M. Voorhees, Elizabeth N. J.

Neutral Storage Battery company, Newark, N. J; capital stock, $300,000; to manufacture and to sell batteries for the storage of electricity; E. C. Harris, Newark, N. J.

Hart & Hegeman Manufacturing company, Hartford, Conn.; capital stock, $21,000; to manufacture all kinds of electrical machinery; Frank E. Hyde, Hartford, Conn.

Paris Electric Light and Railway company, Paris, Tex; capital stock, $300,000; to manufacture gas and supply light and electric power, and operate a street railway; J. J Walsh, Paris, Tex.

Helena Rapid Transit company, Helena, Mont.; capital stock, $500,000; to build, construct, own and operate a power plant and an electric light plant, and to operate and maintain street railroads.

Castle Electric company, Castle, Mont.; capital stock, $50,000; dealing in all appliances necessary to the production of electricity and utilizing same for lighting, power and manufacturing purposes.

American Aluminum company, Denver, Colo.; capital stock, $2,000,000; to manufacture aluminum and magnesium by electricity and other processes, selling and dealing in aluminum and other products, etc.

Westmoreland Electric company, Greensburg, Pa.; capital stock, $50,000; supplying light, heat and power by means of electricity to the borough of Greensburg, etc.; Beacon & Robinson, Greensburg, Pa.

Hall Chemical & Gas company, Chicago, Ill.; capital stock, $1,500,000; to manufacture and sell machinery and appliances for electrical and other purposes; Eastman & Schumacher, 90 La Salle street, Chicago, Ill.

Duquesne Heat, Light & Power company, Duquesne, Pa; capital stock, $20,000; supplying heat, light and power by means of electricity to the public in Mifflin township; J. R. McQuaid, 154 Fourth avenue, Pittsburg, Pa.

Dixon Power & Lighting company, Dixon, Ill.; capital stock, $75.000; to manufacture and sell gas, electricity, and any other illuminating agency for lighting, heating, power and other purposes; A. C. Bardwell, Dixon, Ill.

B. B. Electric Supply & Construction company, New Whatcom, Washington; capital stock, $1,000; to deal in and operate electrical plants, machinery, supplies and fittings, etc.; Lewis Stenger, Box 401, New Whatcom, Wash.

American Watchman's Time Detector company, Jersey City, N. J.; capital stock, $100,000; to manufacture and sell electrical clocks, electrical fire alarms and other electrical and mechanical appliances; Cravath & Houston, 120 Broadway, New York.

Montgomery Electric Light & Power company, Montgomery, W. Va.; capital stock, $50,000; manufacturing, distributing and supplying electricity for lighting and motive purposes in and about the town of Montgomery; Brown & Jackson, Charleston, W. Va.

Electric Power Transmission company (incorporated in W. Virginia), Boston, Mass.; capital stock, $500,000; Buying, owning, selling, mortgaging or otherwise incumbering water powers and electric plants of all kinds and operating the same; C. S. Knowles, 553 State street, Boston, Mass.

Marshall Electric company, Marshall, Ill.; capital stock, $20,000; to construct, maintain, use and operate an electric light and power plant, with all necessary appurtenances in the city of Marshall and furnish light and power for the city and its inhabitants; C. C. Travis, Shawneetown, Ill.

Mercantile Telegraph company, Chicago, Ill.; capital stock, $100,000; to transmit intelligence to a distance by means of electricity and magnetism; to construct telegraph lines between the respective states and territories of the United States and engage in a general telegraph business; Moses & Pam, 122 La Salle street, Chicago, Ill.

City Electric Railway company, Decatur, Ill.; capital stock, $300,000; to purchase, construct, operate and maintain a system of street railways in the city of Decatur, Ill., and adjacent territory, and furnish motive power for mechanical, manufacturing, lighting and heating purposes; Shellaberger Mill & Elevator company, Decatur, Ill.

ELECTRIC RAILWAYS.

The Tacoma Railway & Motor company proposes to increase its capital stock from $500,000 to $750,000.

There is a project for an electric passenger and freight railway to connect Petaluma and Santa Rosa in California.

Citizens of Finlay and Fostoria are pushing a scheme to connect the two cities by an electric street railway. The distance is sixteen miles.

A freight car on the Kansas City, St. Joseph & Council Bluffs railroad crashed into an electric street car on January 6th. Nine passengers were injured.

The Oakland, Cal., Railroad company has petitioned the supervisors for permission to substitute electric power for horses on the Telegraph avenue road.

The Woodland avenue and West Side Street railway of Cleveland will be equipped with electricity as soon as possible. Two power houses will be erected.

The electric cars in Paterson, N. J., began making regular trips December 14th on fifteen minutes' headway, between Passaic and the corner of Main and Market streets. There is now complete electric communication between the centers of Paterson and Passaic, a distance of about five miles.

Great improvements are to be made by the Muskegon, Mich., Street Railway company. It is to increase its power by the addition of a 250 horse power engine, and a new dynamo. It also contemplates extending the line to North Muskegon, and making a loop line of the Sanford street route.

The long fight between the city of Vicksburg, Miss., and the street railroad has finally culminated in the execution of the former's repeated threat to destroy the road's track. The railroad company made no effort to stop the work by injunction, but, it is understood, will sue for damages in the courts.

The Springfield Street Railway company's stables were lately damaged by a fire which originated from a furnace and soon reached three barrels of oil, which exploded. The flames spread rapidly, but all the electric cars on the ground floor were removed without loss. The damage to the building is estimated at $10,000, fully covered by insurance.

A syndicate of Rochester, Syracuse, Boston and Providence men has taken possession of the Globe Street Railway company of Fall River, Mass. The deal was made eight months ago, the syndicate agreeing to buy up the road for $6,000,000, which is twice the amount of its capital stock. Electricity will be substituted for horse power as soon as weather permits.

The Saginaw Union Street Railway company is having prepared plans for a new power house to be erected this winter at some convenient point on the river front and which, with engines, boilers and buildings, will cost about $25,000. It will be provided with four 150 horse power engines, three Babcock boilers, and an additional 150 horse power dynamo.

The length of single track in the proposed electric road from Montreal is given as about twenty miles, and about fifty cars will be used. The line inside the city will be a girder rail, outside the city a T rail of fifty-six rounds. Electricity will be the motive power used. As soon as a franchise is obtained a company will be organized under the charter of the Montreal Elevated Railroad company, with a capital of $1,000,000. If the franchise is awarded building will commence about next April.

The commissioners of the Queen Victoria Jubilee Park at Niagara Falls, Ont., have reached an agreement with the syndicate that proposes building the electric railway along the bank of the Niagara river. This line will in time run from Niagara, on the lake, to Fort Erie, but for the present work will be done only on the section between Chippewa and Queenstown. The syndicate, it is said, gives a bonus of $10,000 and agrees to pay a rental of $10,000 a year. Surveyors are now mapping and staking out the route.

TELEPHONE.

It is rumored that the Canadian Pacific Railway company intends to start a telephone company in Montreal in opposition to the Bell company.

A Boston press dispatch says that the American Bell Telephone company has perfected a telephone by which whispers can be transmitted 500 miles with perfect distinctness.

Some one who is credited with being an authority, says the *Boston Traveller*, estimates that the net earnings of the Bell Telephone company for the fiscal year just ended will not be far from $3 098,971, or 20.7 per cent. on the $15,000,000 of capital stock.

TELEGRAPH.

India is making rapid strides in the matter of its telegraphic communication. While in 1886 there were only 82,000 miles of wire, the latest report gives the number of miles of wire in existence as 113,000.

The Postal Cable Telegraph company has completed its line from Savannah to Charleston, by the country roads, instead of following the railroad. To do this it was necessary to lay a 1,500 foot cable across the Savannah river.

The Supreme Court of Pennsylvania, in the case of Tobias vs. the Western Union Telegraph company, has reaffirmed an old decision that the condition exempting the company from liability for error in repeated messages has no application to the recipient of the message, and that when he suffers from such error the company is liable.

A glance through the code of instructions issued by one of the big cable companies shows that there are a number of places which rarely appear upon the map that may be reached by wire from this country. For $2.25 per word one may communicate from New York with the hectic town of Pram Pram, upon the west coast of Africa, while connections can be established with the lively hamlet of Grand Bassam, in the same region at $1.04 for every ten letters. For $1.17 per word you may address your long-lost relatives or business partners in Djedda, Mecca and Al Hedjas, while the rate to Bunder Abbas, Bassidore and Lingah is sixty-four cents in addition to the boat hire from Jask, Persia, where the message is delivered. Every word sent to New Zealand, via northern Siberia, costs the sender just $3.74, which is the highest rate on the list. It costs sixty cents a word to reach Remanganaguas and Aquada de Pasageros down in Cuba, and $1.88 to telegraph to the people in Sungie Ujong, on the Malay Peninsula.

MISCELLANEOUS.

Thomas G. Grier of Chicago has issued a small pamphlet on motor wiring.

There is a good deal of interest manifested in telegraph circles over the relations of the *Sun* and *Tribune* to the New York Associated Press. On the former paper's withdrawal from the association, all the other papers with the

exception of the *Tribune*, published a notice of their allegiance to the old association.

A communication has been received from G. E. Dorman, electrician with the Standard Electric company, Chicago, in which he states that he would propose "to transmit Niagara to Chicago, with 1,000,000 volts. The generators are feasible," says Mr. Dorman. "The question," he adds, "is the insulation of the line."

To obtain heat from water seems strange enough, and yet that is exactly what is proposed in Switzerland. Maloja Kursaal company, Engadine, has resolved to employ electricity for heating its establishments in winter. The water power of the Mera River, in Aserina, Commune of Vicosoprano, will be utilized for that purpose.

TRADE NEWS.

The Star Electrix company of Philadelphia is very much encouraged by the number of orders it is receiving for its new china switches.

Queen & Co. of Philadelphia, have a number of large orders booked for immediate delivery for portable voltmeters for direct and alternating circuits.

Alexander, Barney & Chapin, New York, sent out a New Years card of greeting that does credit alike to themselves and their publishers, Bartlett & Co. It is refreshing, indeed, to have predominating their good wishes rather than the advertising idea, and for this reason the "A. B. C." company is to be congratulated.

The Hart & Hegeman Manufacturing company, Hartford, Conn, has been incorporated with a paid up capital of $21,000. It has also increased its facilities for the manufacture of the "Hart" switch, and will add other specialties to its lines. The officers of the new company are: G. W. Hart, president; G. S. Hegeman, vice-president; A H. Plase, secretary and treasurer.

The Underwood Manufacturing company, manufacturers of belting, 33 South Canal street, Chicago, reports the sale of a large quantity of belting to the Chicago Arc Light & Power company, whose station was recently destroyed by fire. The company has also recently sold the Chicago City Railway company 200 feet of 62 inch belt. Belts have also been ordered from this company for the Masonic Temple, and for the Washburn & Moen Manufacturing company.

The Pelton Water Wheel company, New York city and San Francisco, Cal., has recently issued a new edition of its catalogue which embraces a vast amount of tabular and descriptive matter relating to the means of utilizing water powers by the Pelton system, making a most valuable contribution to modern hydraulic literature. Much attention is given to the subject of the generation of power for electric transmission. The system here described by the Pelton company makes possible the utilization of this source of energy under a wide range of conditions, and with a remarkable degree of economy, simplicity and efficiency. Engineers and others interested in the development of water powers will be furnished a copy upon application.

BUSINESS.

The Tropical American Telephone company, Limited, New York, has removed to 95 Broad street, rooms 303 and 304.

Holmes, Booth & Haydens of New York, for the past month have been running over time, in order to fill orders for "K. K. line wire."

One of the latest devices in the way of an insulator is now being manufactured by the Security Insulator company, 136 Liberty street, New York.

H. T. Paiste's New Years postal card would seem to indicate that he is a believer in the doctrine of reciprocity. Doubtless, too, by this time, his many friends, through substantial orders, have signified their belief in his platform.

The Empire China Works, Greenpoint, Brooklyn, N.Y., well known through the manufacture of "true hard porcelain," which is used for cut-outs, switches, etc., have already begun to make this product in large quantities for the spring trade.

The Sawyer-Man Electric company, New York, was compelled to run their factory over time during the month of December. This company is also turning out a fine line of wall sockets, with a porcelain or wood base, and with or without key.

Among the recent purchasers of Ball engines are to be found the following named electric companies; The Attica Electric company, Attica, N. Y.; the Citizens' Electric Light company, Braddock, Pa.; the Youngstown Electric Light company, Youngstown, Ohio.

The Ongley Electric company of No. 1 Broadway, New York, has recently issued a handsome pamphlet describing a new electric system and watchman's register now being exploited by that company. The system includes an efficient device for safety signals for use in large factories, warehouses, etc., enabling the engine to be stopped immediately in case of an accident from a distant point, independent of the engineer, a fire alarm, and a complete check on the movements of a watchman. The system has apparently some new features and is worthy of investigation.

The Lodge & Davis Machine Tool company, Cincinnati, has just issued a handsome mounted hanger that is being sent out to the trade. The following named establishments are using machinery made by this company: Western Electric company and Link Belt Machinery company, Chicago; Westinghouse Electric company, Pittsburg; Lunkenheimer Brass Manufacturing company, Cincinnati, and Detroit Electrical Works, Detroit. Lodge & Davis are among the leading manufacturers of iron working machinery in this country.

The Electric Merchandise company, Chicago, doubled the size of its quarters recently, yet there is not half room enough, it is claimed. The amount of business this company is doing, considering the season of the year, is remarkable. While complete contracts are not in order, large orders for repair pieces are received daily. Brand's steel wire track brooms with Wardwell's patent track broom holders and the Burton electric heaters are in good demand. An order, too, for 3,000 pounds of the Electric Merchandise company's black insulating tape is strong testimony to the excellence of the material furnished by this company. Prospects for the spring business are most encouraging.

The Electric Gas Lighting company, 195 Devonshire street, Boston, has just presented to the trade its ninth annual catalogue and price list, which is to supersede all former issues. In revising this pamphlet, in order to render it more useful and convenient to customers, Vice-president and Manager Louis W. Burnham, has endeavored to exhibit not only the several branches of his company's business, but also to demonstrate, as far as possible on paper, its facilities for furnishing the best class of domestic electrical apparatus and supplies at the most reasonable prices. It was announced last year that the United States courts had sustained the letters patent covering this concern's hand-lighting gas burner. This decision has been confirmed in other cases, and since the last issue all the Bogart patents on electric hand-lighting devices have been purchased and the Electric Gas Lighting company has become the sole owners of these most important patents for hand-lighting gas burners. The company has made many valuable improvements, not only in gas lighting apparatus, but also in the whole line of domestic electrical appliances. These improvements are too numerous for mention, and careful examination of this descriptive catalogue is necessary before the extent to which they have been carried will be appreciated.

The Williams Engine company is the name of a new manufacturing firm that has just commenced business in Baltimore, Md., with headquarters at 447 North street. The officers of the company are Jas. B. MacNeal, president; S. T. Williams, vice-president and manager; W. S. Williams, secretary and treasurer. This company was incorporated Oct. 15, 1891, and purchased all the patent rights of Samuel T. Williams. and the manufacturing will be under the personal supervision of the inventor. The company will build the Williams engines in all sizes—single, cross-compound, tandem-compound, triple expansion, condensing and non condensing, horizontal and vertical—keeping in stock for immediate delivery all sizes up to 100 horse power. The capacity of the factory is such that the company will be prepared to deliver sizes at short notice. In a recent letter to the trade a few of the good features of the "Williams' Automatic" for electric lighting work were set forth. The company claims a perfectly balanced slide-valve; an adjustable cover and relief plate; a governor composed of three pieces; four bearing surfaces with all wear in one direction; noiseless running. Every bearing surface of the governor is lubricated while in action, with no interruption for oiling. Uniform speed is attained under all changes of load. Even with a variation of 30 per cent. in boiler pressure the speed remains the same. Great fuel economy is also claimed.

ELECTRICAL PATENTS.

Issued January 5, 1892.

466,357. Electric Annunciator. Charles Molitor, Chicago, Ill.

466,362. Electric Railway Crossing. William Osner, Chicago, Ill.

466,367. System of Electric Distribution for Railways. Nelson W. Perry, Cincinnati, O.

Claim eight is quoted:

"The combination, in a system of electric distribution for movable translating devices of a sectional current conveyor, switches normally closing the gaps between the sections, magnets controlling the switches, two lines of sectional conductors, subsidiary circuits from the main conveyor through the switch controlling magnets, adapted to be closed as the terminals of a translating device, contact with corresponding sections of the working conductors and become the path for the main current when a switch has been opened, and an electrically actuated signal in the subsidiary circuit."

466,368. System of Electric Distribution for Moving Translating Devices. Nelson W. Perry, Cincinnati, O.

466,391. Insulator. William S. Andrews, New York, N. Y.

466,400. Cut-Out for Incandescent Lamps. Thomas A. Edison, Llewellyn Park and John F. Ott, Newark, N. J.

466,427. Extensible Electrical Conductor. Benton C. Rowell, Boston, Mass.

466,447. Device for Electric Elevators. Rudolph C. Smith, Yonkers, N. Y.

466,448. Commutator Brush and Holder for Dynamo Electric Machines and Motors. Frank J. Sprague, New York, N. Y.

Claim five is presented:

"The combination, with the stationary brush holding frame of the rods passing through the same, the brush carried thereby, the spindle entering said frame, the bridge connecting said rods, and the spring on said spindle between said bridge and the head of said spindle."

466,450. Damper Controller. John V. Stout, Easton, Pa.

466,460. Art of Electrolytic Decomposition. Thomas A. Edison, Menlo Park, N. J.

466,471. Underground Conduit for Electric Railways. Charles P. Tatro, Spokane, Wash.

Claim seven is given:

"The combination in conduits for electric railways of an electric rail located along the road, a wall opposite thereto, and a trolley having two wheels to roll on the rail, and one wheel opposite to and intermediate between the two wheels to roll freely on the wall, there being a yielding connection between one of the said wheels and the trolley body, whereby the trolley is kept in contact with the conducting rail at one side, but is free to move on the other side transversely to the line of travel to conform to the irregularities of the track."

466,492. Cable Telegraphy. Wilson E. Facer, Cleveland, O.

466,505. Combined Electrical Protective and Time Detecting System. Jamin S. Morse, New York, N. Y.

This invention consists of one or more thermostatic circuits with the usual annunciator, alarm bell and battery, a circuit controlling mechanism, an instrument of the nature of an electrical watchman's time detector, and auxiliary circuit connections so combined that the time of every operation of the switch which closes for purposes of testing any of the thermostatic circuits, is recorded as well as the character of the test—that is to say, whether the circuits are complete or interrupted.

466,508. Electric Switch. Gwynne E. Painter, Baltimore, Md.

This invention is an improvement in electro-magnetically operated switches for electrical circuits, and particularly where the circuits are employed in connection with chandeliers or other pendant collections of lamps which it is necessary or convenient to operate from a distance.

466,509. Electric Drop Light. Gwynne E. Painter, Baltimore, Md.

466,510. Electric Lamp Socket Switch. Gwynne E. Painter, Baltimore, Md.

466,511. Electric Lamp Socket Switch. Gwynne E. Painter, Baltimore, Md.

466,513. Ore Separator. Charles J. Reed, Orange, N. J.

Claim four reads:

"In an ore separator a hollow revolving drum through which the ore passes longitudinally in combination with fixed magnets outside of the drum, an air current or blast, and a hopper or feed box."

466,514. Ore Separating Machinery. Charles J. Reed, Orange, N. J.

466,515. Ore Separator. Charles J. Reed, Orange, N J.

Claim seven is:

"An ore separator having a hollow revolving drum provided with a roughened interior surface in combination with a series of magnets exterior to the drum, and attached to a carrier or belt."

466,518. Apparatus for Synchronizing Clocks. Ludwig Von Orth, Berlin, Germany.

466,519. Circuit Controller. Henry P. White, Kalamazoo, Mich.

466,539. Car Truck for Electric Railway Cars. Peter M. Kling, St. Louis, Mo.

466,541. Electric Reciprocating Tool. Harry N. Marvin, Syracuse, N. Y.

The claim follows:

"A generator for reciprocating tools provided with independent energizing circuits, consisting in the combination of a field magnet, a revolving armature, a complete or ring collector forming one terminal of the armature circuit, a partial ring collector forming the other terminals, a single brush bearing on the complete ring and two brushes in position to make contact with the collector alternately, and two working circuits, including, respectively, the coils of the drills and leading from the two brushes of one collector to the single brush of the other."

466,562. Incandescent Lamp. Perrin Grant, Portsmouth.

This invention relates to incandescent lamps, the object being to provide a lamp that may be taken apart at any time for the insertion of a new carbon filament or for making other repairs without destroying the glass globe or any portion of the lamp, and when so taken apart the globe may be cleaned on its interior surface to remove the deposits of carbon caused by the disintegration of the old filament.

466,604. Electrical Signal Box. Thomas F. Gaynor, Louisville, Ky.

466,620. Multiple Signal Transmitter. Charles E. Nash, Newton, Mass.

466,644. Electric Push. John F. Wollensak, Chicago, Ill.

466,664 Electric Battery. Patrick B. Delany, South Orange, N. J.

466,686. Electric Meter. Charles K. Huguet, New Orleans, La.

466,702. Multiple Switch Board Busy Test Circuit and Apparatus. Frank A. Pickernell, Newark, N. J.

466,720. Process of Obtaining Insoluble Chlorides by Electrolysis. Stanley C. C. Currie, Philadelphia, Pa.

466,725. Magneto Telephone for Personal Wear. Alonzo E. Miltimore, Catskill, N. Y.

466,726. Insulator. George B. Norgrave, Philadelphia, Pa.

466,760. Regulation of Dynamo Electric Machines. Rene Thury, Geneva, Switzerland.

The claim is given:

"In combination a dynamo electric machine, generator, or motor provided with a rotatable arm or brush-carrier, collecting brushes and auxiliary brushes applied to said arm or brush carrier, an auxiliary electric motor, differential gearing between said auxiliary motor and arm or brush carrier, a relay for controlling said auxiliary motor, and circuit connections between said auxiliary or tell-tale brushes and relay."

466,761. Safety Fuse for Electric Conductors. James A. Wotton, Atlanta, Ga.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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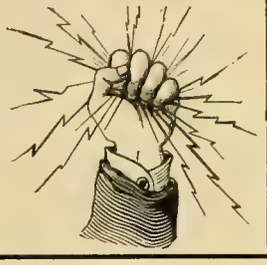

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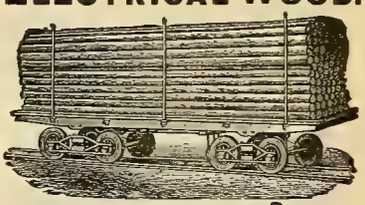

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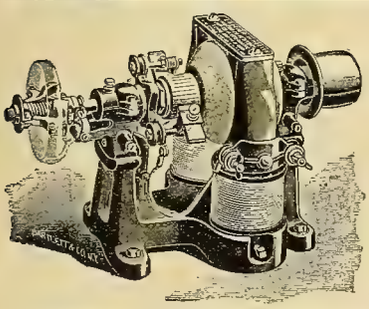

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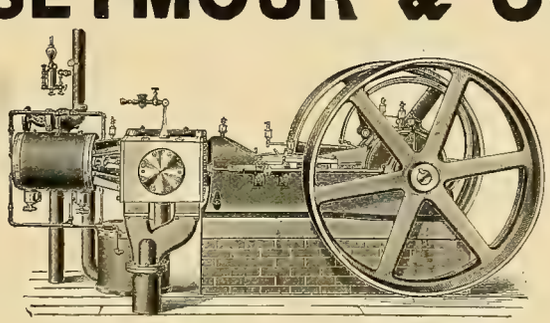

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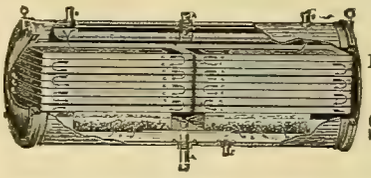

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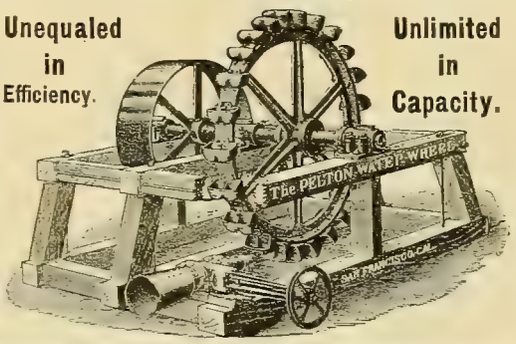

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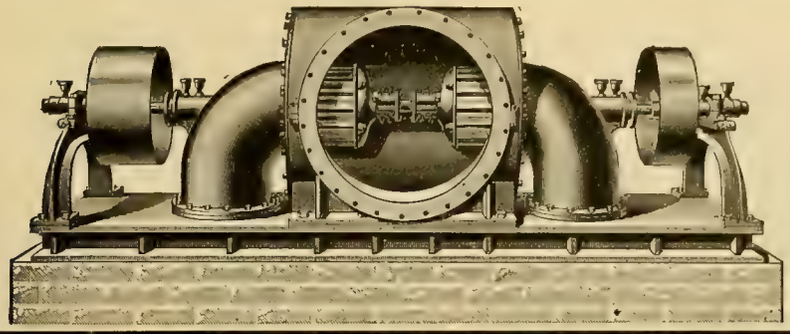

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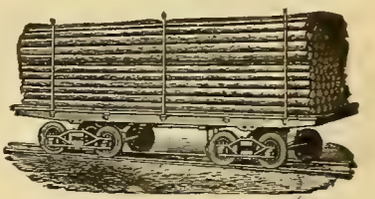

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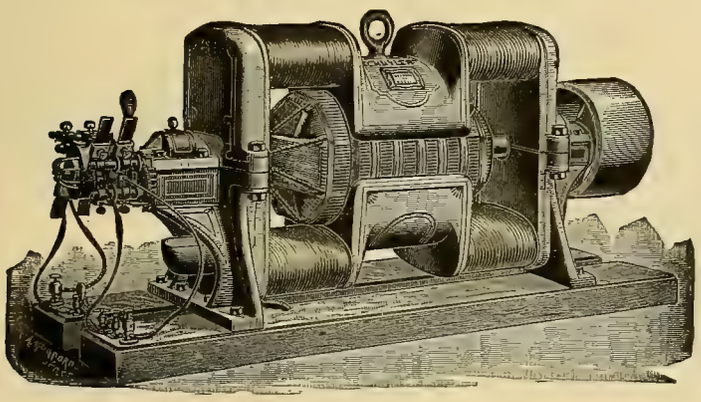

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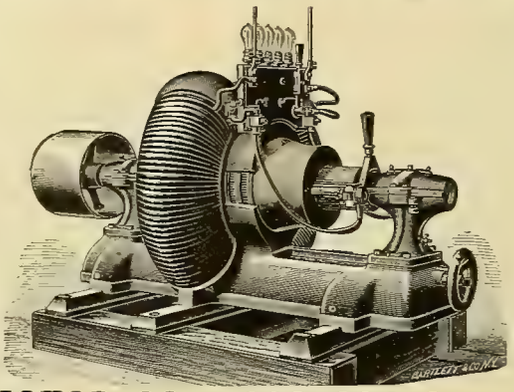

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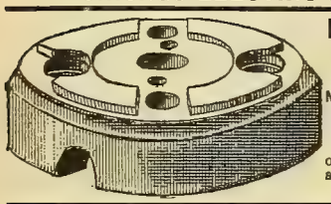

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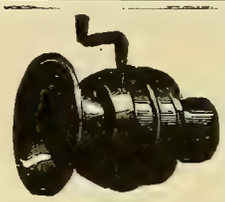

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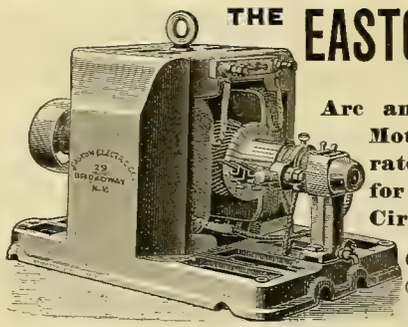

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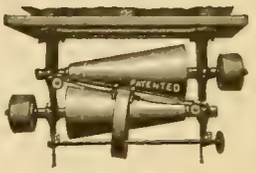
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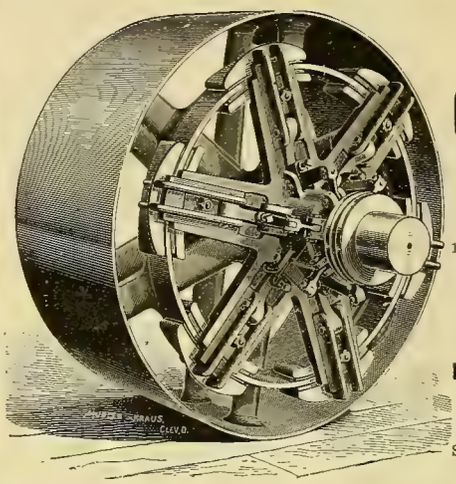

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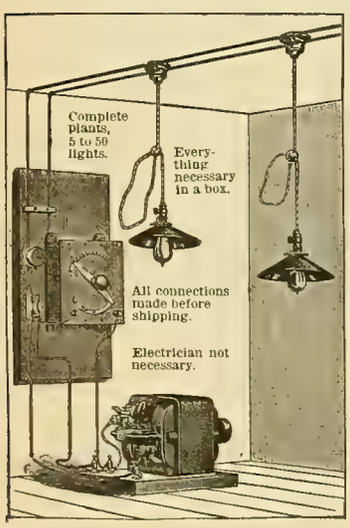

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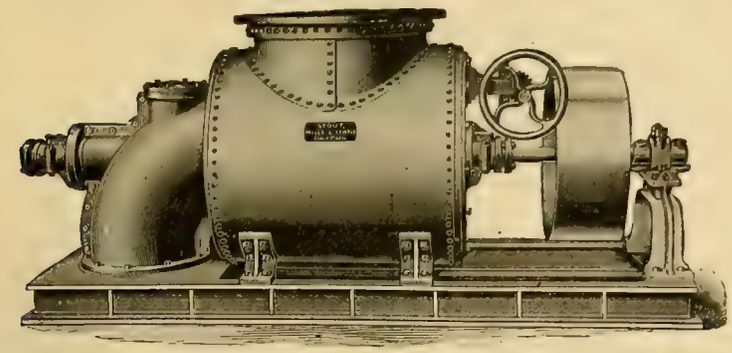

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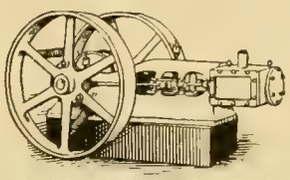

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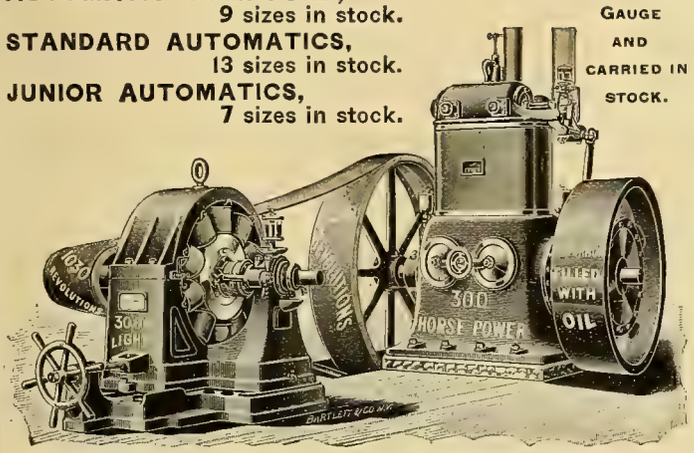

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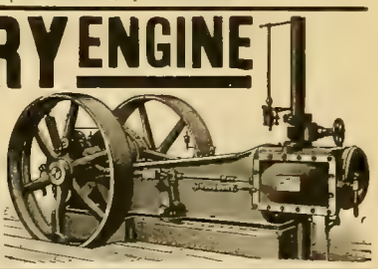

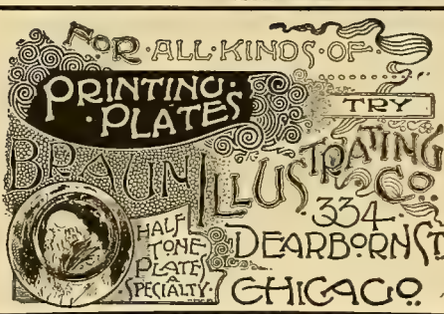

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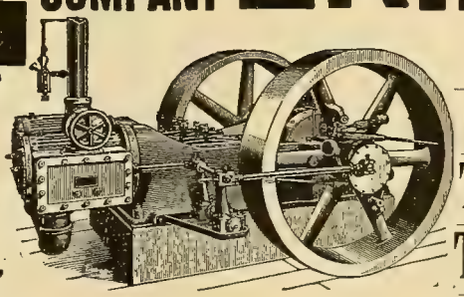

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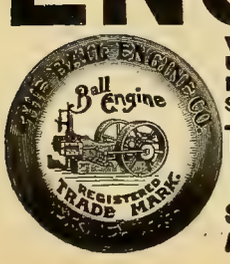

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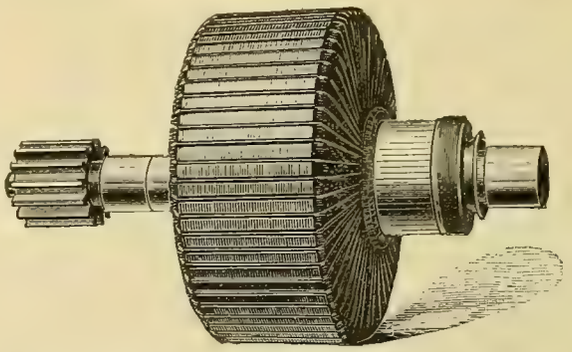

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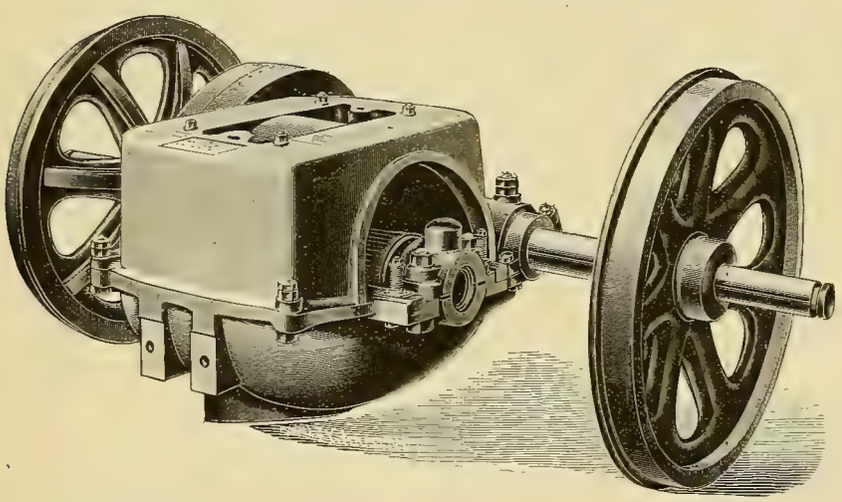

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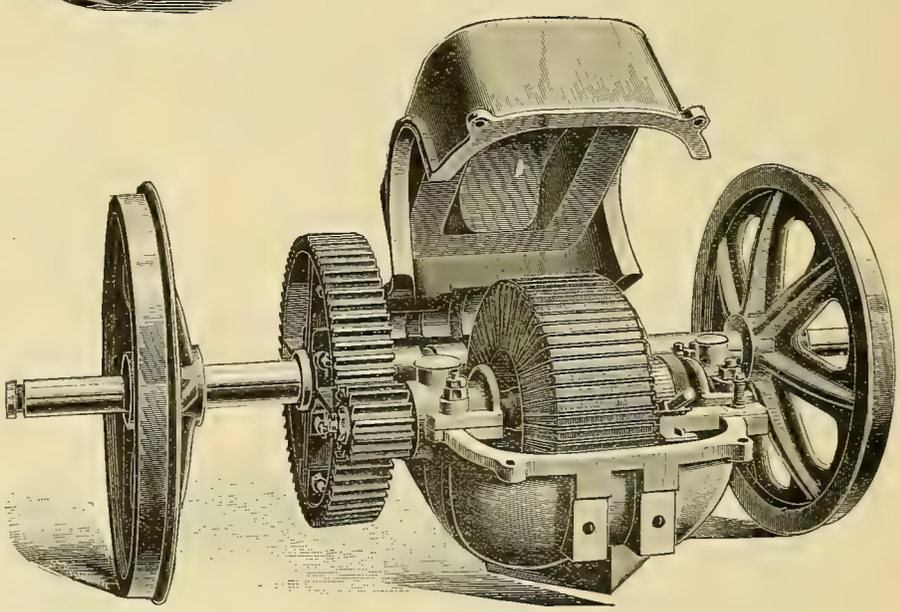

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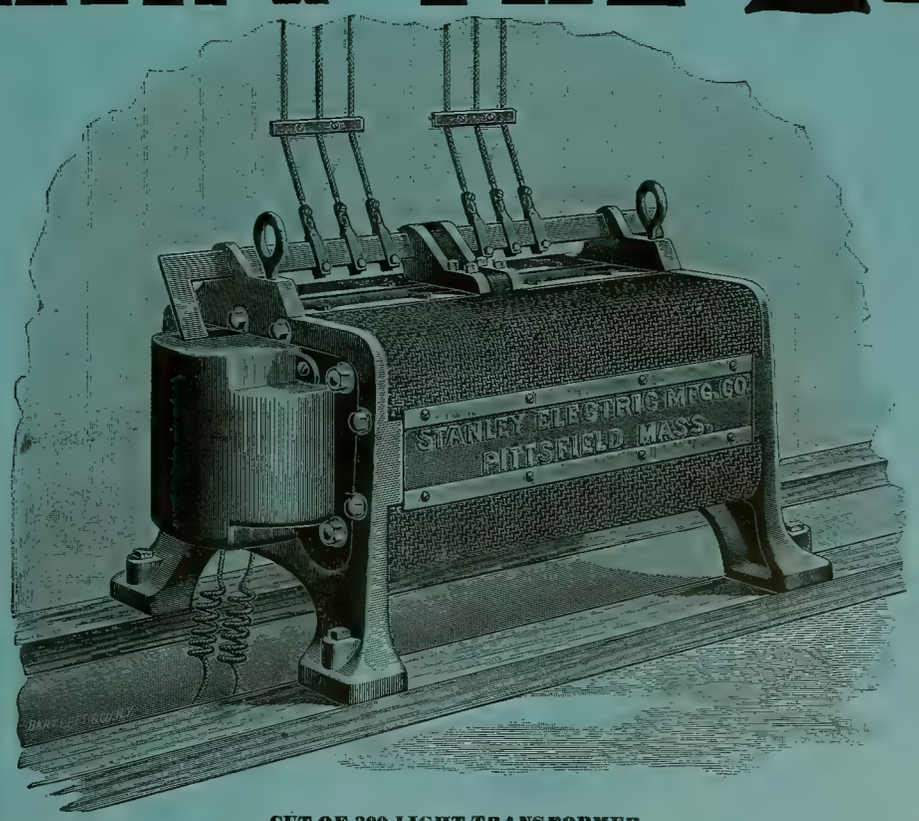

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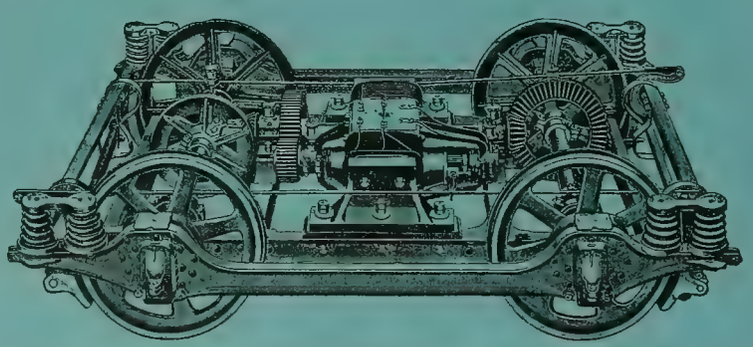

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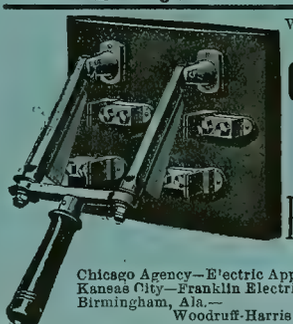

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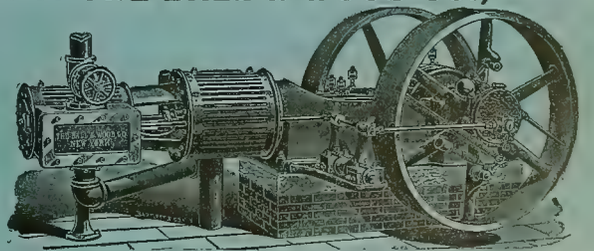

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Woodhouse & Rawson, Ltd....——
Worthington, Henry R.....——

CLASSIFIED LIST.

Aluminum.
Goodrich-Coleman Elec. Works.

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Central Electric Co.
Detroit Electrical Works.
Electrical Construction Co., The.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Arc Lamps.
Beggs, J. E., Mfg. & Supply Co.
Brush Electric Co.
Easton Electric Co.
Fort Wayne Electric Co.
Great Western Elec. Supply Co.
Mosher Arc Lamp Co
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Electrical Supply Co., The.
Knapp Electrical Works.
Samson Cordage Works.

Batteries.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Foster, O. A.
Greeley & Co., The E. S.
Hirlimann, C. J.
Law Telephone Co.
Monitor Electric Co.
Partrick & Carter Co.
Pumpelly, J. K.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Hemingray Glass Co.
Hirlimann, C. J.
Law Telephone Co.
Partrick & Carter Co.
Pumpelly, J. K.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Detroit Electrical Works.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Chicago Rawhide Mfg. Co.
Evans Friction Cone Co.
Link Belt Machinery Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Western Electric Co.

Clutches, Friction.
Hill Clutch Works.

Cordage.
Samson Cordage Works.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Washington Carbon Co.
Western Electric Co.

Construction and Repairs.
Andrae, Julius
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Supply & Contracting Co.
Electrical Construction Co., The.
Knapp Electrical Works.
Leonard & Co., H. Ward.
Smith, Thos. G. Jr.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Keller & Degenhardt.
Lasell, Edw.
Leonard & Co., H. Ward.
Pearson & Co., W. B.
Pond Engineering Co.
Racine Hardware Mfg. Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Smith, Thos. G. Jr.
Temple, J. C.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Insulated Wire Co.
Detroit Electrical Works.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-Outs and Switches.
Alexander. Barney & Chapin.
Andrae, Julius
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Knapp Electrical Works.
Lasell, Edw.
Paiste, H. T.
Partrick & Carter Co.
Star Electrix Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
C. & C. Electric Motor Co.
Colburn Electric Mfg. Co.
Detroit Electrical Works.
Easton Electric Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Heating.
Electric Merchandise Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrical Instruments.
Bunnell & Co., J. H.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Andrae, Julius
Crown Electric Mfg. Co.
Detroit Electrical Works.
Lasell, Edw.
Ries Electric Specialty Co., The.

Electroliers and Combination Fixtures.
Bagdot, E.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co., Ltd.
Thomson-Houston Electric Co.

Elevators.
Link Belt Machinery Co.

Engravers.
Braun Illustrating Co.

Friction Cones.
Evans Friction Cone Co.

Electro-Plating Machines.
Brush Electric Co
Colburn Electric Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Beggs, J. E., Mfg. & Supply Co.
Pearson & Co., W. B.
Pond Engineering Co.
Racine Hardware Mfg. Co.
Sargent & Lundy.
Smith, Thos. G. Jr.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Fan Outfits.
C. & C. Electric Motor Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Gas Lighting, Electric.
Detroit Electrical Works.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
Andrae, Julius
American Electrical Works.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Electric Mfg. Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Lasell, Edw.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co., The.
Star Electrix Co.
Thomson-Houston Electric Co.
Western Electric Co.

Globes and Electrical Glassware.
Baggot. E.
Brookfield, Wm.
Gleason & Bailey Mfg. Co. Ltd.
Hemingray Glass Co.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Andrae, Julius
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Delaware Hard Fibre Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Hemingray Glass Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Lasell, Edw.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Security Insulator Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Detroit Electrical Works.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Lasell, Edw.
New York Insulated Wire Co.
Partrick & Carter Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Co.
Knapp Electrical Works.
New York and Ohio Co.
Sawyer-Man Electric Co.
Somoff, J. L.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lighters, Electric.
Barr Electric Mfg. Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Detroit Electrical Works.
Partrick & Carter Co.

Mica.
Bowers Bros.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mine Signals, Electric.
Detroit Electrical Works.

Mining Apparatus, Electric.
Bain Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Chicago Electric Motor Co.
Detroit Electrical Works.
Easton Electric Co.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Elektron Manufacturing Co.
Foster, O. A.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg Co.

Office Furniture.
American Desk & Seating Co.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors.
Woodhouse & Rawson, Ltd.

Packing.
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H
Loud, H. M & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas.

Poles.
Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Detroit Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co., The.

Securities, Electrical.
Perry & Noyes.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway.
Detroit Electrical Works.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Andrae Julius Co.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Detroit Electrical Works.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Electric Mfg. Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Detroit Electrical Works.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

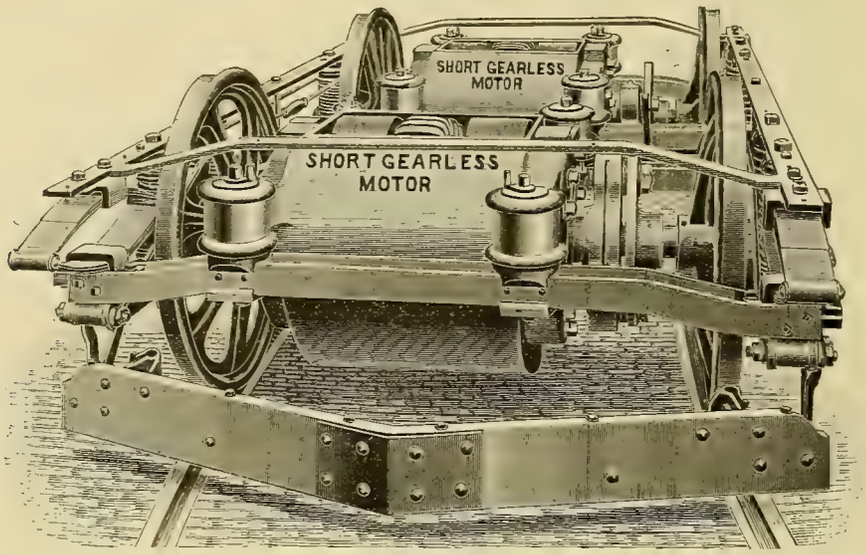
Turbine Wheels.
Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Stilwell & Bierce Mfg. Co.

Valves
Beckerleg, Jas. G.

Water "wheels.
Pelton Water Wheel Co.

Wire, Bare.
American Electrical Works.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

The NORTHWEST Will Soon Have Three More Fine STREET RAILWAY PLANTS Installed by



THE SHORT ELECTRIC RAILWAY CO.,

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All three roads—Minneapolis Street Railway Co., Minneapolis, Minn.; Consolidated Street Railway Co., Grand Rapids, Mich.; Harvey Transit Co., Harvey, Ill.; will be equipped with

SHORT 20 H. P. GEARLESS MOTORS.

SAWYER-MAN ELECTRIC CO.,

BOSTON, 620 Atlantic Avenue.

NEW YORK, 510-534 West 23d Street.

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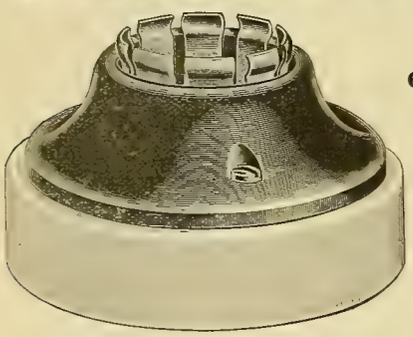


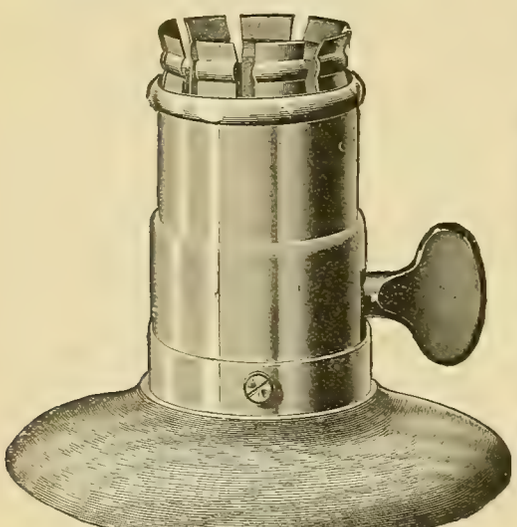
No. 135. All Porcelain Keyless Wall Socket.

INCANDESCENT LAMPS.

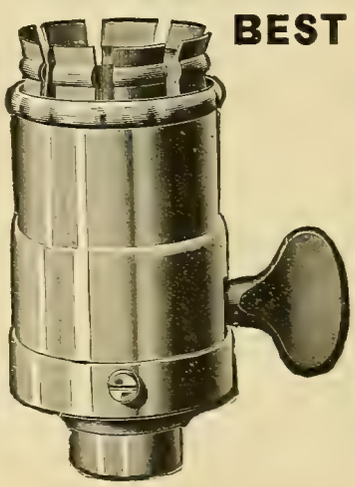
Orders Executed Correctly and Promptly.

SOCKETS.

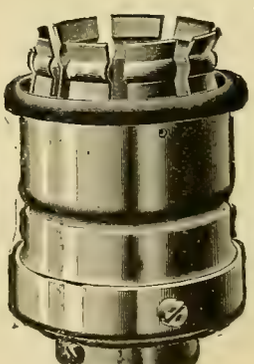
BEST AND CHEAPEST.



No. 125. Key Wall Socket—Porcelain or Wood Base.



No. 110. Key Socket.



No. 120. Keyless ⅝ inch Socket.

ALSO—

No. 115. Keyless Socket, 1-8 in.

No. 130. Keyless Wall Socket—Porcelain or Wood Base.

No. 145. Keyless Socket for 75, 100 and 150 c. p. Lamps.

No. 150. Waterproof Socket.

No. 140. Attachment Plug, with Fuses.

STILL LEADING.

The only wire that NEVER goes back on its friends is

We are General Western Agents for all Okonite Products, which includes the highest grade of

Insulated Wire,

Commercial Lamp Cord,

Improved Candee Weatherproof Wire,

Electrolier Wire,

Switch Cord, Etc.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

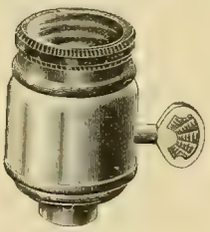
CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad St., New York.

BEST.

STRONGEST.



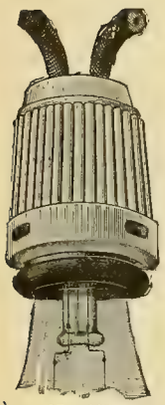
Nos. 6247–6257.

Nos. 6235–6245.

PATENTED

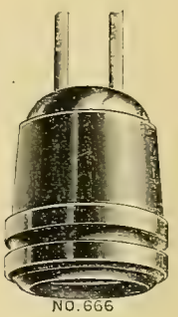
Nos. 6223–6233.

SOCKETS.



No. 667.

Nos. 6259–6269.



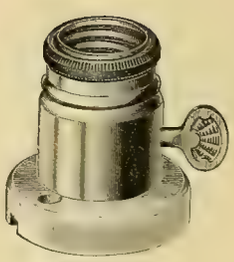
NO. 666

Standard Cat. No.	Old Cat. No.	DESCRIPTION.
6223–6233	1	Standard Keyless Socket
6235–6245	1½	Improved Keyless Socket
6247–6257	2	Standard Key Socket
6259–6269	2½	Push Button Socket
6297–6303	7	Standard Key Receptacle (porcelain or wood base)
6305–6311	8	Fancy Key Receptacle (porcelain or wood base)
6271–6277	3	Standard Keyless Receptacle (porcelain or wood base)
6279–6285	3½	Fancy Keyless Receptacle (porcelain or wood base)
667	667	Porcelain Weatherproof Socket
666	666	Hard Rubber Weatherproof Socket
233	233	Wooden Testing Socket
369	369	Wooden Testing Socket

No. 369.

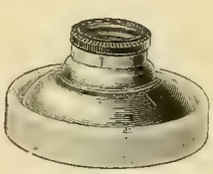
No. 233.

Nos. 6271–6277.



Nos. 6297–6303.

CHEAPEST.



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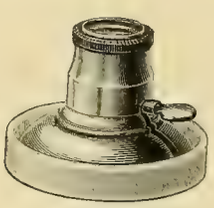

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NOTICE.

In view of the decisions in the cases of Western Electric Mfg. Co. vs. Chicago Electric Mfg. Co., reported in 14 Federal Reporter, 691, and Western Electric Co. vs. Electrical Construction Co. et al., reported in the WESTERN ELECTRICIAN of November 21, 1891, and a large number of cases in which injunctions have been granted on the Gray Patent No. 172,993, February 1, 1876, we claim, as owners of said Gray patent, the exclusive right to make, use and sell, or to license others to make, use and sell, apparatus covered by the claim of said patent, which is as follows:

"The combination of a movable elevator car, the annunciator attached thereto and moving therewith, circuit closing and breaking signal keys on different floors, and mechanism whereby an electric current is maintained between the signal keys and annunciator without interruption by the movement of the car."

We have agents in all the principal cities who will install apparatus licensed by us, and will guarantee the satisfactory operation of same.

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Two 25 light, 2,000 candle power American Arc Light Dynamos.
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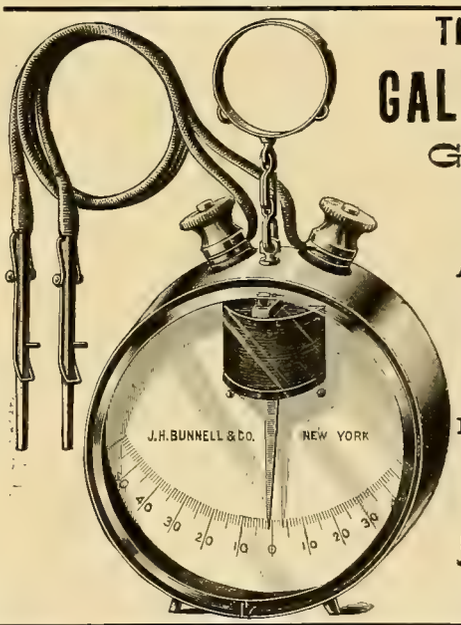

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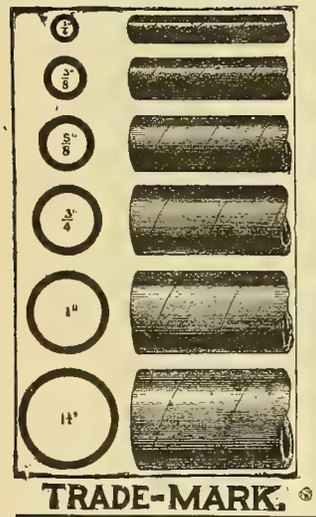

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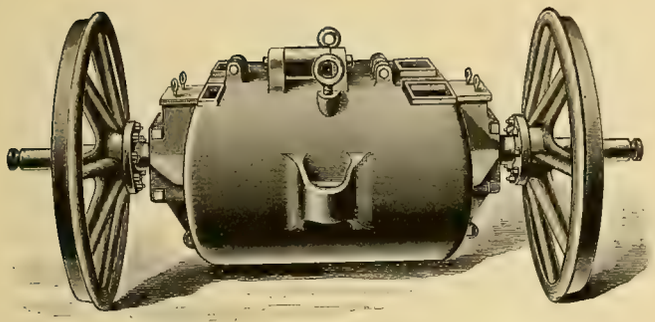

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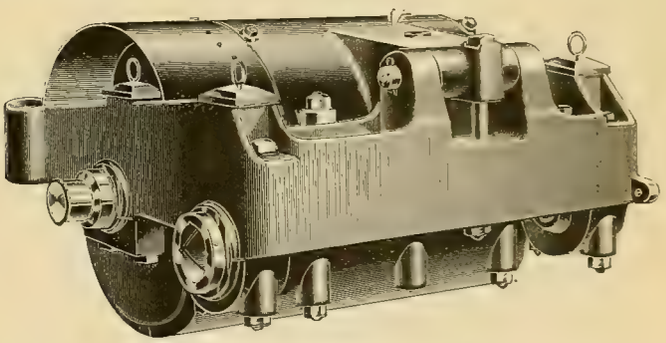

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Noted for Simplicity and Steadiness.

500 to 5,000 candle power, making superior lamp for photo-engraving purposes. Write for price, circular, and sample lamp.

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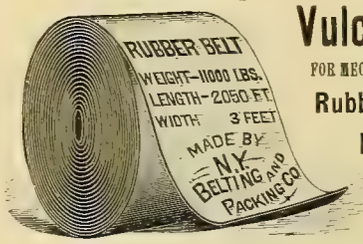

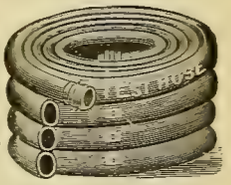

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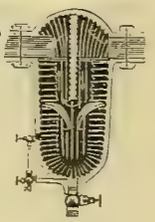

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For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

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Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. X. CHICAGO, JANUARY 23, 1892. No. 4

Cleaning a Telephone Switch-Board with an Exhaust Fan.

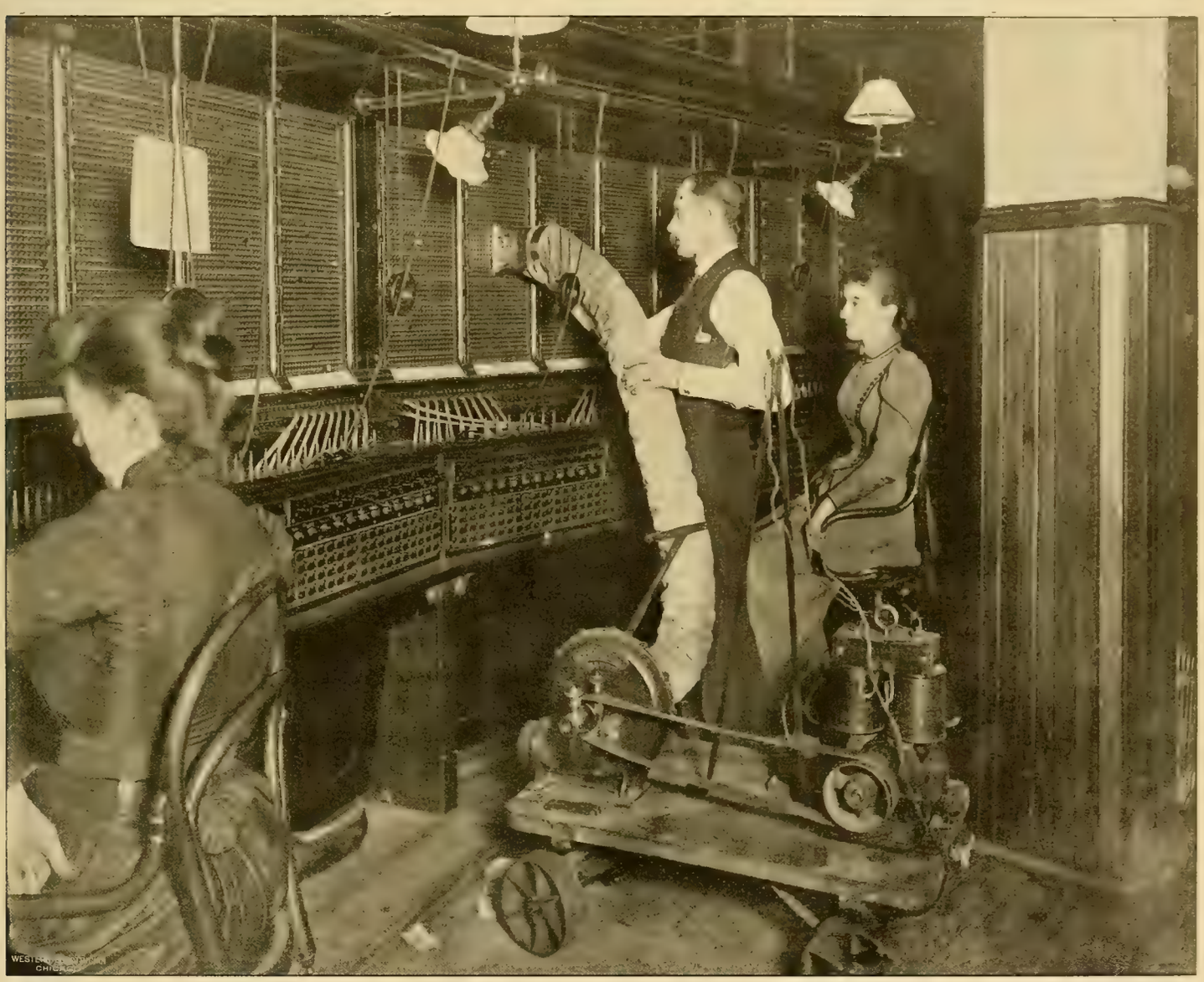
The accompanying cut shows the application of an ingenious apparatus now employed in the switch-board room of the Chicago Telephone company for clearing and keeping free from dust the holes in the switch board. The spring jacks within the holes of the switch-board, into which plugs are inserted in making telephonic connections, have always given considerable trouble from the fact that the contacts become clogged, or coated, and do not make good electrical connections. Inasmuch as these holes are only ¼ of an inch in diameter and the spring jacks are located in the rear of each of the holes, it has been a matter of some difficulty to keep the jacks free from dirt. The method employed heretofore has been to insert, by hand, an oval shaped tool between the jacks and rub away any matter that may have collected. The amount of work entailed by this operation and the number of jacks to be looked after can be better appreciated when it is explained that there are 200 switch-boards, each with 940 holes, making a total of 188,000 contacts to be kept clean.

The object of this machine is to keep the holes, spring jacks, etc., free from the accumulation of dust and moisture, by means of air suction, and thus ever having a clean surface, reducing to a minimum the liability of poor contacts. The cut takes in but a small section of the switch-boards and shows the machines at work at eight o'clock in the evening, when but few operators are on duty.

The apparatus in detail consists of a ¼ horse power Edison standard motor, belted to a No. 00 Sturtevant exhaust fan. Connected to the exhaust pipe is a 5 inch hose, wire wound, and terminating in a 5x5 inch funnel, the edges of which are padded with felt. To the funnel are attached handles for the convenience of the operator. The hose is of a convenient length, about six or seven feet. The motor is equipped with a rheostat and receives current through quite a length of flexible conducting cable that may be attached to convenient lamp sockets located at various points around the boards. An iron rod terminating in a hook receives the funnel and hose when not in use. All of the above described rigging is neatly mounted on a 2x3 Fairbanks truck, so that it may be moved easily along the boards.

The cleaning is performed in the following manner: An operator fastens the plug of the flexible cord to a convenient lamp socket, starts the motor, and then, as he moves the truck along the front of the switch-boards, he slides the funnel over the face of the board. The strong suction from the blower draws with great velocity all dust and particles of foreign matter through and out of the holes, leaving them clean and bright. The funnel is made of such a size as to cover 100 holes at a time, so two sweeps are enough to take in all the holes on one section of the switch-board.

By the use of this air sucking apparatus the efficiency of the telephone service is greatly increased, and the cost of cleaning is reduced to a minimum. When calculated on a basis of the labor required the cost of cleaning of a switch board is considerable.



CLEANING A TELEPHONE SWITCH-BOARD WITH AN EXHAUST FAN.

This apparatus was specially designed for this work by the Edison General Electric company, Chicago.

An electric signaling apparatus for transmitting orders from the bridge to the engine room of an ocean steamer, the invention of D. D. Wass of San Francisco, has been accepted, it is said, by the United States Navy. A complete apparatus will be placed on the new cruiser New York, Lieutenant Finn having approved the construction. The apparatus is so devised that the signal from the bridge is indicated on a dial in the engine room and is repeated back to the bridge by the engineer. This repetition, which is accomplished merely by movement of a lever, insures correct understanding of the order. The inventor expects that seventeen of these electrical indicators will be ordered for the New York, ten for the Monterey and six for the Charleston, and that they will be substituted for the mechanical apparatus now in use on merchant steamers.

Throwing an Electric Railway Switch from the Motor Car.

By the arrangement shown in the accompanying diagram B. I. Potter, Boston, proposes to control a track switch from an electric car by the use of the motor current.

The necessary mechanism comprises, in addition to the ordinary trolley wire, two auxiliary wires as shown in Fig. 1, and an electro magnetic switching device, Figs. 1 and 2, located beneath the track at the switch. The magnets at the switch are placed in operative relation to the platform as indicated, and are independently energized according as it is desired to move the switch lever.

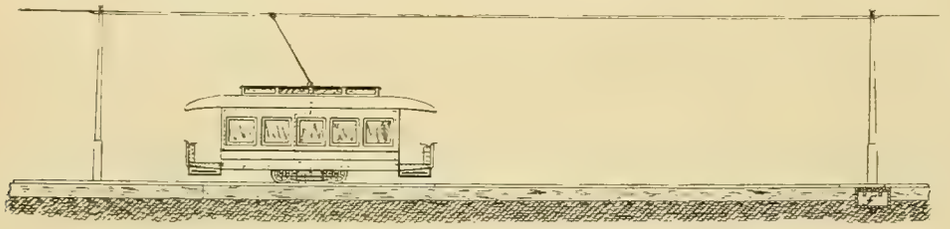


FIG. 2. THROWING AN ELECTRIC RAILWAY SWITCH FROM A MOTOR CAR.

It is hardly necessary to explain the device, as its general arrangement is clearly shown in the diagrams.

The operation is as follows: A car approaching the switch is brought into electric connection with the switch-magnets by means of the two auxiliary overhead conductors. By the use of a simple electrical switch on the car it is now practicable for the motor man or conductor to throw the track switch before arriving at the switch itself.

The track switch may be set at any time after contact is made with the supplemental wires, provided only that the car wheels have not actually entered the track switch. It is in this particular that it is claimed that this apparatus differs from previous constructions in which short contact blocks or plates have been arranged on or in the ground, and the switch actuating circuit completed through brushes carried by the car.

Electricity at the World's Fair.

There is a prospect that the prospectus of the department of electricity, regarding which there has been so much chaffering, will soon be issued. It is likely that it will be much shorter than was at first intended, and that it will contain little beside a general statement of the extent and scope of the department, a brief description of the building, with a perspective view and floor plans, and the special rules of the department. The illustrations that will be used and the rules have already appeared in the WESTERN ELECTRICIAN.

Some figures interesting to the electrical fraternity are contained in the report of William K. Ackerman, auditor of the World's Fair, showing the receipts and disbursements of the corporation up to January 1, 1892. The total disbursements up to that date were $2,068,094.44, of

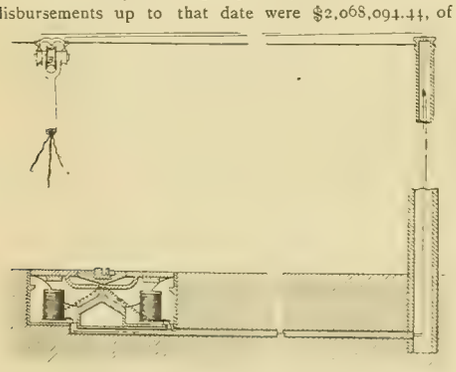


FIG. 1. THROWING AN ELECTRIC RAILWAY SWITCH FROM A MOTOR CAR.

which $5,242.31 was paid for electric lights and $189.54 for gas. For telegraphing $925.39 was paid, while the item of "telephones" is put down as $1,939.85. Among the construction expenses is an item of $87,437.74 for money paid the contractors on the electricity building; $9,770.76 for electrical engineering, and $15,051.34 for the electrical plant. Of the temporary buildings the power house is credited with having cost $5,538.57. The balance on hand was $876,117.82. In the record of the amount distributed by departments the department of electricity is put down as having spent $8,041.42. During December the department of electricity cost $676.65; electrical engineering for construction, $2,020.59, and electric lights and appliances, $1,970.50.

The latest report shows that of the required 5,000,000 feet of lumber for the electricity building 2,440,391 feet has already been placed. Of iron 1,500,000 pounds is required for this building, and 383,000 pounds have been placed in position. The magnitude of the work on all the buildings may be judged from the statement that it is estimated that the standing pine on 4,500 acres will be required to finish the construction work now in progress. This means demanding nine square miles of forest.

The congressional World's Fair committee, of which Representative Durborow is chairman, has completed its formal organization. The sub-committee of the appropriation committee will begin its inquiries at once. It will probably visit Chicago.

The contract for constructing the subways for the electrical wires at the World's Fair has been let to T. C. Brooks & Co. at a price that will make the total cost about $35,000. The work must be done by April 1st.

E. E. Keller, of Chief Barrett's department, is preparing a number of section plans of the main floor and galleries of the electricity building on a scale of a quarter of an inch to a foot. In all there will be 22 of these floor plans, and space will be allotted from them, each exhibitor being furnished a plan with his allotment plainly marked

A letter reached the department of electricity lately addressed to "J. P. Barrett, V. M." Everybody wondered what "V. M." meant, and among other guesses, it was

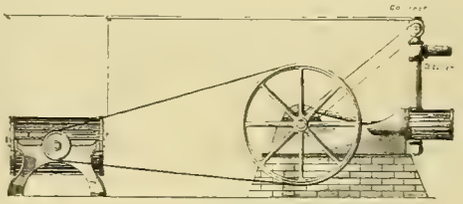


FIG. 1. AN ELECTRIC STEAM ENGINE GOVERNOR.

conjectured that the letters stood for "Very Mighty"—a sly compliment to the chief's popularity at the city hall. Investigation revealed the fact that this was an error, however. The letter came in response to a dictated one which Prof. Barrett had authorized the stenographer—a bright young lady—to sign. This the latter did, attaching her initials in microscopic characters. The recipient, however, evidently thought that the letters represented an honorary title.

Herr Vogel, the representative of Siemens & Halske, left for New York last week. It is stated that he will return soon, with other representatives of the great German firm, and hold further conferences with the World's Fair directors.

A Chicago daily paper has the following item, which, like many others concerning the World's Fair, is "interesting if true:"

When President Harrison touches the electric key that is to start the World's Columbian Exposition the signal will reach every city of considerable size in Europe and America. All this is conditioned, however, on the fulfillment of a proposition made to the ways and means committee. The World's Fair Annunciator company made a written offer to the committee to connect the cities of two hemispheres by electricity, so that when the president gives the signal it will start the machinery of the World's Fair, ring the fire bells and hoist the national flag in towns all over the United States, at the same time announcing in Europe the opening of the great exposition. The proposition will be considered at a later date, when the directors have been satisfied of the responsibility of the company.

Electrical Plant of London calls attention to what seems to be a just cause of complaint on the other side of the water. In speaking of the British Royal Commission, it says:

The sum allowed by the British government, as was known from the very first, is totally inadequate to the expenses of the commission or the due performance of the functions they undertook; being in fact many times less than the sums voted by other countries of inferior commercial standing; so to make up the deficiency the British exhibitors are called upon to pay the difference. The Chicago folks very justly complain, in no measured terms, of this suicidal policy. They say, we have provided you with handsome buildings and given you all the space you asked for, absolutely free; and now you who are supposed to be sent here as a royal commission to protect British exhibitors actually propose to charge so much per foot of floor space to your own people! The question naturally arises, "Is it not time that those who constitute the real exhibition, viz., exhibitors, undertook the management of such things themselves, rather than allow themselves to be made the victims of fussy officials, eager for notoriety, titles or money?"

An Electric Steam Engine Governor.

Frank M. Garland, New Haven, Conn., has devised an electrically operated throttle valve through which he governs a steam engine directly from the dynamo. In a word, by his device the work of the engine is automatically reduced or increased, according to the output required of the dynamo.

Referring to the accompanying diagrams, Fig. 1 is a side elevation of the complete system; Fig. 2 is a plan view of the governor, and Fig. 3 is a side elevation of the gover nor valve with parts broken away to show construction.

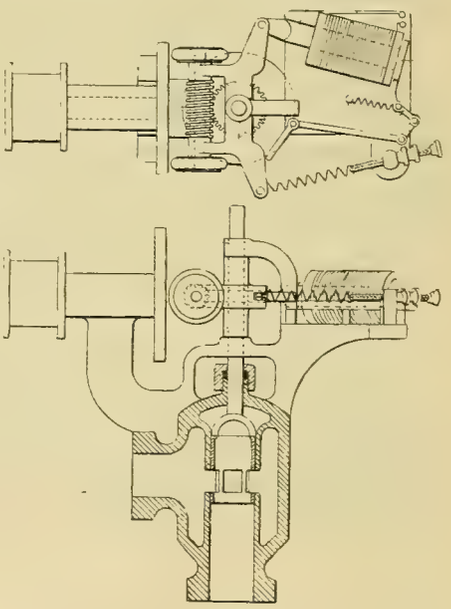
From Figs. 2 and 3 it will be seen that there is a valve casing with an inlet port, valve seat and outlet port, and adapted to be connected to a steam pipe between a boiler and engine. A balanced valve is provided with a spindle that projects through the casing and stuffing box, and is supported by the arms of a web that is cast integral with the upper part of the casing. A portion of this valve spindle between the arms of the web is threaded and bears upon the threaded portion a worm gear, the central hole in which is threaded to fit the spindle, while the teeth on the periphery are cut to mesh with a worm as shown.

The worm gear is held from vertical movement about midway between the arms in an opening in a sleeve that turns loosely upon the spindle. The worm is rotarily supported by journals that turn in bearings projecting from an oscillating lever that is connected with the sleeve. One end of the lever is pivoted to the plunger armature of a solenoid while the opposite end of the lever is connected by a spring with an adjusting screw.

The terminal wires of the solenoid are connected in circuit in any proper manner with the dynamo, the output of which is to control the work of the engine.

Upon the two ends of the worms are mounted friction wheels, the peripheries of which are adapted to make contact with the face of the rotating disk according to the position of the lever as it is oscillated by the pull of the solenoid or the spring. This disk is connected to one end of a shaft journaled as shown, and the opposite end of the shaft bears a pulley adapted to be belted to and driven by an engine. Pivoted to the casing is a bent lever, one end of which projects into the path of oscillation of one end of the other lever. The opposite end of the bent lever is connected by a link with one end of another lever, the opposite end of which bears an armature which is held to the solenoid when a sufficient current is passing along the coils to overcome the tension of the spring.

The operation of the governor will now be understood: When the governor valve is open and steam passes through it to the cylinder and the engine starts, the pulley which is belted to the engine, revolves the disk continuously in



FIGS. 2 AND 3. AN ELECTRIC STEAM ENGINE GOVERNOR.

one direction. As the electromotive force of the dynamo increases, more current will pass through the solenoid, attracting the plunger and bringing the wheel into contact with the revolving disk. The friction of the disk and wheel rotates the worm and drives the gear that is threaded upon the valve spindle, causing the valve to close and cut off steam until the work of the engine is only sufficient to cause the dynamo to send a current through the solenoid to balance the pull of the spring and hold the friction wheels from the face of the disk. Should the current which passes around the solenoid be insufficient to attrac

the armature, the wheel comes in contact with the disk, and the worm and gear are rotated in an opposite direction. This opens the valve and allows more steam to be passed through the engine, so that its work may be increased and the voltage of the dynamo raised.

Pike's Peak Telephone Line.

The line of poles which follows the "cog" steam railroad to the summit of Pike's Peak carries a wire used for telephone service. The line, which is a private one, was put up by the company which owns the marvelous rack railway. The wire was strung last spring, and it will soon be

PIKE'S PEAK TELEPHONE LINE.

determined how well the construction has withstood the rigors of a Pike's Peak winter.

The telephone is employed by the company in controlling the traffic over the road running to the Peak. Naturally but little train dispatching is required, but it is extremely important that communication be possible in the case of accident.

The system is an insignificant one in size, but it possesses especial interest from the fact that the instrument at the summit is the highest telephone in the world; at least telephone men assert that this is the fact. There are only five instruments on the circuit.

The line follows generally the route of the cog railway, which is built on the old trail to the Peak, and it is about twelve miles in length. The poles used are about eighteen feet in height, and are set at distances of 100 feet apart. They are of spruce, and were cut on the mountain side. They were distributed along the railway line from trains on the cog road. No great difficulty was experienced in setting them, although at some few points it was necessary to resort to blasting.

A number nine hard drawn copper wire is used as a conductor. The pole line was built up to a point about 5,000 feet from the summit. From this point on an insulated cable is employed, which is laid over the snow and rocks. This method of construction was deemed necessary for the reason that the old telegraph wire running to the signal station at the summit was constantly broken by the snow. The telegraph line is now abandoned.

The circuit is metallic, though not in the ordinary sense. The rails form the return conductor. The line has given excellent service. It is remarkably free from induction. It has been connected to the metallic circuit of the Colorado Springs exchange leading to Denver, and conversation between the Peak and the latter city has been carried on successfully. The distance is about ninety-five miles. Telephone men say it is one of the best talking lines to be found anywhere. No difficulty is experienced in operating the line unless the freezing of batteries can be considered such. This minor trouble is easily overcome. It was thought that a great deal of trouble might result from lightning, as thunder storms on the mountain side are proverbially severe, but no damage has been caused in this way.

Double Carbon Arc Lamp Litigation.

The Brush Electric company is displaying great activity in bringing suits against the users of double carbon arc lamps other than its own. A suit against the Western Electric company in relation to the "Twin" arc lamp was noticed in this paper several weeks ago. Since then suits have been brought against Carson, Pirie, Scott & Co., the Chicago Arc Light & Power company, Marshall Field & Co., Mandel Bros., Geo. H. Williams & Co., Fish, Joseph & Co., L. Klein, Klein Bros. and the Boston Store, all of Chicago, the city of Muncie, Ind., and the city of Chicago. In each instance the plaintiff seeks to have the defendant restrained from using double carbon lamps which, it alleges, infringe its patents. Western Electric lamps are used in nearly every case, and that company, through its attorneys, Barton & Brown of Chicago, will defend the suits, unless possibly that brought against the city of Chicago. H. A. Seymour of Washington, is the attorney for the plaintiff, and Offield, Towle & Linthicum are the Chicago representatives of the company. None of the suits will come to trial before three or four months have elapsed.

A New York dispatch says: "United States Judge Lacombe to-day handed down a final decree in the suit of the Brush Electric company vs. the Electric Construction & Supply company, perpetually enjoining and restraining the defendants from making, using or selling any arc light electric lamp in which two or more pairs of carbon are independently regulated, controlled, and burned successively."

Central Station at Barmen.

The central station at Barmen is one of the most complete plants on the European continent and was installed by Schuckert & Co., of Nuernberg. A large accumulator plant of the Tudor type is used to increase the capacity of the plant. The station consists of a boiler house, dynamo and engine room, and an accumulator room. It covers an area of 2,300 square meters.

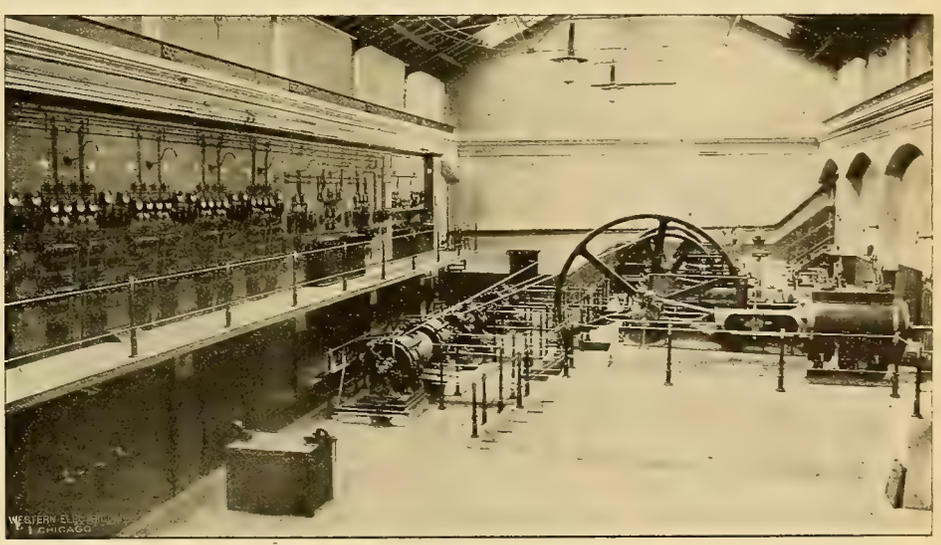
The present capacity of the plant is 5,000 incandescent lamps burning at the same time, or a total installation of 8,000 incandescent lamps.

The boiler house contains six Galloway tubular boilers.

In the dynamo and engine room shown in the accompanying cut there are five compound non-condensing engines of the horizontal type, each of a capacity of 150 horse power, operated at a speed of 110 revolutions per minute. There are ten dynamos employed, each having a capacity of 31,250 watts. One boiler, one engine and the two dynamos connected are held in reserve in case of accident to any of the other machines.

The accumulators consist of four double batteries of 68 cells having a discharging current of 220 amperes and a capacity of 1,100 ampere hours.

The plant is operated on the three wire system and the dynamos and accumulators are used together; that is, the accumulators are operated in parallel with the generators. The generators are shunt machines of the Schuckert flat



CENTRAL STATION AT BARMEN.

ring type, and have a normal speed of 500 revolutions per minute, with a capacity of 31,250 watts.

Two small electric motors are used to work the automatic regulators. They give very good satisfaction at this station, although in Hanover the engineer stated that at present the hand regulators were used altogether.

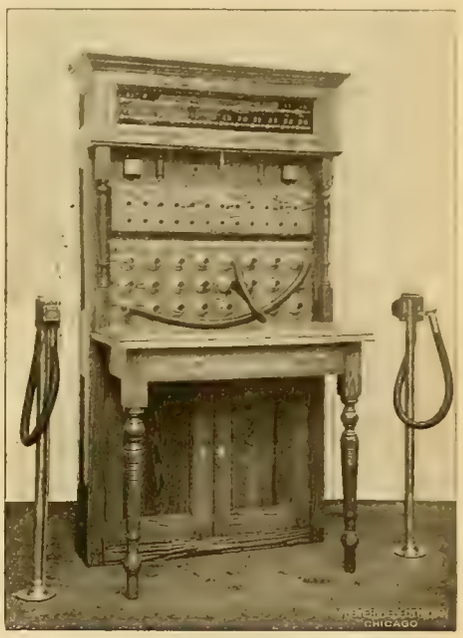
The total number of lamps burning at the same time is about 5,000 of 16 candle power each, requiring 55 watts. The total length of cable used for underground distribution is 50,000 meters. The current is measured at the houses by the use of the Aron meter and the price per lamp hour for 16 candle power lamps of 55 watts is 4 pfennigs.

There are 110 arc lamps in use taking from four to ten amperes.

The plant was built in 1888 after the plans of Engineer Hermann Muller, and began furnishing current to consumers on December 6, 1555. The total cost of the plant was $187,000.

Speaking Tube and Electric System.

Hussey & Co., 211 Randolph street Chicago, have just built and put in place in the Edison General Electric



SPEAKING TUBE AND ELECTRIC SYSTEM.

company's new office building on Adams street, Chicago, a complete speaking tube and electric system for intercommunication between the executive officers of the company. The illustration given herewith shows the central station apparatus, which is constantly in charge of an operator, each branch station being supplied with a very simple and compact appliance similar to those in use at the switch-board and which are shown on either side. The batteries are inclosed in the cabinet and ample provision is made for the use of the entire system at once by the requisite number of flexible tubes. The connections are easily and quickly made and all the details have been worked out with care. At present twenty stations have been connected up, leaving room for growth or for such additions as may be desired.

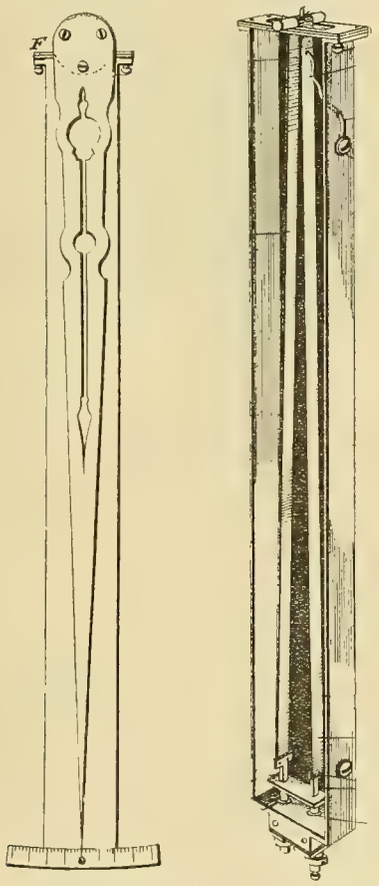
The Wisconsin Telephone company has now a metallic long-distance telephone line connecting Milwaukee, Racine, Fond du Lac, Oshkosh, Neenah, Menasha, Appleton and Chicago.

Brush's Hot Strip Ammeter.

In this ammeter the strength of the current is indicated by a pointer moved over a scale by the expansion and contraction of a metal strip which carries and is heated by the current to be measured.

The device as here shown, which was designed by Chas. F. Brush of Cleveland, is very simple in construction. Figs. 1 and 2 show the external and internal appearance of the meter, while the details will be understood by reference to Figs. 3, 4 and 5.

The working parts of the meter are inclosed in a case of cast iron. From Figs. 2, 3 and 4 it will be seen that a thin flexible ribbon loop of German silver is attached to a rock shaft at the top, while at the lower end of the casing the ends of the ribbon are fastened to the screw rods, which extend through insulating sleeves. Washers surround the screw rods and are seated upon asbestos and mica, as shown, in order that the washers and screw rods shall be insulated from the casing and from each other. As will be seen, there are adjusting nuts to regulate the tension of the ribbons. One of the screw rods is fitted like a binding-post to receive one end of the circuit in which the instrument is to be included. At the upper end of the casing there is a spring plate, Figs. 3 and 5, which carries the rock shaft sustaining the ribbon loop. The rock shaft has a roller bearing on the spring plate, and it is provided with holes into which the pins, set in the spring plate,



FIGS. 1, AND 2. BRUSH'S HOT STRIP AMMETER.

extend, as indicated in the large sectional view, Fig. 5. A pin fastened to the rock shaft passes through a hole in the ribbon. This construction prevents the ribbon from slipping upon the rock shaft. The long pointer, Fig. 1, is fastened to one end of the rock shaft.

It should be explained that Mr. Brush found by practical tests that an ordinary knife edge bearing would soon deteriorate, and for this reason he adopted the roller construction as shown in Fig. 5.

The meter is operated as follows: The adjusting nuts are first turned down so as to impart considerable strain upon the two parts of the ribbon and the spring, and when properly adjusted, the hand will point to zero on the indicating scale. When current is passed through the instrument it flows, as shown, through a part of the ribbon. The current, therefore, heats this part of the ribbon, owing to its resistance to the passage of the current, and the degree of heat to which the part is subjected varies with the strength of the current flowing through it. The heating effect of the current operates to expand this portion, and as it slackens it relieves the spring plate of a portion of its restraining force, and thus allows it to retract. But owing o the fact that one part of the ribbon is not expanded, this part still exerts its normal restraining force on the spring, the result of which is that the latter will partially rotate the rock shaft and cause the pointer to move over the indicating plate, the extent of movement being dependent upon the strength of the current flowing through the other part. It should be mentioned that the operation of the instrument is not due to the amount of heat to which part of the ribbon is subjected, but to the difference in heat to which the two parts of the ribbon are subjected.

Litigation over Telegraph Securities.

Important litigation is in progress in New York in which Edward S. Stokes appears as plaintiff and John W. Mackay as defendant, the cause of the action being the possession of telegraph securities held by Mackay, which Stokes claims should have been delivered to him under a contract dated Dec. 26, 1888. This contract was made by Hector De Castro, it is claimed, on behalf of Mackay. Stokes alleges that for $100,000 he agreed to deliver stocks, bonds and contracts to Mackay, consisting of bonds and stock of the United Lines Telegraph company and certain stock in the Chicago Board of Trade Telegraph, Pacific Telegraph company, Pacific Mutual Telegraph company, Lehigh Valley Telegraph company, and contracts with E. L. Martin for the purchase of additional stock in the Pacific and Pacific Mutual Telegraph companies. Stokes says that he gave all his $115,000 in par value of the bonds of the United Lines Telegraph company, which the defendants refused to accept Feb. 25, 1888, and that the defendants paid him $25,000 on account. Stokes demands the $75,000, with interest from Feb. 26, 1888. Mackay denies making the agreement. De Castro admits making it, but denies that he made it as agent for Mackay or for himself. It was executed, he says on Stokes' assurance that it had no value to bind Mr. Mackay, was merely formal, and would accommodate Stokes in this transaction. Mr. De Castro admits that as agent for Mackay he gave Stokes for investment various sums of money between Sept. 30, 1884, and Oct. 23, 1888, aggregating $1,233,358. He denied, however, that in the transaction in suit he was empowered to act for Mackay.

In the action now on trial Stokes testified that in the latter part of 1884 and beginning of 1885 he had conversations with Mackay about getting control of the Bankers and Merchants' Telegraph company. It was agreed that Mackay should foreclose on the Postal Telegraph company and Stokes was to secure control of the Bankers and Merchants'. They were to consolidate the two companies and divide the surplus received over their investments.

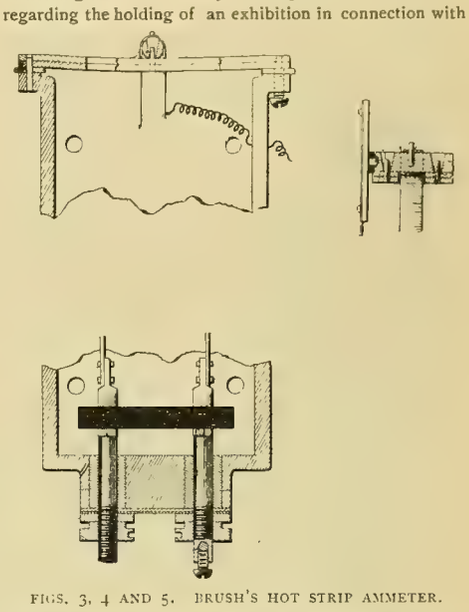
Some interesting corresponence has been brought out in the trial. On Feb. 6, 1885, Mackay wrote Stokes that the whole business had better be closed out. He said that he did not believe that if Stokes perfected the consolidation of the Postal and Bankers and Merchants' there would be any money in it except for the Western Union and the Baltimore and Ohio. Later Mackay wrote again that he wanted nothing more to do with the telegraph business, saying, "I would not take the Postal and the Bankers and Merchants' as a gift." Again Mackay wrote Stokes that he would sooner lose $200,000 than see him "stuck up," but he wanted to get rid of the whole business. He advanced $50,000 at this time. He advised Stokes when he got ready to close to retain Roscoe Conkling and pay him well. Later he wrote advising Stokes to get out of the whole deal as soon as he could. Robert Garrett, he declared, was playing a losing game with the Baltimore & Ohio. "Gould hates Garrett bad and will make no terms with him. I do not care about the money I have put in this business. I just want to get out," Mackay declared. There were letters from Stokes to Mackay urging him to hold on to the matter, as victory was in sight, and he was master of the situation, but Mackay's only answer was that the difficulty was "to get the coin," and he could not and would not furnish it.

Street Car Strike in Indianapolis.

The recent street car strike on the electric and horse car lines in Indianapolis was distinguished by many exciting incidents. Thus on the 12th an effort was made to run a motor car on one of the North Side electric lines. The police were in charge of it, and a dozen detectives were inside in citizens' dress as passengers. The motor man was dragged from the car and was roughly handled before he was rescued by the police. The strikers entered the car and there was a desperate struggle between them and the detectives, resulting in a number of the former being arrested. Later another attempt was made to start an electric car. A hundred or more of the strikers threw themselves in front of it, some of them on their faces with their hands almost under the wheels, as if inviting the motor man to crush them. The car was stopped barely in time to save life. Later dispatches announced that the strike had been settled, the company making many concessions.

National Electric Light Association.

George F. Porter, secretary of the National Electric Light association, has issued a circular letter to associate members of the organization announcing that the headquarters of the association during the Buffalo convention will be at the Iroquois hotel. Referring to the subject of holding an exhibit he says: "Inquiries have been made regarding the holding of an exhibition in connection with

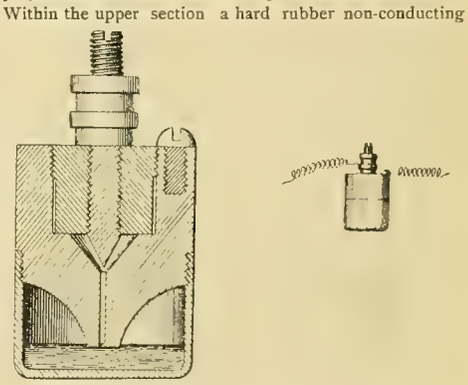


FIGS. 3, 4 AND 5. BRUSH'S HOT STRIP AMMETER.

the meeting, but the matter has not yet been decided. Should enough members signify their desire to exhibit to justify the management in taking such action, space and power will be provided gratis. Kindly advise me at your earliest convenience of your wishes in the matter."

A Compact Electric Heat Alarm.

The little device here shown is for use in connection with journals and other parts of machines where injury is liable to be occasioned by overheating through friction or other causes. It is designed to give an alarm automatically when the heat begins to be excessive. The most essential portion of the device consists of a metallic cylinder made up of two sections. The lower section which is closed and solid at one end and open at the other, is provided with an inside thread at the open end. The upper section is fitted with a shoulder and outside thread, so as to screw into the first section as a plug, forming one cylinder. Extending from this shoulder is a projection shaped like the frustrum of a cone, of such length that when the two sections are screwed together it reaches very nearly to the bottom of the lower section. A small hole through this projection connects the hollow parts of the two sections. Within the upper section a hard rubber non-conducting



COMPACT ELECTRIC HEAT ALARM.

plug is screwed. Through this last named part a metal spindle passes, connecting at its outer end with one of the poles of an electric battery. The other battery connection is the set screw in the upper section. A nut holds the spindle in position.

For operation the first section is partly filled with mercury, the two sections screwed together, and the device is then fixed into the journal box. Excessive heat causes expansion of the mercury, and forces it through the hole connecting the two sections, bringing it into contact with the spindle, thus completing the circuit and giving an alarm by means of the electric bell. The alarm was designed by Morril S. Pierce.

Effect of the Earthquake on Electrical Property in Japan.

The effect of the recent earthquake in Japan, to which reference has already been made in the WESTERN ELECTRICIAN, is plainly shown in the illustrations herewith presented, which are reproductions of photographs of the ruins of electric light and telegraph stations. It is estimated that the destruction to property far exceeded that of any former shake in the domain of the Mikado.

The electrical interests suffered greatly, the pole lines

EFFECT OF THE EARTHQUAKE ON ELECTRICAL PROPERTY IN JAPAN.

throughout the district affected being almost entirely destroyed, and the apparatus of the several companies being greatly damaged. Despite the fact that electricity is used only to a comparatively small extent in Japan, the crippling of the companies had a marked effect, and called attention to the necessity of the modern method only recently introduced.

The electric companies have already made considerable progress in repairing the damage caused by the earthquake, and in rebuilding their stations they will utilize all the improvements in construction that have been made. The photographs from which the cuts were reproduced and for which we are indebted to the San Francisco *Examiner*, were secured by an American gentleman traveling in Japan at the time of the earthquake.

Substituting Electric for Oxy-hydrogen Light.

The introduction of the electric light to take the place of oxy-hydrogen lights is attracting considerable attention. Following is an abstract from an article in a photographic journal on this subject: In the early days of arc lighting the great objection to the lamp was found in its uncertain regulation, resulting in hissing, flickering, and even in short periods of almost total extinction. The arc lamps in use to-day, however, give so constant and uniform a light that this objection has practically disappeared.

On account of the intense light given by the electric arc many workers have endeavored to apply it as a substitute for the oxy-hydrogen lamp used for lecture room purposes. It will readily be seen that there are numerous difficulties in the way of a practical solution of this problem. Obstacles are found both in the regulation of the carbons and in their relative position to each other, and in keeping the supply of current to the lamp constant.

Some nine or ten years ago Mr. Douglass experimented with a light at the South Foreland lighthouse, in which, by an ingenious arrangement of the carbons, the crater of the arc was maintained constantly in the same relative position to the center of the lens, and furthermore the crater reflected the light forward, so that almost the entire amount of light emitted by the arc was thrown toward the lens. The results of his experiments were as follows: Taking the light given in a horizontal plane with the direct vertical arrangement of the carbons as 100, he found the light given toward

the East or front equaled	287
North or side equaled	116
South or side equaled	116
West or back equaled	38
Mean	159

Lately D. L. H. Laudy of Columbia College has adapted this arrangement of carbons to lecture lanterns.

It is obvious in this that the ordinary position of the carbons in the arc lamp has been very much modified, as the crater, of course, generally throws the light downward instead of to one side. This peculiar position of the crater is obtained by placing the carbons in such a manner that the axis of the upper or positive carbon coincides with the edge of the lower carbon farthest from the lens The regulation of the carbons is on the principle of a focusing lamp, the arc always being in the same position in space. This is effected by a double movement of the positive carbon to a single movement of the negative, as the two are brought near to each other to compensate for the burning away of the carbon. The feed is perfectly constant, and so long as care is taken to maintain a voltage at the required figure the lamp will be perfectly free from hissing or flickering. As a consequence of this the variation in the intensity of the light is practically *nil*, and the intensity of a given lamp can be estimated within very narrow limits.

In connection with this electric lecture lantern several interesting points regarding its ready adaptability for the work are deserving of mention. Any lantern that has been used with the oxy-hydrogen light can easily be altered to carry the arc lamp. Other electric lamps for this kind of work have generally required special cases of more or less cumbersome nature. The oxy hydrogen light requires considerable skill in manipulation, and occupies a good deal of time to set up and keep in working order. The arc lamp is adjusted in a few seconds, and when once started the regulation is entirely automatic, no special skill being necessary in using it beyond the ordinary electrical knowledge requisite for the handling of an electric light of any kind A further and very important advantage in favor of the arc lamp for lantern use is its extreme economy. It is found as a result of careful experiments that the oxy-hydrogen light costs about $1.50 per hour, whereas the arc lamp can be run at a cost for current not exceeding 20 cents per hour; indeed, this is a liberal estimate at the ordinary meter rates for current.

A Neat Little Model.

The exploiter of a rapid transit scheme, the designer of a new system of electric propulsion, and, in fact, almost every inventor of machinery requiring power, finds a model not only useful but an almost indispensable aid to him in illustrating the features of his apparatus. Where to show the working of the device to the best advantage, power and light are necessary, electricity, nowadays, is invariably resorted to. Many inventors, though, while fully aware that electricity is a most convenient agent to be employed in models, are often times not well enough versed in such applications to fit up their devices with electric appliances. Anything, then, that helps the inventor cannot fail to be of value to a large number of the readers of the WESTERN ELECTRICIAN, and it is for this reason that the description of the little model represented in the illustration is presented.

The sign on the locomotive in Fig. 1 tells its own story. The little engine is running with fires drawn and the miniature electric car is pushing it around the track.

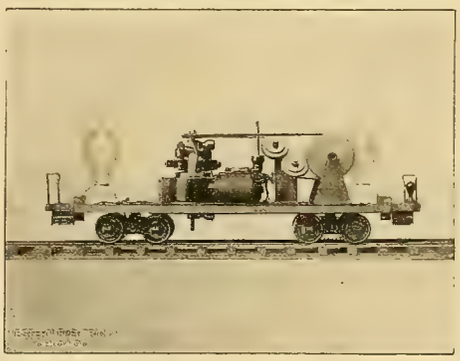


FIG. 2. A NEAT LITTLE MODEL.

These two little models were an attraction at a recent industrial exposition at St. Louis, but until now the details have not been published. The models formed an interesting feature in the Thomson Houston company's exhibit, which was in charge of B. J. Arnold, one of the consulting electrical engineers of the western department. Having but a short time in which to prepare his exhibit, Mr. Arnold hit upon the idea of pressing into service the miniature locomotive. The little engine was one that had been built by Mr. Arnold when a boy during odd hours and vacations from school. It is interesting also to note in this connection that the locomotive was built in a blacksmith shop and without the aid of the tools and appliances that to-day are considered essential.

The engine is a perfect working model of locomotive No. 3 of the "Burlington Route" and runs perfectly by steam. The object in using it in this exhibit was to illustrate the idea expressed by the sign on the cab.

The car, the interior mechanism of which is shown in Fig. 2, was designed to fit a ⅜ horse power C. & C. motor, and the ingenious manner in which the motor is fitted to the car axle is one of the features of the model. The sides of the car were of glass and were covered with advertising matter relating to the record of the electric company making the display. In the car and on the engine there were incandescent lights, connected in series and in multiple, according to the voltage and candle power of the lamps, as to show the advertisements to the best advantage.

From the edges of the canopy top of the exhibit an elliptical track was suspended by wires arranged to form a

EFFECT OF THE EARTHQUAKE ON ELECTRICAL PROPERTY IN JAPAN.

Howe truss, and upon this the miniature train was placed. A bare No. 12 copper wire, fastened to the ties with staples midway between the rails, served as the trolley wire and the track formed the return circuit. A copper brush bearing upon the wire made the connection to the motor.

A Precedent in Electric Insurance.

A press dispatch from Salem, Mass., says: "In the Superior Civil Court yesterday the jury in the case of the Lynn Gas & Electric Light company against the Meridian and twenty-three other insurance companies returned a sealed verdict for the plaintiff, and assessed damages to the amount of $9,161.66. The action was to recover $9,000, the aggregate insurance held upon the power house and light station of the plaintiff in Lynn. There was a slight fire in the tower of the station among the main wires, which resulted in the short circuiting of the entire system. The explosion of a large pulley in the main shaft, the racking of the engine, and the bursting of the mammoth fly-wheel, which tore through the walls of the building wrecked the structure. The companies refused payment of the insurance on the ground that the fire was not the cause of the damage. They contested the case, as its decision involves a precedent for future electric plant insurance. Exceptions have been taken, and the case will go to the Supreme Court."

Drunk on a Telephone Pole.

This story, which has a very obvious moral, was telegraphed from Grand Rapids, Mich., as a press dispatch: "Calvin Baldwin, a telephone lineman who was stringing new wires on a pole, becoming chilled by exposure, took two drinks of whisky to keep the cold out and then returned to his perch near the top of the pole. He had hardly reached his position when his comrades on the next poles noticed that he was acting queerly. They went to his assistance, and when they climbed up to where he was they found him drunk and in great danger of falling to instant death on the pavement below. He was so drunk that he could not climb down, and declared that he would not any way. One man grasped him by the belt and held him up by main strength for a quarter of an hour, while the other procured a rope. He was finally lowered to the ground with the rope around his body, and was taken home."

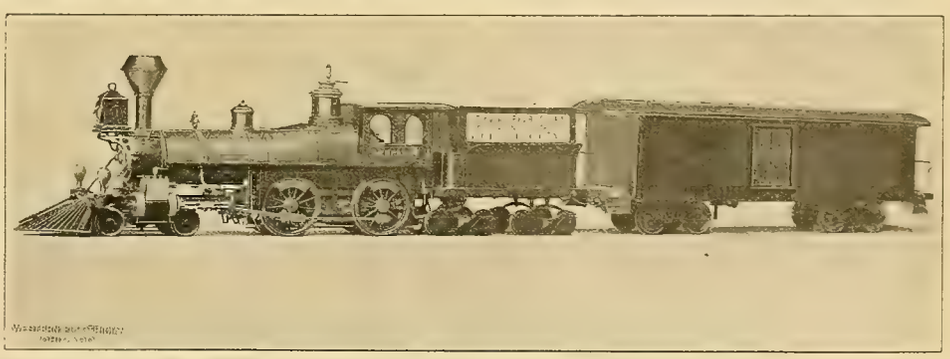


FIG. 1. A NEAT LITTLE MODEL.

A company is being organized for the purpose of erecting an electric light plant at Hartford, Ky.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application

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THE Chicago Electric club has taken steps toward a permanent organization. At the meeting, Monday evening, it was decided to form a stock company, thereby entirely reorganizing the club, and providing for its permanent support. It is believed that this will insure the future prosperity of the club. This organization will no doubt be called upon during the World's Fair to entertain many distinguished visitors and it is now preparing to get into position to do justice to the electrical fraternity of the western metropolis.

BROOKLYN'S new mayor, according to the New York papers, has come to appreciate the fact that his views are not in accordance with those of his constituents on the subject of the electric railroad. The board of aldermen has again passed the resolutions granting permission to the surface roads to substitute electricity in place of horses. It was announced that in case Mayor Boody again disapproved the resolution it would be passed over his veto. In view of this fact, the mayor has sent out to other cities for information on the subject of the operation of the trolley. He will not, it is said, again interfere unless he has had some additional facts upon which to base his action.

A SHORT article on the storage battery, by F. K. Irving, is presented in another column. The most salient p ints brought out by Mr. Irving, and the ones that should be particularly interesting to those about to install storage battery plants, relate to the energy recoverable from a given weight per cell under different conditions, and also as to the life of accumulators. Mr. Irving, who is a practical storage battery manufacturer, goes on record with the statement that he finds "apparently the average life of the peroxide positive is from six to eight months' active service." The lead negatives in some cases, says Mr. Irving, "have a life of about three years." Of course, the above statements were qualified with reference to the treatment of the apparatus.

MR. EDISON is reported to have suggested the use of electricity, with a stream of water as a conductor, in case of war with Chile. His plan contemplates the defense of fortifications by this means. Electrical engineers will be inclined to view the idea with skepticism, but even should it prove practicable the idea of making it public is not a particularly happy one. If war should be declared by the United States, the military operations of this country would be mainly offensive. The plan of our army and navy officers would not be to wait quietly at home until the enemy chose to attack us, but to force the fighting in Chile and to keep our adversaries busy on their own ground. In the main we would be the aggressors and the enemy would fight on the defensive. Unfortunately, therefore, Mr. Edison's suggestion, if practicable, would be principally of value to the Chileans.

OPPONENTS of the extension of the electric system at Milwaukee have furnished in their argument before the common council of that city the best possible evidence of the fact that the electric railway supplies unequaled facilities for rapid transit. It was proposed to extend an electric line through a thickly populated district which has never had communication with the down town district of the city. It was of course expected that the proposition would be received with unanimous approval, and as a matter of fact over ninety per cent. of the people interested in the matter favored the project. The opposition came from a comparatively few small storekeepers on the outskirts, who admitted that their objections were based on the fact that they feared their business would be injured if the line was built. This, it is scarcely necessary to say, was explained by the fact that the electric line would allow the people to go down town to do their shopping, and the small dealers on the outskirts, realizing that they could not compete with the big houses, presented their grievances to the aldermen with the hope that they might prevent the extension of the line. City officials have been known to committ many outrageous blunders, but it could hardly be hoped that the people of Milwaukee would tolerate such action as was proposed in this instance.

ONE of the most interestiong subjects discussed in Mayor Grant's annual message to the New York board of aldermen is that of rapid transit. The mayor relates the steps already taken to secnre improved service, and he refers to the plans already submitted by the commissioners. He says that these plans are comprehensive and that they have met with the general approval of the public and the almost unanimous commendation of the press. The proposed line, he continues, will extend up Broadway to Fourteenth street, and thence by diverging lines to the east and west, reaching the largest centers of population least provided with rapid transit facilities.

The mayor seems to approve the general plan of the commission despite the fact that the New York *Sun* recently quoted him as being opposed to any underground system. Another passage of interest to those engaged in electric traction is that referring to the subject of rapid transit for the annexed district. On this point Mayor Grant says: "For its surface roads I favored the trolley system as being peculiarly adapted to its needs. The people of the Twenty-third and Twenty-fourth wards are at a disadvantage in their facilitiesfor rapid transit which their geographical position does not justify. While the people of the west side are now enabled to proceed from their residences to their places of business in one railway by the payment of one fare, the people of the annexed district are compelled to patronize two different lines and pay two fares. When the proposed line of railway laid out by the Rapid Transit commissioners is built the difficulties will be remedied."

It would seem that for this reason alone the people of New York would take kindly to the proposition of the Rapid Transit Commissioners. At the present time the city is without a comprehensive system of rapid transit.

A CERTAIN spirit of jealousy crops out occasionally in the English electrical papers when references to American achievments or inventions are made. Thus the *Electrician* of London, in reviewing the year, indulges in this little fling: "Electric traction still continues to make progress of that slow but sure description so dear to the English nation. The general adoption of electricity on urban tramways seems as far off as ever. At Leeds Mr. Graff Baker has been plucky enough to give us a somewhat dubious blessing in the shape of a plain undiluted specimen of the American overhead trolley system Mr. Baker appears to have imported a consignment of his native characteristics, together with his cars, for, despite the changed environment, he has already had a miniature 'smash,' and is now 'in interference' with the National Telephone company. All who admire pluck will wish him well out of his difficulties." This is certainly an admirable way for an electrical journal to further the interests that it professes to advocate. The ill concealed sneers of the *Electrician* can scarcely be inspired by any more worthy motive than a petty spirit of envy at the conspicuous success of the United States in electric traction and the deplorably backward condition of Great Britain in this respect. Now that the English are beginning to wake up to the practical, commercial value of overhead trolley railways they are compelled to copy after America. But this step should be hailed as an indication of progress, and not made the basis of sarcastic jibes. The *Electrician* should be ashamed of itself.

OF late, and in fact ever since the World's Fair was located at Jackson and Washington Parks, the electric companies exploiting railway systems have been agitating the subject of securing facilities for the satisfactory exhibition of their machinery. Apparently the management of the exposition has not awakened to a realization of what the electric railway companies actually require to enable them to make a display that shall be creditable alike to the exhibitors and the Fair. It has been suggested that the several companies be each allowed a mile of the proposed intramural road in Jackson Park, as it was thought these exhibitors would only want electric power for their cars, and would be satisfied with this scheme as an advertisement. Without going into the details of this scheme, which might be characterized a half-hearted one and one that would be beset with difficulties, we believe that when the electric companies' preparations for their displays are well under way there will be a cry for better facilities than those which would be offered by a single line to be used in common by all exhibiting companies. It is needless, perhaps, to point out that the manufacturers of railway systems do not sell only the car equipment. Some of them sell generators, and a few have been known to claim, like the arc light man, that his devices would "only run on a certain company's dynamos." While such claims may be disregarded, yet the fact that a company has a complete electrical equipment to place before the people, should entitle it to consideration.

For this and other reasons it is fair to presume that the plan that would insure the most striking and complete exhibition in this particular line, will be the one through which each company will have a chance to display its own particular system in its entirety and on a separate track. Of course, the first objection to any such plan as that just outlined will be found in the question as to whether sufficient space could be found within the grounds to accommodate all the standard systems. In answer to this probable objection it is but necessary to point to the Midway Plaisance and Washington Park. Perhaps some of the railway companies will be satisfied with the facilities which may be offered by the intramural line. But why not allow those exhibitors who desire to do so, to equip each a complete system locating the lines either in Midway Plaisance, or perhaps better in Washington Park, with the power stations in Washington Park? There seems, too, to be a general forgetfulness of the fact that the inventor of conduit electric railway systems has been most prolific of late. Where will such equipments be exhibited? To sum up, it seems reasonable to ask that as Washington Park is to take the overflow of exhibits, the electric railway companies be granted the privilege of taking space in this portion of the grounds, should they see fit to do so.

The Chicago Electric Club.

The last meeting of the Chicago Electric club, which was held on the evening of January 18th, was a most important one, from both a scientific and a business standpoint. The first part of the evening was devoted to a debate between Alexander Dow and Wm. Stanley, Jr. The subject under discussion was, "Electric Power Transmission; Alternating or Multiphase vs. Direct Current." Mr. Dow took the side of the continuous current and Mr. Stanley, through his representative, W. B. Tobey of the Stanley Laboratory company of Pittsfield, Mass., ably defended the alternating system. F. B. Badt who had been appointed judge gave his decision in favor of Mr. Stanley. After the reading of the two papers above mentioned another paper on "Electric Power Transmission," by D. C. Jackson, was read. An informal discussion then ensued in which Messrs. Tobey, Wilmerding, Dow, Dorman and Grier participated.

The club then turned its attention to business in the consideration of a plan for the reorganization of the club on a stock basis. The special committee appointed by the board of managers of the club, composed of Messrs. Gilman, Sunny, Terry, Kreidler, and Degenhardt, for the purpose of considering the advisability and practicability of reorganizing the club's finances on this basis presented the following resolution for the consideration of the members:

Resolved, That this committee recommend that the club be reorganized under the state law, for profit, with an authorized capital of $25,000 (par value of each share, $10); $15,000 of the stock to be offered for subscription at once, and the proceeds of the sale to be used as follows:

To return to the members of the club in stock all sums that have been advanced to it by gratuitous subscriptions and assessments since its formation in May, 1887

To pay off any outstanding obligations, and more especially to provide a fund with which to take care of all necessary expenses in connection with the enlarging of the present quarters of the club, or moving the club into larger and more commodious quarters, and for the purpose of extending its restaurant service, etc.

That said stock be sold on the basis of paying the subscribers, if earned, 6 per cent. per annum interest; that is, 3 per cent. semi-annually on the first day of January and on the first day of July; any additional earnings above 6 per cent. to be retired as a surplus. That the stock shall be registered by one of the trust companies of Chicago, at whose office the dividends shall be payable.

After considerable discussion the report of the committee on the reorganization of the club on a stock basis was adopted, the plan submitted was indorsed, and a committee of three was appointed to make a proper revision of the constitution and by laws. It was further decided to have the plan of reorganization as contained in the four principal clauses of the committee's report posted on the club's bulletin board.

Figures from Philadelphia.

The Philadelphia *Record* has been figuring up an astonishing loss of electricity in the heating of conductors, with this result: "One dynamo can produce enough electricity for 2,500 lights. If there were no such loss, the same dynamo could produce 2,941 lights. Each dynamo thus loses electricity enough for over 441 lights. In the Edison station alone, which contains eighteen dynamos, twelve dynamos are running at present, supplying a maximum of 30,000 lights, burning at one time. The loss of wire heating from this station is, therefore, 5,294 lights. As the company charges ¾ of a cent an hour for each lamp, the expense of the loss amounts to nearly $40 an hour, or $960 a day, and computing at the same full time, $350,000 to $400,000 a year. This is what the lost electricity would have cost the consumer. The company is actually out 15 per cent. of its coal bill. Under the usual pressure each lamp represents one-fifteenth of a horse power. The Edison station is out by the wire heating 353 horse power, or 84,704 candle power. There are in Philadelphia twenty-one electric light plants of all sizes, about four of which possess over 10,000 candle power each. As most of these are private plants, the average loss is much lower than that of the Edison station. A fair estimate of the aggregate power of all these various plants places the total production at 200,000 lamps. This represents a loss of 35,249 lights. The ground and air is thus receiving constantly, from a million wires, a steady supply of electricity to the extent of 564,704 candle power, or 2,353 horse power."

Electric Wires and Underwriters.

How to avoid the danger of fire resulting from defects in the electrical wiring of buildings is one of the serious problems that owners, builders, inventors and insurance men are continually considering, says the New York *Times*. The danger from this source is most menacing, and labor to overcome it is unremitting. The New York Board of Fire Underwriters is in constant communication with electrical experts and theorists on the subject.

Speaking of the matter, Superintendent Anderson of the electric wiring department of the board, said: "This is no new question with us, but one of years' standing. For more than five years the board has been availing itself of the opinions and deductions of Prof. Henry Morton of the Stevens Institute of Technology on matters pertaining to it. We aim to find out the weak points and defects in every system in use in this city, the liability of each to cause trouble, and to guard against them.

"We do not aim a blow at any one system, but rather at the defects of all. Thus, Prof. Morton has within a few days made us a written report upon questions submitted to him by us. This is a case in which a pinch of prevention is worth a pound of cure."

The Ancient and Modern Accumulator.

By Frank K. Irving.

Accumulator is the name wrongly given to the secondary battery of the present day, which is an apparatus capable of storing energy in the shape of chemical combination and giving it out again in the shape of electrical energy. A secondary battery is in reality nothing more than a reversible battery or pile, capable of being regenerated by sending an electric current through it in the opposite direction to that which it itself produces. There is in it a recombining of its component substances in their original state, and thus a fresh quantity of energy may be produced, limited in each case, however, by the nature and quantity of the active materials and the duration and power of the charging current. Theoretically, every battery, the chemical action of which does not eliminate the active gases, when in the act of charging, is a reversible battery and capable of becoming a secondary cell. Practically no metal but lead in some condition or other has thus far proven a commercial success in the secondary battery. The success of lead, too, has only proven a partial one, as the life of the lead positive is limited to about six months' active work. A secondary battery may, after a fashion, act as a transformer; that is to say, currents of much heavier amperage than that of the original charge may be obtained from it for a proportionately shorter time. Or, vice versa, the cell may give a smaller current for a longer period of time than that of the original charge. For example, one hundred small secondary batteries may be charged in quantity or multiple by two or more primary batteries having an available charging electromotive force of 3.5 volts. After sufficient charging the secondary batteries may then be coupled in series, and the electromotive force of each cell, multiplied by the number of cells, may be taken from them for as many ampere hours as are represented by the quotient of the total charge divided by the number of cells. The most simple way to construct the secondary pile is to roll two long broad lead plates, separating them from each other about one-eighth of an inch by any good flexible non-conducting substance, leaving a terminal for a negative and positive connection, and then binding the pile together with rubber bands. This battery can be placed in a circular jar, say about five inches in diameter and seven inches high, filled with sulphuric acid and water, mixed in a proportion of one to ten. This arrangement is the typical Plante battery.

When a secondary cell of large surface is new and the charging current is passed through it oxygen appears almost immediately on the positive plate, and it is not long before it is covered with a fine coat of peroxide of lead. On the other hand, the hydrogen, after having reduced the slight percentage of oxide with which it may have been covered by exposure to the air, soon makes its appearance on the other plate. If now, after some seconds the secondary current be tested it will be found that the "crispness" of the spark, so to speak, is already very energetic, and the chemical action during the discharge has been as follows: The oxide on the plate, which during the passage of the charging current was negative, has slightly peroxided, at the same time that the peroxide that formed on the other plate during the passage of the charging current was reduced by hydrogen, therefore, the two plates are covered with a slight coat of oxide and of reduced metal, which facilitate the action of the charging current when again turned on. The lead plate, which, during the first passage of the charging current, was negative, is covered with a coat of oxide after the discharge takes place. It results, therefore, that if the charging current is again turned on the first portion of hydrogen will be applied to the reduction of this coat of oxide, instead of the thin coat due solely to exposure to the air, as happened previously. In consequence, the appearance of hydrogen on the surface of this plate will be retarded to a greater extent than it was in the first instance. This time the first portion of the oxygen set free on the surface meets a coat of reduced protoxide or subdivided metallic lead, on which the gases have a greater hold than on the original lead plate. That is, to say, the gases are more easily absorbed, consequently a delay may also be noticed in the appearance of oxygen on this plate.

When the cell is again discharged these phenomena are reproduced, and after this operation has been repeated a very great number of times it will be seen that the surface of the plates are in a more favorable state for reoxidation, as the coat of oxide alternately formed and reduced, becomes denser, and the resulting secondary effects last longer and are more energetic. It will, in fact, be noticed that the more charging current a secondary battery receives the longer will be the duration of the secondary current. All the work of the battery is thus accumulated in the shape of oxidation of the lead plate on one side, and the reduction on the other of oxidized lead produced by the previous discharging current. When in a well formed cell the gases commence to appear and escape, this is a sign that the battery can effect no more useful work in the storing of energy. A well charged secondary cell will furnish a discharge which depends on the size of the plates, the amount of active material used therein, and finally on the external resistance of the circuit. We may use the following analogy to illustrate the discharge of the secondary battery, viz.: A very large vessel holding a great quantity of liquid at a slight depth may furnish for a long time through a small orifice a nearly constant flow, ceasing suddenly as soon as the liquid gets to the level of the orifice. So with the secondary battery of great surface, which only diminishes in strength a short time before entirely stopping its supply. The initial electromotive force of a well-formed secondary battery is about 2.2 volts, falling during the discharge to about 1.9 volts. The low internal resistance of the cells, which is usually about .005 of an ohm, explains the strength of the current furnished. Secondary batteries can keep an accumulated charge for a considerable length of time, giving off about 60 per cent. efficiency after three weeks' standing. According to Plante the secondary battery has about 90 per cent. efficiency, but this is seldom reached in practice.

The formation of the secondary cell is a long and costly operation, and many plans have been devised to reduce both the cost and the time. Among the first to discover one of the many ways now in use, was Plante, who accelerated the formation, by increasing the temperature of the electrolyte during charging.

A better plan is to soak the plates in a strong nitric acid solution for about 48 hours, thoroughly wash in clean water and then place them in the cells filled with the proper electrolyte for charging. Although a dissolution takes place, forming some nitrate of lead, the thickness of the lead plate is not materially diminished by this process. The action of the acid produces a sort of metallic porosity, so that the chemical action is not limited merely to the surface of the plate, but it also acts internally, facilitating in consequence the action of the charging current.

Secondary cells so treated will, in a week, after three or four reversals of the charging current, give results that it would have taken months to produce in the old way. The secondary battery of to-day is constructed on the same principle as the old Plante cell, with the exception of the plain lead plate. The improvements were made by Faure, who covered the lead plate with a mixture of red lead, which was held on by felt. These plates were then placed close together in the retaining cell, which was filled up to the proper height with the acidulated water. This type has ong since been abandoned, in favor of the present batteries. In these the felt, which soon rotted in acidulated water, is not used, but perforated lead plates in the shape of a grating are employed. The reduced lead and the peroxidized lead in the grating are therefore in the form of small blocks, surrounded on four sides by a net work of lead conductors.

All experiments with secondary batteries go to show that the total recoverable energy from a given weight per cell, diminishes as the work demanded in the given time is increased; that is to say, the greater the current taken out the less will be the total output. In recent experiments with the modern secondary battery five to six ampere hours per pound of plates have been obtained with a mean useful potential at the terminals of 1.9 volts. A horse power of electrical energy is thus obtained from a weight of about 60 to 80 pounds of complete cell. As to the duration and life of secondary batteries, no absolutely reliable figures are so far available. Undoubtedly the lighting apparatus installed permanently, and charged and discharged systematically, will last very much longer than batteries for vehicles, subject to rapid charging, irregular use and such knocking about as they usually receive. Apparently, the average life of the peroxide positive is from six to eight months' active service. The lead negatives in some cases have had a life of about three years. Thus it will be seen in the manufacture of secondary batteries the great object is to obtain a comparatively indestructible positive electrode, which should be able to make a battery useful for at least two years' active work.

Novelties in Switches.

In the accompanying cut is shown a new switch which is being put upon the market by the Star Electrix company of Philadelphia. This switch, Fig. 1, is intended for a panel or wall, and, as will be seen, instead of protruding, as is the case with ordinary switches, the handle or button is set in a recess so that the end comes flush with the wall. An interior view of improved construction in the 10 ampere single pole switch is shown in Fig. 2. The handles

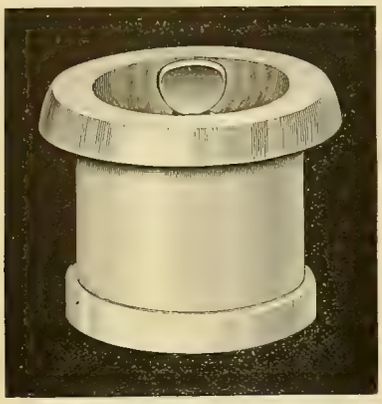
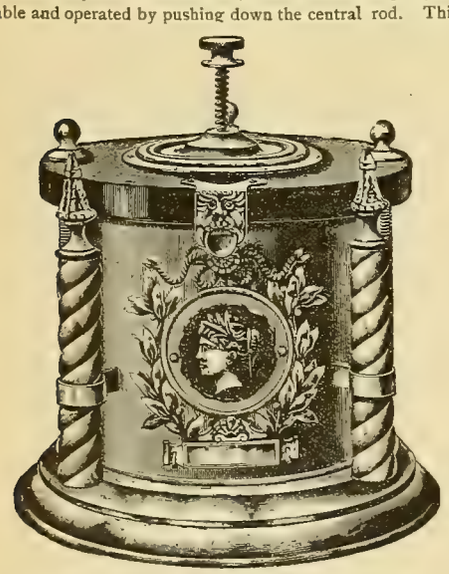


FIG. 1. NOVELTIES IN SWITCHES.

have a large flattened metal nut in their interior, making it impossible to break or twist them off, while the wire connections are provided with a very convenient set screw.

Electric Lighter.

The attractive novelty represented by the accompanying cut is a late invention, and is styled an electric lighter. It is operated by pressing the little button at the top of the center rod, when the light instantly appears at the opening under the ornament upon the upper band. It is made of highly polished nickel plate, is but six inches high and occupies only six square inches on the table or mantel. Its construction is simple, and it can be readily taken to pieces and readjusted. Current is furnished by a small battery, which can be easily replenished. Although the device was originally designed simply for a lighter, it has been found practicable to add several useful accessories. A medical coil, with hand electrodes, can be readily attached, by which either gentle or sharp electric shocks can be given. The lighter can also be connected by wire to the doors and windows of the house, thus providing a complete electric burglar alarm, or if in a city it can be connected with a street wire to the nearest police station. Another adjunct is the call bell, which is also easily adjustable and operated by pushing down the central rod. This



ELECTRIC LIGHTER.

lighter is manufactured and sold by the Barr Electric Manufacturing company of New York.

Sir William Thomson's advancement to the peerage calls out this reminiscence: While he was demonstrating an algebraic problem to his class in Glasgow University one of the students peppered him on the bald spot on his head with a hard paper pellet. Instantly he threw the chalk he was using on the floor, and, facing around with clenched fist and eyes aflame, he shouted: "Who did that? If I knew who dared to throw that pellet, by Heaven, I would crucify him!" The students played no more tricks with him for a long time thereafter.

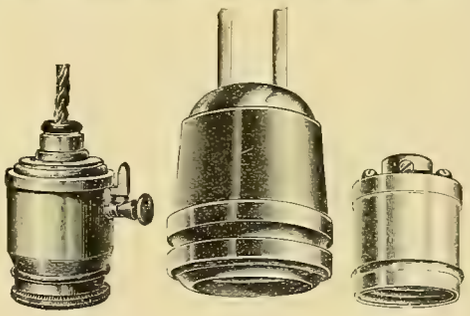
New Edison Sockets.

The new sockets recently placed on the market by the Edison General Electric company are illustrated in the accompanying cuts. The pressure or push button socket, Fig. 1, is similar in size to the Edison key socket, but, instead of a key projecting from the side, it has a small button and a spring catch. By pressure exerted on the button, it is pushed in until contact is made and the lamp lighted, the button being retained in this position by the small retaining catch. To extinguish the light this catch is pressed, the button is thrown out and the contact immediately broken. The pressure socket is designed for use on flexible cord and other pendants, but can be used in many instances where the ordinary key socket is now employed.

The small keyless socket is designed for fixtures of an artistic character where it is intended to avoid giving a heavy appearance. It is shown in Fig. 2 and the dimensions of this socket are about 1¼ inches by 1 inch.

In Fig. 3 is shown a socket which can be used in breweries, laundries, dye houses, boiler rooms and other places, where moisture and steam have a disintegrating influence on nearly all insulating materials. It is a hard rubber keyless socket. Its construction is somewhat similar to the porcelain weather-proof socket, but with important points of difference, however. The shell is of hard rubber, and has a neat appearance. The interior parts are embedded in insulating material of strong moisture resisting properties, and the connecting rubber covered wires are led out through two small holes in the top of the hard rubber shells. It has been found to present the necessary qualifications for use in tunnel lighting.

In the other sockets and receptacles, both key and keyless, of the Edison company, there will be an important improvement. Hitherto, the insulation of the socket has been of the best material that could be found, but now



FIGS. 1, 2 AND 3. NEW EDISON SOCKETS.

that a porcelain factory has been established at the Schenectady Works, hard, white vitreous porcelain, will be the insulation employed in the future.

A New Snap Switch.

It would seem that the field was pretty well covered in the way of switches and other devices for interrupting or controlling electric currents, but changes are being made every day, and new forms adopted. The snap switch shown in the illustration is the design of Charles Wirt. It is of small size but has a large carrying capacity as it will break the full current on 220 volts without injurious sparking. It is very neat in finish and appearance, and is made by the Electrical Supply company, Chicago.

A Talk with Edison.

In the New York *World* of January 17th appeared a long interview with Edison. Although written in the extravagant style which characterizes the daily newspaper allusions to this inventor and his achievements, portions of the article are very interesting. For instance, Mr. Edison was asked how electricity could be called into service in case of a war with Chile.

"That," said he, "I want to talk about. It is true I have invented an electric torpedo, the Sims-Edison torpedo, which we have sold out to the Armstrong Gun company. It is a very fine thing. It is put on a wire, as of course you understand, and moved by electricity. It can be run out two miles ahead of a man-of-war's bow and kept at that distance ready to blow up anything in reach. It is a very pretty and destructive toy. But it is not in that kind of thing that I take pride. What I want to see is some foreign nation coming to this country to attack us on our own ground.

"That is what I want to see, and I think that electricity will play such a part in war when that time comes it shall make gunpowder and dynamite go sit in humble obscurity with the obsolete flint arrow-head and call him brother. Every electrician, when that time comes, will have his plant for making the life of his enemy electrically uncomfortable. Here is one item of defense which I have in mind.

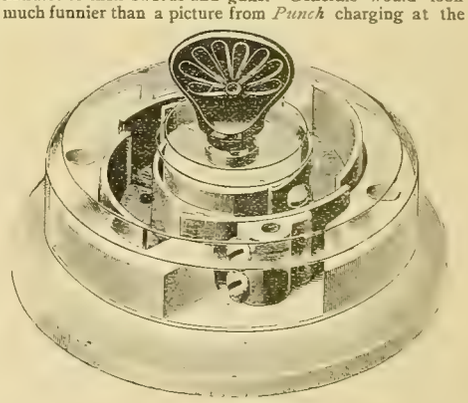
"It is simple as A, B C. I have never spoken or written about it before. With twenty-five men in a fort I can make that fort absolutely impregnable so far as an assault is concerned, and I should only need twenty-five men in the fort to do it. This is not guesswork but a matter of absolutely scientific certainty. In fact, twenty-five men would be a very liberal garrison. Some years ago when the wires loaded with heavy electric charges began to go up everywhere, I predicted that there would be danger of the firemen receiving deadly shock by the electricity running down the streams of water which might cross the wires. The insurance people laughed at the idea. But I tried it on a cat, and the cat and I found my theory

FIG. 2. NOVELTIES IN SWITCHES.

to be true. That is to say that I did, and the cat found it out if there is another world for cats. He never knew anything about in it this world.

"In each fort I would put an alternating machine of 20,000 volts capacity. One wire would be grounded. A man would govern a stream of water of about four hundred pounds' pressure to the square inch, with which the 20,000 volts alternating current could be connected. The man would simply move this stream of water back and forth with his hand, playing on the enemy as they advanced and mowing them down with absolute precision. Every man touched by the water would complete the circuit, get the force of the alternating current and never know what had happened to him. The men trying to take a fort by assault, though they might come by tens of thousands against a handful, would be cut to the ground beyond any hope of escape. Foreign soldiers undertaking to whip America could walk around any such fort as mine, but they never could go through it. It would not be necessary to deal out absolute death unless the operator felt like it. He could modify the current gently so as simply to stun everybody, than walk outside his fort, pick up the stunned generals and others worth keeping for ransom or exchange, make prisoners also of the others if convenient or if not convenient turn on the full force of the current, play the hose on once more and send them to the happy hunting grounds for good."

The picture raised by Mr. Edison is certainly a most beautiful and attractive one. It is nice to think of all the fine descriptive matter that could be written. Such a fort and such a warfare as Mr. Edison has planned would make old-fashioned generals and M. Detaille, of battle scene fame, turn in their graves. We should have infantry moving on forts at a quickstep, dressed all in rubber, with chilled glass soles to their shoes and non-conductor handles to their swords and guns. Generals would look much funnier than a picture from *Punch* charging at the



NEW SNAP SWITCH.

head of their armies riding on horses shod with rubber arctics, the generals themselves carrying large rubber umbrellas, with gutta percha handles, over their heads.

The world owes a great deal to Mr. Edison for the things he invents and for the ease with which he gets out of the common place and makes life worth living. This fact was pointed out to Mr. Edison and then this question was put to him:

"The world owes you a great deal. How much has it paid you for the work you have done?"

Mr. Edison laughed.

"Oh, I don't know," said he. "Probably as much as the world thought it was worth."

"Mr. Edison, some people think you have made untold millions. Incidentally they are glad if you have. Others say you have not made much of anything. That most of the money your inventions produce goes to make other gentlemen fat and happy. Could you take the trouble to go carefully with me over all your inventions, make an estimate of the amount of money which they produce, and

give me some idea as to what share you got of that wealth?"

Mr. Edison thought he could. First he wrote down the following list of his inventions, which, as he said, were his commercial inventions, that is to say those which by returning a profit had proved their own success.

As he made the list he made comments on the various inventions, and that list is interesting, because, written in his own handwriting, it gives his own estimate of his personal share in the various electrical inventions with which his name is connected.

District Telegraph.—"Of that I am one-half inventor."

Quadruplex System of Telegraphy.—"That is my invention."

Stock Ticker.—"Of that I am one-half inventor."

Telephone.—"One-half my invention."

Electric Pen and Mimeograph.—"My invention."

Incandescent Lighting System.—"My invention."

Electric Railroad.—"I am one of the inventors of that."

Phonograph.—"My invention."

"The district messenger service is in use in 600 cities and towns in the United States. The investment amounts to about $4,800,000, paying about 5 per cent. The system employs about thirty thousand persons, averaging $1 a day salary.

"The quadruplex system of telegraphy is in use on 72,000 miles of Western Union wire. Eleven years ago the Western Union reports stated that the quadruplex system saved $560,000 in interest and repairs. Inasmuch as every mile of wire actually built does the work of four miles of wire, the quadruplex system represents 216,000 miles of phantom wire, worth $10,800,000.

"On these $10,000,000 worth of wires there is no repairing to be done. The value of those phantom wires is therefore represented by a saving of $860,000 in repairs at $4 a mile annually, besides the interest on the $10,800,000 which it would have taken to build them. Three thousand men work on my duplex instruments."

"Mr. Edison, how many millions do you make out of the millions which that invention of yours creates?"

"Not many. I sold the system to the Western Union sixteen years ago for $30,000, and spent the whole of it in experimenting in trying to make a wire carry six messages instead of four. I didn't succeed, so that financially I am worse off than I would have been had I never invented the quadruplex system."

"How about the stock ticker?"

"That employs about five hundred men at work and represents an investment of $8,000,000, paying about 5 per cent. a year. From that invention I have received at different times $50 000. I spent $60,000 in getting the thing up. That again was a loss."

"Now for the telephone, Mr. Edison. Everybody supposes that you and Prof. Bell have millions stowed away, made on your telephone inventions."

"Bell invented the receiver. That is the end of the telephone which you put to your ear. He was trying to use that simultaneously as a transmitter, but could not make it go. The thing, therefore, did not pay. I invented the carbon transmitter, which made the telephone a financial success by making it commercially available. Here are the financial figures on the telephone, which really stagger me now that I come to look them up. Throughout the world there are at least one million telephones in use. They pay $50,000,000 a year rental. They represent an actual investment of $100,000,000 at least, capitalized at twice that sum, and paying about $10,000,000 a year profit. That invention of mine was a very good thing for the girls, which is a gratifying thought. It employs 20,000 people, mostly young women. I got for the telephone about $102,000 in all. Taking out what I expended in experiments I probably realized $25,000 in clear profit. Bell made about half a million. Many people imagine that he made an enormous fortune, but he didn't. It was his father-in-law who made a vast fortune by getting control of much stock.

"My electric pen and mimeograph duplicating apparatus is used very largely here and in Europe. Three hundred men make a living out of it. The profits on that are not large.

"My incandescent light system is the most satisfactory to contemplate as regards the employment it gives to great numbers of men. Throughout the world 36,000 men make a living out of that invention. In my shops at Schenectady I employ 3,800 hands; at my Harrison lamp works, 1,000; in the New York works, 150. About four million lights are burning. These represent an investment of cold cash of a hundred millions. I can count up eighty-seven millions. In addition to that customers have paid twelve millions more for the installation of wires. The thing is capitalized, taking all of the companies together, at about two hundred millions paying from 4 to 20 per cent. a year. My patents on incandescent lights netted me about $140,000. I spent about $400,000 in experimenting.

"The electric railway is, of course, not such a big enterprise. I built the first in the United States at Menlo Park in 1879. It was three miles long, and on it I obtained a speed of forty miles an hour. I sold it out long ago. I did not get my money back on it.

"The phonograph is a new thing. It will take four or five years to pioneer it. It will be greater than the telephone. To pioneer a thing is to get it on its feet. It took twelve years to pioneer the typewriter. Yes I might invent an electric typewriter, a noiseless one, but the thing is not pressing, as it is in very good condition now. I have sold the phonograph out, but about that there is a complicated story, which need not be told. I have made no money out of it, but there is one thing which I am now working on out of which I shall make money and of which nobody can get any share except the boys here who own the thing with me. That is the magnetic concentration of iron ore. It is the latest commercial thing I have got up. I have a mill at Ogden, N. J., with a capacity of 2,000 tons in twenty hours. This is the idea briefly. Iron ore is not Bessemer ore unless it contains as little as a fifty thousandth part of 1 per cent. of phosphorus. If it has more phosphorus than that it is brittle and cannot be used for making Bessemer steel. We are obliged for our eastern manufacturing interests to import Bessemer ore from Algiers, Cuba, Spain, etc., as the freight from Michigan is too expensive. We import about 1,600,000 tons per year. New Jersey contains the largest strip or area of primal rock containing ore in the United States. There is probably more ore in this state in the primal rock than in all the rest of the states put together. The magnetic concentration of that ore would produce enough to supply the United States for centuries. The process of concentration—that is, of extracting magnetically the small particles of ore from the rock in which it is scattered—makes it Bessemer ore of the highest quality by destroying the phosphorus in it. I have been for three years leasing all the available deposits of ore in New Jersey. I have secured eighteen square miles of mineralized rock now. This will be for me a regular Standard Oil enterprise. In six or eight years I shall take out ten or twelve million dollars' worth of ore a year at a profit of about three millions a year clear. I have now in contemplation eight mills.

"From my various patents, so far as the patents themselves go, I have stood an actual loss in experimenting and in lawsuits of $600,000. I should be better off if I had not taken out any patents. I do not mean to say that I am a pauper, as you might think from my talk. But my money has not been made out of patents, or out of any protection that the Patent Office has given me. I have made it all out of manufacturing, and I have made quite enough to pay for my experiments and to get a good living, which is all that I care about."

"Mr. Edison, Chauncey Depew in his speech at the World's Fair dinner commented on the fact that whereas in the exposition in Philadelphia there was only a few overhead wires to tell the tale of electrical inventions, the Chicago Exposition will contain a building of great size, devoted exclusively to the progress of electricity, and filled with machines, nearly all of them the work of one man. If you were to try, regardless of space, how big an exposition of your own work do you think you could get up? How many machines have you worked on in your life?"

"Well, it would be hard to say. I have worked on as many as forty machines at one time. An exhibition of all the machines that I have worked at and experimented on, if I had kept them, would cover about twenty-five acres."

Generating Stations and Their Physical Hazards.[1]

By Geo. P. Low.

Electric lighting people, in combating the belief that central stations are an extra hazardous risk, are enduring the penalty imposed for violating the unwritten, though well established, law condemning cheap and make-shift constructions. We all remember how, only a year or so ago, anything under the sun in the way of a shed would be pressed into service for housing electric light machinery. Everything about the plant wore a temporary aspect; nothing appeared permanent, and the only apparent aim of the electrical concerns at that time appeared to be to furnish electric light at the earliest possible moment. Cheap frame structures of the roughest materials were hurriedly erected, tumble-down saw and grist mills were patched up, and even abandoned barns were made to serve as electric light stations. Then, as if pledged to the motto, "Anything goes," the electrical equipment was placed in reckless disregard of safety, and another electric light station would be launched into existence to tempt fate and invite disaster. The *Chronicle* fire tables show that during the nine years previous to and including 1890, 129 electric light stations were burned in the United States, but considering the wretched construction of so many of them, it is hard to understand why this number is so small unless it be that Providence prevails—not the public enemy. Is it a wonder, then, that the level-headed fire underwriter who does nothing without a reason discriminated against these risks? Their inherent hazards were certainly great and sufficiently so in some cases to prohibit insurance, but now the lesson of experience has been learned, the necessity for central station construction after the most approved methods is fully realized, and the electric lighting industry in this particular, at least, is in a state of transition. New stations are being properly erected and many of the old ones are undergoing reconstruction or are being torn down and rebuilt in accordance with the modern ideas. Better days are already here, and generating stations, whether for isolated or central station work, are no longer necessarily a risk to be avoided as one "sure to go."

I cannot believe that many have a conception of the wonderful influence electric lighting has exerted in developing and more nearly perfecting many mechanical appliances. A dozen years or so ago the ordinary single expansion slide valve engine or the Corliss compound engine represented the highest perfection attained in the art of steam engine building. The value of these engines is not to be detracted from, yet they were all capable of running only at slow speed, and their efficiency was not near so high as the engines manufactured at the present time. Those artificial individuals known as corporations fully understand that the profits of the business they carry on depend almost as much upon the legitimate reduction of operating expenses as upon actual receipts, and in response to their demands the not infrequent use of extravagant countershafting has been made no longer necessary; the automatic high speed engine has been perfected, and finally, the triple expansion engine wrests nearly every ounce of power from steam by bringing it down to almost a vacuum. Even the firing of boilers has become an art, so much so in fact that in some well-regulated stations engineers can tell almost the exact amount of coal burned in a given period by noting the "load," or the number of lamps burned during that time. Why this occurs may be easily understood; dynamos and steam engines are both automatic in their action, that is, they develop only such power as is required to perform the work allotted to them. Each arc lamp absorbs electric energy requiring the expenditure of approximately one horse power in its production. If, therefore, fifty arc lamps are burning from a dynamo and ten lamps are switched off, the power required to run the dynamo will instantly drop from say fifty horse power to about forty horse power. The load of ten horse power being taken from the engine, its tendency is to accelerate in speed but the moment this occurs the governor notes the change and cuts off whatever surplus steam there may be in excess of that necessary to produce the power required. Less steam is, therefore, taken from the boiler, and with proper firing, less coal will be consumed. If, in your travels, you find an electric light station where the exact lamp or ampere load is recorded continuously or at frequent intervals and where every pound of coal going under the boilers is carefully weighed and noted with the time, and results are carefully compared, then, I dare say, you may rest assured that the station managers are live, wideawake, careful men who would permit no careless or hazardous construction to exist that would jeopardize their property. I have never yet had occasion to seriously criticise the electrical equipment of an electric light plant in charge of a man who exercised wise station economy.

Regarding the construction of the station proper, the building, to meet the standard, should be such as is recognized as the best factory construction, and as such it may be of brick or stone, preferably not over two stories high. An electric light station is, in brief, an "electricity factory," and electricity, though intangible, is the product of its whirling machinery, just as fabrics come from cotton and woolen mills, or as sugar comes from a refinery. Each should be of plain mill construction, and, in the standard risk, the roof should be of slate, metal, or gravel. Of course, all precautions should be taken regarding stairways and elevators. If possible, they should be placed outside, or, if inside, they should be inclosed, and provided with self-closing doors and hatches, respectively. The boiler house should be in an adjoining building, and in any instance, it is quite essential that the boilers be separated from the engine and dynamo rooms by means of a competent fire wall, carried up through the roof, and provided with approved fire doors. It is said that linemen have more to fear from gravity than from the current in the wires they handle, and, if reliable statistics were available, it would probably be proven that more linemen are killed by falling from poles than by electricity. Possibly, too, if the truth were known, it might be proven that defective boilers and flues have caused as many, if not more, central station fires than electricity; but, be this as it may, no one will question the propriety of separating the boiler and dynamo rooms by a fire wall. It is obviously equally important that the station should be provided with a full fire equipment, consisting of fire pumps of ample capacity, good hose on approved reels, fire buckets, tanks on roofs or standpipes and automatic sprinklers judiciously placed. When all these conditions exist, and when everything is kept neat and clean, when oil and waste are properly cared for, when steam pipes are made tight and well felted, when bearings are perfectly aligned, and when litter and dirt are never to be found, then—aside from its electrical equipment—will the station be maintained in accordance with the sound views of the fire underwriter.

But the consideration of the hazards attending the electrical equipment of generating stations is more properly the subject matter of the present paper, and intuitively the first appliance demanding attention is the dynamo. It is not such an easy matter for the layman to recognize the difference between high and low potential dynamos as it was even a few months ago. A new class of low potential machines, known as multipolar dynamos, are being brought forward that appear like high pressure alternating machines in several details, and in some cases alternators are now made to generate low potential currents, which are afterward transformed to high pressures, but from the standpoint of safety it is well to consider all dynamos as high pressure generators. In other words, mount all dynamos properly, keep them all perfectly clean, run all connecting wires after the most approved methods, and then safety will be assured in every instance. Wherever possible it is advisable to mount dynamos on a stone or concrete foundation for stability's sake, but never place the machine on such a foundation direct. A thoroughly dry wood base, well filled to prevent the absorption of moisture, must intervene. Concrete or stone is a conductor of electricity, and to place a dynamo on such a foundation is possibly to maintain a grounded circuit, the hazards of which have been fully described. As to dynamos themselves comparatively little can be said. They should be kept neat and clean, and they should never be located in places exposed to inflammable dust or the flyings of magnetic material. Machines should always be protected with a waterproof cover when not in use, and they should never, in any instance, be exposed to dampness of any sort. The only parts of a dynamo that are susceptible to wear are the bearings, the commutator and the brushes, and the depreciation on these is low, if the machine is properly cared for. It has been said that "the best system is the man who runs it." Equally true is it that the behavior of a well made dynamo depends upon the care it receives. If the circuits it supplies with current are of faulty construction the machine receives abuse just as malignant as neglect in cleanliness. Burnouts of dynamo armatures or fields are, therefore, like fuse blowings, symptoms that disorder exists somewhere or other in the system. The destructibility of dynamos by fire, is, I judge, about equal to that of high grade steam engines, but contrary to the prevalent belief, dynamos are not necessarily susceptible to either serious or material injury

1. Read before the Fire Underwriters' Association of the Pacific, Jan. 15, 1892.

by water. The dynamo used by the Pacific Oil and Lead works, prior to their fire last year, remained under oil and water for fourteen days, yet it is now in daily use and giving satisfaction. Another machine fell into the Columbia river while being unloaded from a steamboat, and remained there over three weeks. Yet it was fished out and is none the less efficient for its soaking. About all that is necesary to restore wet dynamos to their original condition is to exercise great care in drying them out by sending a current through their coils. Careless or hurried drying will frequently result in a burned out machine which will necessitate rewinding. To do this entails a cost almost impossible to approximate to any close certainty. Some concerns are able to do their own winding, in which event the cost may be 30 or 40 per cent. of that of a new machine, but if it becomes necessary to send the machine to the factory to have it rewound, then the cost, with freights added, may approximate from 50 to 70 per cent. if not more, of that of a new machine. In one or two instances, adjusters have been imposed upon and underwriters have been grossly swindled by misrepresentations regarding the fire or water damage sustained by dynamos, and before settling a loss on a dynamo which is not irreparably injured, it is frequently better to secure the report of a disinterested expert upon its condition. If a dynamo is burned, and yet retains its original shape—that is, if the field magnets or frame have not become cracked or warped or tempered by heat or sudden cooling—then it is safe to say that the only portion which may have sustained serious injury by fire will be the winding, possibly only the few outside layers. Armatures are more susceptible to injury by fire, but they can frequently be rewound and made thoroughly serviceable at a cost varying from twenty-five to forty per cent. of the original value of the machine. It should be borne in mind, however, that these figures are by no means absolute, as it is quite impossible to establish a universal rule regarding the destructibility of dynamos. Dynamos, or armatures, "burn out" from short circuits, defective construction, or careless or ignorant handling, and these accidents are attributable to conditions which should not exist, and under which the machine is not supposed to run. The rule exempting fire underwriters from losses on dynamos occasioned by fire within themselves is, I think, well taken.

From the dynamo, leads or wires are taken to the switch-board, a very essential contrivance designed to facilitate the throwing of different outside circuits upon different machines, and to group different machines or circuits together in every advantageous manner. The switch-board also contains all such cut-outs and switches as are necessary for safety, or to control all circuits and apparatus, and also many of the station instruments, such as the lightning arrester, for protecting the apparatus from lightning; the ground detector, for notifying the attendant whenever a ground comes on the circuit; also ammeters for measuring the current strength or amperage of each machine or circuit, and voltmeters for indicating their potentials. Then resistance boxes or rheostats—one for each dynamo—are generally placed on the switch board. These generally consist of coils of iron or German silver wire so connected to the dynamo that the current used for exciting the field magnets flows through them. By moving the lever of the rheostat, resistance consisting of a wire or wires of low conductivity may be thrown in or cut out of the field windings, entailing a less or greater current flow through the coils and consequently a decreased or increased electromotive force from the dynamo, as has been previously explained. Rheostats are essential to the satisfactory working of most forms of dynamos, and in policies the specific amount named on dynamos should include the value of the rheostats which must be considered not as an accessory device, but as a part of the original machine. The other instruments that appear on the switch-board and have been referred to are not absolutely essential to the working of the dynamo. They are necessaries which enable attendants to keep the plant, both inside and outside the station, in such a condition that both safety and satisfactory service will be assured, and as such their independence from the dynamo will be recognized. A dynamo may burn, yet the switch-board or station instruments may receive no exposure therefrom, neither will a burning switch-board necessarily jeopardize the dynamos connected to it, and for this reason, if for none other, specific amounts should be written on station instruments as well as on dynamos. To "blanket" them is to "blanket" two distinct risks. As to the destructibility of station instruments, those appearing in the switch-board generally consists of five pieces of mechanism comparable to fine clockwork, though not as intricate or as complicated. The instruments found in a well-equipped testing room of an electric light station are, however, among the most delicate, exact, and expensive used in any branch of science. Their value is frequently great, and being very delicate they are readily susceptible to injury by either fire or water.

Generally, the hazard attending the use of switch-boards is considerably greater than that of dynamos—or, more properly speaking, perhaps, fires originate on or around switch-boards more frequently than about dynamos; but in every instance, except, possibly, lightning, electric fires originating in generating stations must be looked upon and deplored as preventible fires. From their nature, switch-boards are the points from whence every portion of the system supplied by the station receives its current and hence the maximum potential and the maximum amperage always exist at that place. It is most essential, then, that the workmanship and materials in and around the switch-board be of the best and most recent character. Unless it is quite impossible to do so, station switch-boards should be placed far enough away from walls or partitions to permit easy access on all sides. Do not close in the switch-board in any manner. If it is wainscoted in and provided with a door, some evil genius may file away his cast-off shoes, coat, oily jumpers and waste, broken bottles, and sardine and oyster cans—as I once found—behind there. These are the jackasstical deeds and things that frequently lead to the troubles which occur in generating stations. Permit no part of the switch-board to remain out of sight, and then there is much less liability of litter accumulating. Again, switch-boards should be entirely of non combustible material, such as marble or slate, but wood may be used without material hazard. Of course, all switches, cutouts, rheostats, and other instruments exposed to heating or arcing should be mounted on non combustible bases. In some low potential systems, and even in electric railway work, bare conductors consisting of heavy copper wires or bars are frequently placed on the front of the switch-board. They are rigidly secured and well separated, and I fail to see that any hazard accompanies their use. Only the best solid rubber insulators should be used behind switch-boards however, and all wiring should be run on porcelain knobs or glass insulators in such a manner as to maintain as great an air space as is possible between the conductors. The use of wood cleats on high potential switch-boards is seldom, if ever, advisable, and it would be far better if none but porcelain or glass insulators were used for all work within stations. The wires leading from dynamos to the switch-board should rarely be led down and run under the floor unless the space below be an occupied, finished room, and invariably wires in passing through walls, floors or wood work should be encased in the heavy glass tubes known as floor insulators. Unless special and unusual precautions are taken it is never advisable to conceal wires in generating stations. They should always be run in plain sight on porcelain or glass insulators, and it is of the greatest importance that they be well separated and rigidly run. To bunch station conductors is to indulge in a foolhardy experiment, always to be advised against.

Wire towers are in themselves a necessary evil so far as the underwriters' idea of station construction is concerned, but in many cases their use may be obviated without inconvenience. It has been suggested that a far less hazardous arrangement than a wire tower, with its shaft or fluelike opening extending from the dynamo room up through the roof, is afforded by imbedding a massive wooden girder in a convenient outer wall of the station, then leading all outside wires out through holes bored through the girder. Of course these holes must slant upward as they pass inward, in order to prevent the ingress of water during rainstorms, and they must be well bushed, preferably with glass floor insulators sufficiently long to pass clear through the timber. When these suggestions have been carried out and the lines have been provided with competent water drips or loops and glass insulators to relieve the wires from strain at the girder, then the hazard attending the use of a wire shaft and tower will have been eliminated. Electrically speaking, no unusual hazard exists in wire shafts and towers, provided the construction is proper, but the objection raised against them is that entertained against all kinds of similar openings, such as light wells or elevator shafts. Should the wiring in them be indifferent or improperly done, however, then a formidable electrical hazard would exist. It will be remembered that nearly all competent insulations are highly inflammable, and in the shaft leading to a wire tower the wires run vertically, or are hung upon reels. Should a short circuit occur, the arcing would ignite the insulation which would carry fire along up the line like a taper. Being fanned by the strong draught, which always rises in such openings, the fire would certainly spread, and blazing drops of melting insulation would create unlimited trouble, which would not be averted by throwing the current off the wire or shutting down the plant. In such an instance automatic sprinklers would render a service of inestimable value, but to sprinkle burning wires carrying current, would, I think, be making a bad matter decidedly worse.

It is meet that in discussing central station construction mention should be made of outside lines and line building. In low potential systems bare copper is oftentimes used on all outside pole lines, and the practice, though not the best, is generally recognized as reasonably safe provided the circuits are substantially supported and carried above all other wires. Bare wires in overhead electric railway circuits are, however, not to be tolerated except, of course, for the trolley wire, which must be exposed to contact with the trolley. This is necessary principally for the reason that electric railway feeders run under all other lines and are almost sure to cross with falling wires or with circuits under construction or repair. As a preventive the placing of guard wires seems to be the only competent suggestion. Some electric railway companies have placed their supply circuits underground, carrying up feeders to the trolley wires at necessary intervals. Such a practice is to be commended as in this case at least a wire underground cannot engage in mischief making for the simple reason that it is not accessible to anything susceptible to injury. Though this condition may apparently prevail in all underground electric constructions, still it does not actually exist, for the undergrounding of electric light circuits have developed new and unlooked for hazards, principally among which is the liberation and ignition of explosive gases. The undergrounding of telephone, telegraph or other similar signal wires is not, however, subject to the difficulties attending the burying of electric light circuits, and if all such signal wires were placed in subways the frequent fires that occur from crossed circuits would be obviated.

Regarding the pole lines and outside construction, I have often thought that a first-class system of housetop construction would be far safer and far more satisfactory than distributing circuits by pole lines. If all electric light wires were placed on substantial frames, firmly secured to fire walls, and so constructed as to maintain all wires at least ten feet above flat roofs, and if all telegraph and telephone wires were placed on similar structures, entirely separate and apart from the electric light racks, then crossed circuits would occur with less frequency, the streets would be free from poles, and firemen would not be hampered by wires every time they endeavored to raise a ladder to a burning building. Be this as it may, however, I cannot but feel that proper housetop construction has a legitimate sphere of usefulness. Line wires carrying high potential currents are generally protected with some weather-proof insulation—that is, an insulation designed to withstand the variations and exposures of the weather. It is also essential that this insulation be very tough and non-abrasive. Some companies run their high potential circuits with a solid rubber insulation, and I believe this to be an excellent practice, despite the yet-to be-proven claim that the modern rubber insulations fail to survive atmospheric changes.

What has been said will, I hope, convey an idea of the inherent hazards of generating stations, and, in conclusion, I can only emphasize the conviction that, with the competent safeguards and methods of construction now used and practiced, the occurrence of an electrical fire in a generating station is the occurrence of a preventible fire.

CORRESPONDENCE.

New York Notes.

NEW YORK, January 16.—Rapid transit is the most prominent question of the hour in this section, though but little progress toward the practical solution of the problem can be said to have been made. Both this city and Brooklyn are badly in need of improved service, as is well known, and the people are clamoring for relief. In both cases electricity has the lead thus far, though there is determined opposition, mainly from prejudiced partisans of other systems.

The last step taken by the Rapid Transit commission of th's city was the petition presented this week by the attorney of the road showing what steps had been taken toward securing permissions of the interested property owners. The commissioners will apply to the General Term of the Supreme Court on the first Monday of next month for the appointment of three commissioners to take testimony and report to the court whether the railways should be constructed and operated on the routes adopted by them in October last.

The act under which the commissioners are proceeding provides that the consents of the local authorities and one-half of the owners of property affected by the scheme must be obtained, and if that cannot be done then application must be made to the court for the appointment of commissioners to determine and report whether such railways ought to be constructed and operated. The common council has approved of the routes proposed, but the owners of more than one-half the value of property along the proposed routes have refused to give their consent. These latter include the Standard Oil company, the estate of John Jacob Astor and William Astor, and Amos R. Eno. The Astor property is valued at upward of six million dollars.

In relation to the application of Mr. Dana's committee that the route be changed so as to avoid Madison avenue, the commissioners announced that such a change would be impracticable. According to the advice of the council for the commissioners, the board has no power to change the route of the east side line without abandoning all the work done up to date, and beginning anew. This, of course, was considered out of the question.

The question of substituting electricity for horses on Brooklyn surface roads is still before the city officials. At the meeting of the Brooklyn Board of Aldermen this week, no attempt was made to override Mayor Boody's veto of the trolley resolutions, but the four railroad companies interested presented a fresh application for permission to use electric instead of animal power. A preamble and set of resolutions similar to those adopted on December 21st, and vetoed by Mayor Boody, were then adopted by a vote of 15 to 4. Should the mayor again veto them it is thought there will be enough votes forthcoming to pass them over the veto. It is thought, however, that the mayor will not again attempt to delay the introduction of the electric system. According to the daily papers he has written to the mayors of other cities in order to ascertain how the trolley works there, and has asked that all opponents of the system call to sell him. His veto will be overridden, and it is said he wants to have very strong reasons for it or he will not file another, but will let the resolutions become operative by lapse of time.

According to the *Times* of this city a new complication has arisen through the labor unions, which may interfere with "the smooth running order" of the new system if introduced on the Brooklyn surface roads. Drivers will be advanced to the importance of motor men with new and greater responsibilities, and a corresponding increase of dignity to uphold. The conductors will remain as they are, although, with larger cars and more passengers, they will have a great deal more work to do. So those who be-

long to the union have decided to demand an increase of 25 cents a day in their wages. This may not seem to be very much money to an outsider, but the stockholders of the roads have been considering it. The Brooklyn City Road has demand for the services of over 3,300 drivers and conductors, and this increase means an additional expenditure of $825 a day. On "Deacon" Richardson's roads 530 men are employed, and it would mean an increase of over $130 a day.

The State Railroad Commission has granted the application of the Coney Island & Brooklyn Railroad company for permission to operate its cars with the overhead single trolley electric system from Hamilton Ferry through Hamilton avenue, Smith, Ninth and Huntington streets, and Ninth avenue, Brooklyn, and Coney Island avenue, Flatbush. The grant is made on condition that the company conforms to all the requirements of the Supreme Court decision rendered Dec. 14, 1891, and the requirements set forth in the common council resolution of December 21st. "We shall begin work at once, and expect to run cars from Coney Island to Hamilton Ferry by electricity inside of four months," said Gen. H. W. Slocum, when he heard the decision.

The Metropolitan Telegraph & Telephone company suffered a loss of over $4,000 by the destruction of the poles and wires by falling walls of Van Tassell's grain elevator during the fire to-day. Four of the company's poles were broken and two more will have to be taken down. The line of wires which runs along the river front from Barclay and Dey streets to King's Bridge is the largest in the world. The poles are 80 feet long, with 26 stringers, each containing 10 copper wires, making 260 wires in all. This network of wires runs down Eleventh street to Thirteenth avenue and turns the corner so close to the burned building that the wires might be reached with the hand from the upper windows. Three times during the fire the walls fell against the wires and when the flames were finally extinguished two of the big poles were down, two others sagged threateningly, and the ground for two blocks was covered with a mass of stringers, wires and cables. The firemen also suffered, for when the wires fell two lines of hose were cut as clean as if a razor had done the work.

Long before the wires fell the Metropolitan company's foreman, foreseeing trouble, ordered a gang of men to the spot. Aerial cables were stretched over the housetops from Twelfth avenue and Eleventh street diagonally across to Thirteenth avenue and Thirteenth street. Each of these cables contained fifty-eight conductors, and as soon as the ends were made fast it was a comparatively simple task to "fan" out the wires and resume the service. This work was done with such dispatch that the service was resumed to almost all points before night It was never at any time entirely discontinued, for, pending repairs, the Metropolitan company transacted its Albany business by the way of Scranton and Syracuse and its Boston business by the way of Bridgeport.

Mayor Grant has received a report from the United States Electric Light company stating that the company had removed its overhead wires and poles on Broadway from Bowling Green to Liberty street; on Chambers street from Greenwich street to West Broadway; on Exchange place from William to Broad street; on Liberty street from Broadway to Nassau street; on John street from Broadway to Cliff street; on Cliff street from Park Row to Nassau street; on Park Row from Broadway to Beekman street; on Nassau street from Spruce to Frankfort street and on Bowling Green from State to Whitehall street.

A report was also received from the Metropolitan Telephone company, in which it was said that all of its overhead wires had been removed except a few on Elizabeth street which will be taken down in a few days.

There has been a good deal of litigation during the week in which electrical securities formed the basis of contention. The controversy between Ed. Stokes and John W. Mackay as interesting to the telegraph people and the stockbrokers, as the plans of Mackay and Stokes to secure control of two important corporations were divulged in court.

Another action of vital importance to holders of securities, though of less general interest, was the injunction proceedings, conducted in Judge Barrett's court, between Martin A. Frank and the Edison Electric Light company and the Edison General Electric company. On the 13th inst. Judge Barrett enjoined the Edison Electric Light company from paying a dividend of eighty per cent. or any other dividend, in trust debentures of the company. The order was granted on application of Martin A. Frank, who holds thirty-one shares of stock. Mr. Frank alleges that the Edison General Electric company has absorbed a majority of the stock of the local company. He says that the latter company was incorporated with a capital of $1,500,000, and the General company with a capital of $12,000,000, which is said to have been increased to $15,000,000. The Light company has never paid a dividend, but intends to pay one by issuing bonds. Furthermore, he says, the General company, in its control of the Light company, has diverted the assets of the latter company from the purpose for which it was incorporated. Later, however, the injunction was dismissed on the ground that the plaintiff should seek relief in a separate action, and not in the present suit. In his opinion, granting the temporary injunction, the judge said: "Of the inherent illegality of the proposed scheme I had no doubt.... Upon what principle can a corporation issue its bonds in order to raise money to declare dividends? That is simply borrowing money for the purpose contemplated." Continuing, he says that if the bonds are not paid at maturity, and the securities are insufficient for their liquidation in full, the company will be liable for the deficiency. That deficiency may Ampair, or may wipe out, the capital.

When this injunction was dismissed, Judge Barrett again referred to this point, saying: "I did not mean to be understood as asserting that a corporation could not, under any circumstances, distribute its surplus earnings through the instrumentality, in part, of bonds issued to represent such earnings. There may, undoubtedly, be circumstances which would justify such an expedient for temporary purposes. And, indeed, it might be made to appear that such bonds simply represented surplus earnings, and could not possibly impair the actual capital of the company. But I have not changed my opinion as to the scheme here sought to be begun. In my judgment the affidavit of the defendant does not justify the issuing of these debenture bonds upon the collateral security of stocks and bonds of the subsidiary companies for the purpose of raising money to declare a dividend upon the stock of this defendant."

The question of furnishing this city with a police telegraph system that will accommodate the department is now being seriously considered by the commissioners. The matter has been before the board on many occasions, and it has always been conceded that the city is very much behind the times in its present old-fashioned methods of transmitting information. At a meeting last week Commissioner Martin suggested that the board name a day on which the patentees and owners of systems could appear and explain the working of their inventions. The afternoon of January 29th was selected for the hearing. All of the inventors of the several systems were invited to appear before the board on that day with models or drawings, and the commissioners will select those which they think are worthy of a practical trial.

Four men were arrested Thursday for tapping wires leading to the Harrison pool rooms on First street, but as the Western Union Telegraph company failed to make a complaint the prisoners were discharged. There have been many indications of late that "wire tappers" have been at work in this city and vicinity, and the police have been kept busy running them down. Numerous arrests have been made, but thus far there have been no signs of fear displayed by the offenders.

John Conlan has recovered a judgment for $500 against the Jersey City & Bergen railroad for injuries sustained in a collision between an electric car and a wagon he was driving.

The people of North Plainfield, N. J., are greatly dissatisfied with their street lighting service. No complaint is made against the lamps, but the manner in which they are distributed about the streets does not give satisfaction.

The block signal station, near Port Morris on the Harlem Branch railroad, which was destroyed by fire about three weeks ago, will be in readiness for the operators in about a week.

The plant of the Barriett Electric company has been sold by the sheriff for $94. This company was incorporated in 1889, with a capital stock of $10,000, to manufacture electric motors.

The new fire alarm system put in at Peekskill, N. Y., is now ready for use. The boys of the town take delight in sending in false alarms and exhausting the electric batteries.

W. F. O.

Milwaukee, Wis

MILWAUKEE, January 16.—The street lighting contract which the city and the Badger Illuminating company have entered into does not contain the proposed provision to allow the city the privilege of purchasing the Badger plant at any time at a price to be agreed upon by arbitration. The provision was in the contract as drawn up by the city attorney, but the Badger people manifested strong opposition to such a provision, declaring that they would not sign the contract unless the objectionable feature was stricken out. The city officials finally yielded the point. Their haste to close the deal after the Milwaukee Power & Lighting company's injunction had been dissolved, to protect themselves against any more trouble and delay, may have had something to do with the withdrawal of the condition of optional purchase. By the contract, which runs for four years at $110 per lamp per year, the company agrees to furnish the city with lights of 2,000 nominal candle power and to place them wherever the city may direct in the streets and public parks. The company assumes all damages sustained by people injured as a result of the streets being torn up. If the company fails to burn 70 per cent. of its lights for sixty days, it will pay the city $60 per day for each day it fails to burn its proportion of lamps and if any lamp is not lighted for four days it shall not be deemed to have earned anything for those days. The lamps must be kept burning from a half hour after sunset to a half hour before sunrise. The Board of Public Works is given the right to determine the amount earned by the company under the agreement. The city agrees that at no time will it use fewer lamps than at present, the number in use being between 500 and 600. The city may test the lamps at any time. The common council, it is expressly stipulated, cannot require the company to move more than two lamps per month from one place to another Those that find fault with the contract, by the way, take exception to the long time rather than to the price.

The Villard syndicate has absorbed the Milwaukee Electric Light company, a concern that has been operating under a charter granted several years ago to the Milwaukee Telegraph company. Its power house and office have been located for more than two years at 170 West Water street, and R. J. Thomas, formerly of the Thomas & Wentworth company, was its manager. Its business grew until it supplied about 100 arc lights, and nearly 2,000 incandescent lights. It used the Western Electric system. Under its franchise the company might have duplicated all of the Badger Illuminating company's lines in the city and become a very formidable competitor in the future. The buying out of the company has removed all danger in that quarter. The arc light dynamos will be removed to the Badger plant, and the incandescent light plant to the Edison building. The Villard syndicate, of course, will carry out all of the smaller company's contracts. Mr. Thomas and his associates, among whom are probably the Western Electric people, received $30,000 for their plant and franchise. The deal shows that the Villard people are determined to monopolize the electric lighting business as well as the street railways. They now control the street railway business of the city and the purchase of the Milwaukee Electric company's plant and business leaves only the Milwaukee Power & Lighting company in the field against them, so far as electric lighting is concerned. In no other city does the Villard syndicate appear to have invested so heavily, although it is reported that it is buying up Cincinnati railway systems.

The common council committee on railways has killed the ordinance to allow the Villard syndicate to build an electric railway on Fond du Lac avenue. The ordinance caused a long and bitter fight, the result of which is not generally satisfactory. An electric line on Fond du Lac avenue appears to be needed, and the great majority of property owners from Schwartzburg down favor such an improvement. The whole district west of Twelfth street and north of Walnut street is without a street railway. It is a thickly populated district, and is rapidly growing. However, the storekeepers on the thoroughfare which runs diagonally across the northwestern portion of the city oppose an electric line because it would frighten farmers away, they think, and tend to induce residents in the neighborhood to go down town to do their shopping. About 100 people, pretty evenly divided on the question, attended the final meeting of the committee. The spring election had much to do with the result.

Attorney N. S. Murphy began suit against Benjamin M. Weil, a prominent citizen and leading real estate agent, to recover $12,500 alleged to be due from the sale of electric light patents to the defendant in February, 1887. On that date, it is alleged, Mr. Murphy and Henry E. Jacobs jointly sold to Weil 250 shares of the paid-up stock of the Jacobs Electric company for $25,000, of which $12,500 was to be paid on the date of transfer and the balance to be paid in four payments, two of $1,000 each, one of $3,000 and one of $6,500 It was stipulated that if some of the patents then applied for were not granted, $12,500 of the money agreed to be paid should be refunded to the defendant. The patents were allowed and issued on June 28, 1887. Jacobs died in May, 1891, and the complaint filed by Mr. Murphy alleges that Weil succeeded in making a settle-

ment with him before he died at half of his obligation under the contract, and that Weil never paid Murphy, and refuses to pay him the $12 500 which is due him. The Jacobs patents relate to the regulation of heat in buildings, and are said to be rather valuable.

The university extension lectures on electricity, under the auspices of the Wisconsin Electric club, began at the high school building on Friday evening of last week. It was a bitterly cold night, but the audience was by no means small, and the lecture must be set down as a decided success. Dr. H. B. Loomis, the lecturer, handled his subject "Electrostatic Induction," very ably and clearly. He experimented very fully. Last evening he lectured on "Electric Currents." It is an interesting fact, in this connection, that the *Evening Wisconsin* published full and authorized synopses of both lectures, and announces that it will treat the remaining lectures in the same way. It is thought that the university extension lectures on the subject will materially increase the public interest in electricity.

A court order has been issued requiring the Electric Light & Power company of Beloit to show cause why a receiver should not be appointed for it. The company has been financially embarrassed for some time, and its bills for lighting have been attached. Its plant, upon which $60,000 has been expended, is said to be worth only $15,000. C.

San Francisco, Cal.

SAN FRANCISCO, January 12.—After a delay of several months Chief Scannell of the San Francisco fire department has at last served notice on all electric lighting and power companies in San Francisco that unless their wires were removed from roofs within ten days from the date of notice, or by January 14th, the fire department would immediately proceed to remove them. The delay was occasioned by the non-receipt of the remittitur affirming the validity of the city law under which the action will be taken, but now that it has been received the chief will proceed at once. The original law, enacted three years ago, prohibited the maintenance of either electric light, power, telephone or telegraph wires on roofs of or attached to buildings, and on March 30th Judge Sawyer of the United States Circuit Court upheld the ordinance and dissolved the temporary injunction that had been issued to the Electric Improvement company against Chief Scannell. In this opinion Judge Sawyer said among other things:

That the stretching of these wires over buildings in the manner practiced, as shown by the evidence, no one, I think, can assert, after reading the affidavits, is not extremely dangerous, both as being liable to originate fires, and as obstructive to the extinguishment of fires otherwise originated. Indeed, the danger is a matter of common knowledge. * * * * Who can say, in view of the constant and perpetual menance, that the provisions of this ordinance are unreasonable? Is it unreasonable because the remedy against this great public and private nuisance is prompt and efficient when no other remedy is certain to be equally so? We know not how soon a calamity from this source may come upon us. It may be while we are litigating the question. * * * True, the supervisors cannot make an article dangerous by simply declaring it to be so, when, in fact, it is not. But the practice at which this ordinance is aimed is shown to be dangerous, and we ourselves all know it to be so. There can be no successful disputing of the fact. * * * I regret to be obliged, by this decision, to affect so seriously the interests of the enterprising parties who are endeavoring to supply our citizens with electricity for the various purposes to which it is now applied. But I cannot decline to administer the law as I find it for the safety and security of the lives and property of the citizens of San Francisco.

Acting under this opinion Chief Scannell prepared to annihilate all wires attached to roofs, whether they be electric light or telephone or telegraph, but this brought forth a mighty howl from the telephone and telegraph people, who succeeded so well in convincing the Board of Supervisors that no harm could ever come from their circuits, that the old ordinance was repealed and a new law, aimed only at wires carrying currents for electric lighting and power purposes, was enacted. The litigation that followed upon the attempt to enforce this ordinance was described in the WESTERN ELECTRICIAN at the time. It consisted principally of the suit brought by Geo. L. Henzel to enjoin Chief Scannell. The Superior Court, through Judge Hebbard, held that the ordinance was valid and constitutional. Neither the Electric Improvement company nor the Pacific Electric Power company, both of which were vitally interested in the measure, took an active part in the Henzel suit, and Henzel did not appeal the case to the Supreme Court. Both companies named operate extensively on house top circuits, for the simple, but potent reason that the supervisors will neither grant them franchises nor will they permit them to run wires on poles. The Electric Improvement company has a fine pole line built up Broadway street, yet the poles alone are standing, for the company can not stretch a single wire on them. With this condition of affairs existing it is very probable that the companies referred to will take up the fight and carry it to the highest tribunal.

The San Francisco *Chronicle*, though it is not openly advocating electric roads, is certainly winning the plaudits of the electrical fraternity in calling attention to the defects of the cable railway systems. If ever an accident occurs that is inherent with the cable, the *Chronicle* publishes it and directs attention to the fact. S.

St. Paul, Minn.

ST. PAUL, January 16.—The Electrical Engineering & Supply company is making satisfactory progress on the installation of a central station plant for the St. Paul Electric Manufacturing & Construction company—locally known as the "West Side" company. The contract provides that the initial run shall be made not later than February 1st. The company that will own and operate this plant—as previously noted in the WESTERN ELECTRICIAN—proposes manufacturing a line of electric apparatus and electric specialties, the supplying of light in a manufacturing district where the factory is located having been taken up as a secondary consideration, while experimental work on a new light and power system, embracing many new ideas, is being conducted. The National transformer system has been adopted, two 750 light generators having already been placed in position. The steam plant will consist at the start of two Russell engines, built by Russell & Co. of Massillon, O., of 90 horse power each. They are now being set. When completed, this plant will be one of the most complete in the West.

The Electrical Engineering & Supply company has also a large force of men at work installing the lighting and power plant in Col. J. J. Hill's residence, which, when completed, is to be the largest and finest plant in a private residence in the world.

The Northwestern Thomson-Houston company has sold to the Villard syndicate for use in this city and Minneapolis, in connection with what is undoubtedly the finest electric street railway system in the world, ten complete central station generators, each of 335 horse power capacity. Among other recent sales made by the same company is six 50 horse power car equipments, and three 100 horse power generators to J. H. Lawrence of Helena, Mont. The road has heavy grades, making the extra power very desirable.

The Columbia Electric company has just installed in St. Paul for Lindkes, Warner & Schurmeier, a Columbia generator of 300 amperes, and 110 volts capacity. This machine is to be run in connection with an old plant, the first one built by the Edison company in St. Paul—and makes the total capacity of the plant about 1,000 lights. D. H. O.

PERSONAL.

Prof. Elisha Gray was in New York last week.

B. P. Van Court has recently been appointed manager of the Detroit Motor company.

An excellent portrait of City Electrician Barrett appeared in the last number of the *City Hall Record* of Chicago.

H. Laws Webb and George H. Guy, editors, and C. McL. Paine, business manager, of *Electricity*, have resigned.

F. B. Badt of Chicago, while visiting Washington recently, was a visitor at the White House by special invitation of Mrs. Harrison.

F. S. Terry, manager of the Electrical Supply company, Chicago, has been seriously ill during the last week, and it is feared that he may have pneumonia.

C. A. Daigh of the Electrical Engineering & Supply company has been suffering from the grip for the last three weeks, but is now slowly recovering.

A. S. Garfield of the Thomson-Van Depoele Electric Mining company was in Chicago during the early part of the week. Mr. Garfield was in charge of the electric drilling in the bed of the Mississippi River at Moline, Ill., which was lately completed.

NEW INCORPORATIONS.

Forest Park Electric Street Railway company, Pittsburg, Kan.; capital stock, $50,000; to construct and operate an electric railway; W. D. Ford, Pittsburg, Kan.

Sierra Valley Telegraph company, Sierraville, Cal.; capital stock, $20,000; to construct and operate a line of wires or electro magnetic telegraph attached to po'es; J. E. Berry, Downieville, Cal.

Peoples' Manufacturing & Investment company, Denver, Colo.; capital stock, $100,000: manufacturing illuminating gas, sinking gas wells, building water, gas, electric and smelting works.

Fair Electric & Manufacturing company, Hoboken, N. J.; capital stock, $100,000; to manufacture and repair electrical machinery and devices of every kind; I. Smith, & Mahon, Hoboken, N. J.

Ellenville Electric company, Ellenville, Ulster county, N. Y.; capital stock, $30,000; the manufacture of electricity forlight, heat and power.

Citizens' Passenger Railway company, Steelton, Pa.; capital stock, $100,000; operating an electric street railway in Swatara township and Steelton, Dauphin county, Pa.; Thos. T. Hargest, Harrisburg, Pa.

Illinois Electric Lamp company, Chicago Ill.; capital stock, $25,000; manufacturing and selling incandescent electric lamps and other electric appliances; O. M. Smith, room 80, 161 La Salle street, Chicago, Ill.

Citizens' Electric Light, Power & Heat company, Dubois, Pa.; capital stock, $2,000; supplying light, heat and power or any of them by electricity to the public in Dubois, Clearfield county, Pa.; W. C. Pentz, Dubois, Pa.

Clinton County Electric Light, Heat & Power company; Lock Haven, Pa.; capital stock, $25,000; supplying light heat and power by means of electricity to the public in Lock Haven, etc.; Henry C. Terry, Bullitt Building, Philadelphia, Pa,

Monte Cristo Mining & Improvement company, Seattle, Wash.; capital stock, $100,000; to deal in and operate mines and mining property, mills and mill sites, railroads, telegraph and telephone lines, electric light plants, gas and waterworks, etc.; J. P. Hendricks, Seattle, Wash.

Galena City Mining & Investment company, Seattle, Wash.; capital stock, $60,000; to deal in and operate mines and mining property, mills and mill sites, railroads, telegraph and telephone lines, electric light plants, gas and waterworks, etc.; J. P. Hendricks, Seattle, Wash.

Shelbyville Electric Street Railway company, Shelbyville, Ind.; capital stock, $100,000; to construct, own, maintain and operate a system of street railroads, switches, sidetracks and all necessary turnouts to be operated by electricity as the motive power; Geo. Ray, Shelbyville, Ind.

Strohm Automatic Electrical Safety Block System company (incorporated in West Virginia), Philadelphia, Pa.; capital stock, $5,000,000; manufacturing, selling and renting to railroads or other companies block and safety appliances; Benjamin S. Wright, 24 Church street, Philadelphia, Pa.

ELECTRIC LIGHTING.

The parliament house at Madrid, Spain, is to be lighted by electricity.

The Improvement company of Elizabeth City may erect an electric plant.

The Edison Electric Illuminating company of Atlanta is erecting its electric light plant.

The Salem, Va., Electric Light company is putting in a 125 horse power engine as an addition to its electric light plant.

Work is progressing on the electric light plant at Paragould, Ark., and it is thought that the station will soon be in operation.

A franchise to erect an electric light plant at Wichita Falls, Tex., has been granted to the Wichita Falls Electric Light company.

The Roanoke, Va., Electric Light & Power company has let the contract to the C. & C. Electric Motor company for an entire new plant.

The city of Mobile, Ala., has let contract to the Economical Electric Lighting company of New York, for lighting the city of Mobile by electricity.

The De Land Manufacturing company of De Land, Fla., has contracted with the Thomson-Houston Electric company for the erection of an electric light plant.

The twenty central stations of London have a capacity of supplying over 550,000 incandescent lamps. It is estimated that 300,000 lamps are actually connected with the mains of these companies.

The Edison General Electric company is installing in the car shops of the Great Northern Railway company at St. Cloud, Minn., an electric lighting plant having a capacity of 500 16 candle power lamps.

The Edison Light & Power company of Minneapolis has been making extensive additions to its central station equipment. It is installing a thousand horse power boiler and setting up a two hundred and fifty horse power Ball engine to drive two one hundred kilowatt Edison dynamos.

H. A. Stuckey of the National Electric Manufacturing company is installing a 300 light direct current system at Lipton's packing house, Union Stock Yards, Chicago The machinery is nearly all in place, and it is expected that the current will be turned on not later than February 1st.

The city of Pueblo, Mexico, has 200 arc lamps of 1,200 candle power each, which are supplied from dynamos at a station thirteen miles distant, where the river Atoyac furnishes power to a 200 horse power double turbine wheel. Each of the four circuits is about twenty-six miles in length.

The sub-committee of the Chicago council committee on gas, oil, and electric lights, to which was referred the ordinance for the lighting of a large number of streets in the Fifth and Sixth wards by electricity, has received no bids for the work, and the matter was referred to City Electrician Barrett with a request that he secure proposals.

The Columbia, S. C., Gas & Electric Light company and the City Railway company, recently consolidated, have organized with J. T. Marshall, president; T. T. Moore, vice-

president, and W. G. Childs, secretary. Bonds to the extent of $100,000 have been placed, and arrangements will at once be made for the erection and completion of the plant.

Cleveland city officials are considering the project of installing an electric plant in the city hall for lighting the municipal offices. Last year it is reported it cost $1.600 to light the city building and now it is proposed to install a dynamo and engine for $1,875. The proposition is still under consideration.

The Excelsior Electric company has filed a claim of $1,000 against St. Joseph, Mo., which, it claims, is the balance due upon the municipal plant which it installed for St. Joseph. It is claimed when the plant was turned over to the city by the Excelsior company that the municipality paid all claims then presented and secured a "receipt in full."

The National Electric Manufacturing company has just installed for the Wheaton, Ill., Electric Light & Waterworks company an incandescent plant of 750 lights, it being an addition to a municipal arc plant already in use. The power is supplied by a New York Safety engine. H. A. Stuckey of the National company, Eau Claire, started the plant on July 5th.

The electric light towers in Alameda, Cal , range from 100 to 125 feet in height, and City Electrician Goldthwaite proposes to reduce them to about 80 feet. The higher towers have five lights, and the city electrician thinks that three lights on an eighty foot tower would prove as satisfactory. The towers will remain in the same respective positions, and will be reduced by taking out a couple of the middle sections.

A thief who has for a long time, in all probability, been stealing incandescent electric lamps at the Paris theatres, has just been arrested by a clever device of the management of the Porte St. Martin. As it was found that a great many lamps had disappeared at that house, the electrical engineer so arranged the fittings that when a lamp was removed the electric current sounded an alarm. The man was thus caught as he was making away with a lamp in his pocket.

The Fort Wayne central station in Chicago that was recently burned out is now able to supply all demands made upon it, and Manager Harding asserts that he has more customers than before the fire. The old Sun plant on Plymouth place, much enlarged and improved, is now used exclusively, but when the repairs now in progress are completed a new plant will replace the burned-out station in the Adams express building on Dearborn street, and then the two plants will be run conjointly. In the new plant the engines and dynamos will be placed in the basement, instead of on the first floor, as formerly.

ELECTRIC RAILWAYS.

The Wheeling, W. Va., Railway company, it is reported, will greatly increase the capacity of its power plant.

Paul Smith and others have been granted a franchise to construct an electric railroad at Montgomery, Ala.

The Savannah & Isle of Hope Railway company of Savannah, Ga., will probably adopt electricity as a motive power.

Negotiations are pending for the sale of the Brunswick, Ga., street railway to men who intend to substitute electricity.

The Macon, Ga., & Indian Springs Electrical Railroad company has commenced the survey for its electric railroad.

The construction of a rapid transit street railway at Austin, Tex., issaid to be contemplated by John W. Hoyt of New York and others.

It is reported that an electric railroad will be built from Huntington, W. Va., to Ashland, Ky.. by F. N. Fordyce of Detroit, Mich., and others.

The common council of Yonkers, N. Y., has voted in favor of the petition of the Yonkers Street Railway company to change its power to electricity.

Frederick W. Hunter is said to be endeavoring to secure control of the Overland railway at Nashville, Tenn., with a view of changing it to electric power.

The United Electric Railway company of Nashville, Tenn., has recently established a new machine shop and added largely to its power plant, at a total cost of about $200,000.

It is reported that northern capitalists have organized a company to build an electric railroad from Tampa to Tarpon Springs, Anclote, Sutherland, Dunedin and Clearwater in Florida.

A bill has been introduced in Congress incorporating the Washington & Bladensburg Street Railway company, to build an electric railroad. The capital stock is to be not more than $500,000.

The citizens of Toronto, Ont., have voted against running street cars on Sunday. The returns, with four divisions not computed, show 9,849 for and 13,917 against the Sunday running.

A committee of the chamber of commerce of Fredericksburg, Va , is investigating with a view to the construction of a street railway. Both horse and electric power will be considered.

A press dispatch from Belleville, Ill., announces that Mayor Weber has a proposition from a company that wants a franchise for an electric railway, as well as for a line to East St. Louis. The negotiations with the Atterbury company have fallen through completely, but the mayor claims the new company's propositions will be satisfactory.

The Rochester, N. Y., Railway company has been sued for $5,000 damages by John F. Walls, whose mother was struck by an electric car last July. It is claimed that death resulted from the accident.

The Olympia Light & Power company has closed negotiations for a loan of $250,000, and will speedily begin the construction of four miles of electric railway within the city. A line to Tumwater will also be built by this company.

The Rochester Railway company adopted the expedient of keeping its cars running all night on January 13th in order to keep the trolley wires as free from ice as possible. Much annoyance has been experienced from this cause.

It is stated that an underground electric railway is projected for Vienna. It is to connect all the principal railway terminii as well as the more important centers of the city. Surface electric lines form a portion of the scheme, which is comprehensive in its scope.

Work on the Metropolitan electric railway at San Francisco is being so rapidly pushed forward that the section of the line to First avenue will be in operation January 5th. The contracts which were let by the company amounted to $300,000. The power house will cost $20,000.

The ordinance for a franchise for the Calumet electric railroad in the extreme southern portion of Chicago is causing much discussion among the aldermen. The principal objection was to the number of grade crossings, but the ordinance was finally recommended for passage by the committee.

Judge Hart of the District Court at Duluth, Minn., has rendered a decision of importance as a precedent in street railway cases. He decided that the Duluth Street Railway company had, under right of eminent domain, authority to condemn private property for street railway lines. No case involving this question ever came up in Minnesota before, so far as known.

In describing the underground electric railway system proposed for Berlin, the president of the company says that each train will consist of three coaches, with a total seating capacity of 120 persons, and a locomotive. The speed will be fifteen miles an hour, and the trains will move about one third of a mile apart. For the whole system sixty-four locomotives and 175 coaches will be necessary. The fare will be 2½ cents for all distances.

TELEPHONE.

It is reported that the British postoffice authorities contemplate opening a telephone line between London and Dublin. The working of the Paris-London telephone has so far been attended with marked success, and it is doubt, less due to this circumstance that the new line is projected.

It seems impossible to satisfy some people, and among this class are found the cranks who are constantly waging war on public corporations. An officer of the People's Telephone association of Rochester, N. Y., is reported as saying: "There ought to be an immediate and emphatic protest against the action of the common council in ratifying the transfer of the telephone company's poles to the electric light company. When the famous dispute with the telephone company was settled it was on condition that the company would put its wires underground and take down the poles. That agreement is not kept when the company transfers its poles to another corporation that will maintain them. The poles are now dangerous to life and ought not to be allowed to stand in the streets. The objection to the telephone wires was due to the fact that the people feared they might come in contact with the electric light wires."

A correspondent at Ashtabula, O., gives the following account of the changing of the telephone and telegraph lines from one side of the main street to the other. Alfred Field, in front of whose house there are two large and very old shade trees, refused to have them trimmed unless paid for it. He demanded $50 if the trees were trimmed or $400 if they were cut down. The city would not pay all the $50 the companies interested refused to pay anything, and Mr. Field remained obdurate. A special meeting of the council was called and the marshal was authorized to notify property owners on the street that every sign, post, tree, pole, etc., excepting electric light, telephone, telegraph and street railway poles must be at once removed. No attention was paid to the order, which was aimed at Mr. Field, but at 3 o'clock Saturday morning some unknown man, supposed to have been in the employ of the telephone company, cut the offending limbs from one tree, but was frightened away before he could tackle the other one. Saturday afternoon, however, the men while putting up the wire succeeded in fixing the other tree. It is said that Mr. Field was expecting a night visit and was on the watch armed with a shotgun but had fallen asleep shortly before the visitor arrived.

TELEGRAPH.

The telegraph wires furnishing race news to the pool rooms in western cities were tampered with last week, and in Omaha before the discovery was made $1,500 was paid by the pool rooms to men who were in the deal.

The stockholders of the American District Telegraph company, New York have approved the proposition for an increase of the capital stock from $3,000,000 to $4,000,000 last week, and also ratified the purchase of the Mutual District Telegraph and the Mutual District Messenger companies, which were bought for $1,275,000. The $275,000 needed in addition to the increase of $1,000,000 in the capital stock of the American company, to carry out the contract, will be supplied out of the treasury stock of the American company.

On April 1st 1891, there were 11,44- Imperial telegraph offices in Germany. The length of the telegraph lines above ground amounted to 57,791 miles, whilst the underground only 3,631 miles; there are also 1,562 of under sea telegraph communication in the possession of the Imperial Postal and Telegraph Department. Telegrams were forwarded to the number of 24,864,066.

Until one year ago the city of Plainfield N. J., had no fire alarm system whatever, and much loss was incurred as a result of delay in getting word in case of fire to the town bellringer. Last spring the common council bought a system, and distributed the electric signal boxes around the thickly settled portion of the town. The system has been so effective and become so popular that the council has decided to extend the service, and last week instructed the fire committee to place boxes in various localities where needed, so as to protect more thoroughly the residence portion of the city

The telegraph and electric wires have proved a most useful adjunct in the determination of longitudes, says the New York *Sun*, and our Bureau of Navigation, which has given particular attention to this work, will doubtless improve the opportunity to fix the longitude of Honolulu by this best of all methods, as soon as the proposed cable is laid. No sooner was the first Atlantic cable ready for business than Gould, with its help, determined the difference in longitude between Greenwich and Washington, and our Bureau of Navigation also fixed the longitude of Bahia, Rio de Janeiro, and other South American ports by the telegraphic method, as soon as Brazil was connected with Europe by cable.

By an act recently passed by the legislature of Georgia the railroad commission has issued the following order: "Where messages are received for the public the service shall not be discontinued without first obtaining the consent of the commission, the reasons therefor to be set forth in a petition. This rule goes into effect at once. Telegraph companies shall not charge or collect more than 25 cents for any message of ten words or less, exclusive of date and address, between any points in the limits of the state, or more than two cents for each additional word in a day message or one cent on each additional word in a night message, and no additional charge shall be made for repeating the message. This rule to go into effect February 1st."

The suit brought by the Stock Quotation Telegraph company against the Board of Trade of Chicago to recover $20,000 damages was decided in favor of the defendant last week. In 1886 the telegraph company and the Board of Trade entered into a contract whereby the board agreed to furnish market quotations for the company's tickers. It was claimed that in July, 1887, the board discontinued giving reports without notice to the plaintiff. It was shown, however, that the thirty days' notice required by the contract was given and the judge entered judgment for the defendant. Another suit between the same parties is pending. The telegraph company alleges that the board entered into a contract Oct. 12, 1887, to use its tickers and to purchase its plant for $5,000. For breach of contract damages are placed at $15,000. In the latter case the board claims that the contract was made by unauthorized persons.

TRADE NEWS.

The Russell Electric Company, Boston, has removed its office to Portland, Me.

The American Circular Loom company, Boston, is busy in filling orders for Canvas Jacket wire and cables.

The Germania Electric company, Boston, is meeting with remarkable success with its new shade holder.

The Consolidated Electric Manufacturing company, Boston, is presenting its friends with a very unique paper cutter.

The Newton Rubber company, Boston, reports that orders for rubber storage battery cells are coming in rapidly.

The Eastern Electrical Supply company, Boston, will soon place on the market a number of novel devices which it is now perfecting.

G. W. Payne & Co. of Pawtucket, R. I., report an increasing demand for wire braiders' spoolers, especially from the West.

Manager J. A. Armington of the Holtzer-Cabot Electric Company, Boston, has been confined to his house during the last week by sickness.

The Samson Cordage Works, Boston, expect to make an extensive exhibit at the convention to be held at Buffalo in February.

J. L. Somoff, New York, has received a letter from parties in Bombay, India, asking for the agency in that country for his goods.

The Bradbury-Stone Storage Battery company of Lowell, Mass., is preparing for an extensive exhibit at the convention to be held at Buffalo in February.

The Laminar Fibre Goods company, Boston, expects to place a new line of conduit on the market within a short time. The results of several tests of this conduit were very satisfactory.

The Redding Electric company, Boston, has added another floor to its factory. This house will make a special department for its electric watchman's register, as the

sales of this apparatus have thus far been in excess of the production.

Among the contracts which have lately been awarded the Hill Clutch Works, Cleveland, is one for a large number of clutch pulleys from the Cincinnati Electric Light company.

The insurance firm of Endicott & Macomber, Boston, has recently made contracts with a number of electrical firms, insuring them against loss from accidents that employes might receive.

General Manager C. B. Elliott of the Revere Rubber company, Boston, is perfecting a number of important electrical appliances for street construction, which will be offered for sale in a month or two

The Porter-Leavitt Electric company, Providence, R. I., is building a factory which it expects to occupy about March 1st. This company is at present working overtime to fill the orders on hand for immediate shipment.

General Manager H. B. Cram of the Bernstein Electric company, Boston, has been confined to his home with a severe attack of the grip for the past three weeks, but he is now able to be at the office a short time each day.

Gould & Watson, Boston, state that since they have opened their Chicago branch they have received a large number of orders for moulded mica insulators, and that the prospects for a western trade are very encouraging.

The Electrical Specialty company of Pawtucket, R. I., is making a great succes with its new cut out switch for pole use. F. H Angel of this company is shortly to make an extended business trip through the West and South.

Secretary A. S. Miller of the Boston Bridge Works reports the present outlook for construction work as being much better than was the case last year. He is at present very busy in figuring upon several important contracts, three of which are for points west of Chicago.

The National Telephone Manufacturing company, Boston, has recently issued a new circular, giving an exhaustive description of its apparatus, and also showing a list of a few of the many contracts which have been filled during the past year. The circular tells its own story.

General Manager H N. Fennar of the New England Butt company, Providence, R. I., reports that his company has sold more machinery to the electrical trade during the past year than in any previous year. This company is already preparing an extensive exhibit for the World's Fair.

The annual meeting of the Duplex Street Railway Track company was held at 51 Wall street, New York city, January 12th The Hon Carl Schurz presided, and favorable reports from the executive officers were received. The annual election was postponed until the first Tuesday in February.

At the annual meeting of the New Process Welding & Spinning company held at the office of the company in Chicago on Jan. 5 1892 the following named officers were elected for the ensuing year: Geo. D Cook, president; Mortimer McRoberts, vice president; W. L. Trowbridge, secretary.

Whitmore & Robinson, electrical engineers, Boston, have on hand a large amount of traction work, and are preparing to begin operations when the weather permits. The concern is also completing a number of important tests upon electrical apparatus which has been submitted to them for approval.

President Mason of the Burton Electric company reports that great interest in electric heating is shown in Europe and that many inquiries have been received from England and Germany. There are also indications that a brisk demand for electric heaters for house use will spring up as soon as the apparatus is placed on the market.

Queen & Co of Philadelphia, have placed a new portable voltmeter on the market. The instrumant may be used for measuring both alternating and direct currents. The pointer is dead beat and direct reading, and the indications are pronounced accurate within one per cent. The makers announce that up to date the demand has been very great.

The annual meeting of the stockholders of the Rockford Electric Manufacturing company was held January 12th The report of the secretary and treasurer showed the affairs of the company to be in a very satisfactory condition. The officers and directors for the ensuing year will be C. M. Haven, president; G. E. Knight, vice-president; W. B. Roberts, secretary, treasurer and general manager; Geo. A. Mayo, superintendent and electrician; Geo. F. Penfield, W. F. Woodruff, E. H. Marsh, J. W. Calkins, directors.

BUSINESS.

The Buckeye Electric company of Cleveland, has recently moved into a new factory and is now making 1,500 incandescent lamps a day This output will be rapidly increased until the capacity of the factory—5,000 lamps per day—is reached.

The Fletcher & Fletcher Electric company, Cleveland, O., has several large wire contracts under way and reports an unusually fine business for December in all lines. H. S. Gray manager of the company, has largely increased the company's facilities by the addition of a number of superior workmen and by a material addition to the stock of supplies.

The Card Electric Motor & Dynamo company of Cincinnati has been fully reorganized with the following officers: J. W. Wilshire, president and treasurer; Geo. Bullock, vice-president and C. B. Simrall, secretary. The company has been placed on a good financial basis and it is expected that the manufacture of the well known Card apparatus will soon be commenced on a large scale.

Hussey & Co., 211 Randolph street, Chicago, have just built and put in place a very handsome and efficient annunciator with a return call system, for the Rushville Hotel company of Rushville, Ill. The annunciator has a needle indicator, but is operated by gravity, making a simple and novel combination. Hussey & Co have also designed and are manufacturing a combination letter-box and push-button for apartment houses that is very attractive, and has a number of novel features.

The D. & D. Motor Manufacturing company of Minneapolis has its plant fully established in a fine new factory at 745 and 747 Washington avenue, N., and has employed a large number of workmen turning out a new motor and generator. This company was formerly located at St. Paul, but Mr. Donaldson, the promotor, succeeded in getting additional capital at Minneapolis and has moved his factory to that place. The D. & D. apparatus has already secured a good name and with ample capital this company ought to be able to build up one of the leading electrical institutions of the Flour City.

The Electric Supply & Contracting company, Cincinnati, has just installed for the American Book company a 300 light Eddy generator as an addition to an arc plant of twelve lights already in use. This company has also recently installed a 40 kilowatt C. & C. generator in the St. Nicholas Hotel, Cincinnati, as an addition to an incandescent plant, making about 1,000 lights in use. Another contract with a street railway company at Mansfield, O., for rewinding a number of railway armatures and substituting a 500-volt system for a Daft system of 110 volts has also been completed by this company. This work has been done in a thorough manner. Several new car equipments have been added to this plant.

A ten horse Perret motor furnishes power for the half dozen presses and other machinery in the jobbing department, with ample reserve power for increase of both plants. Steam for drying matrices is furnished by Murray's generator and steam table combined, which is both economical and convenient. The *New Era* says: "As you are aware we selected the Perret motor from a number of competitors because, while equal to the best in points in common, it was the only one which developed its maximum power at such slow speed as enabled us to run our line shafts without the intervention of countershafting. The experience of a year fully confirms our judgment in the selection of these machines."

The Athens, Ga., Railway company writes that the Detroit Electrical Works equipment furnished by the latter company has proved satisfactory in every respect. The plant consists of four 30 horse power motors and one 80,000 watt generator. The general manager of the road says: "We have had very little trouble or expense with the bevel gear; in fact, there is no trouble with it when the friction collars are kept well adjusted, which is very simply and easily done. And as to the dynamo, it has not caused us one minute's delay or one cent of expense. As to the whole equipment, we find it to be the simplest and easiest to keep in repair of any of the systems that I have ever inspected." The same official expressed himself as being favorably impressed with the single motor.

The unique and very safe and convenient form of fuse on the Stanley transformer has created a demand for the same style of box separate from the transformer, and the Stanley Electric Manufacturing company is therefore now manufacturing them apart from the converter. Wherever a branch is taken off from the main primary wires it is very desirable to insert in it a fuse, so that if a short circuit occurs on that branch the lights supplied by it will alone be affected. The new fuse box is suitable for use on primary circuits carrying current up to 15 amperes, and the company considers it is the safest and most convenient box made. Its interior construction is the same as the fuse box on the Stanley transformer, and the points of superiority claimed for the device are: 1st.—It is, of course, double pole and each fuse is in a separate porcelain chamber, so that when a fuse blows there is no danger of the current short circuiting from one pole to the other. This is the worst objection to most primary fuse boxes. 2d.—A fuse can be replaced on a live line with perfect safety and in a very short time, and the use of screw driver or wrench is entirely unnecessary. 3d.—The porcelain plugs in all boxes are interchangeable, so that by having an extra plug or two no work is necessary while on the pole. The western agent for the sale of this box is the Electrical Supply company, Chicago.

ELECTRICAL STOCK MARKET.

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, Jan. 16th, in New York, were:

	Bid.	Asked
Edison General Electric Company, Capital $15,000,000	92	93
Edison Illuminating Company of New York	80½	81½ Ex. Div.
" " " Brooklyn	72½	77½
" " " Boston	100	105
" " " Chicago	130	140
Edison Ore Milling Company	15	20
United States Electric Company of New York	15	25
United States Illuminating Company of New York	30	40
Brush Electric Company of Cleveland	30	40
Brush Illuminating Company of New York	30	40
Thomas-Houston Electric Company	51	52
" " Preferred "	26	27
Westinghouse Electric Company	13	13½
North American Phonograph Company	2½	5
New York " "	2½	5
Automatic Exhibition Company	2	3

ELECTRICAL PATENTS.

Issued Jan. 12, 1892.

466,781. Electric Steam Engine Governor. Frank M. Garland.

466,784. Electrical Annunciator. William F. Harte, Omaha, Neb.

466,787. Electric Indicator. Charles W. Holtzer and George E. Cabot, Brookline, Mass.

466,798. Electric Battery. John S. Nowotny, Cincinnati, O.

Claim fifteen is quoted:

"A carbon cell having its outer surface filled with paraffine and coated with shellac, and the upper portion filled with paraffine below the point where the contacts are secured to it."

466,800. Wire Support for Electric Railways. William Q Prewitt, Lexington, Ky.

466,802. Electric Switch. Edwin W. Rice, Jr., Lynn, Mass.

466,807. Electric Trolley. Elmer A. Sperry, Chicago, Ill.

Claim six reads:

"In an upright coiled flexing erecting spring, a trolley pole supported by one end, a head fixed to the other end of the spring, and a support upon which the head rests by means of a swiveling joint, in combination with mechanism attached to the head adapted to confine the flexure of the spring within a single plane with reference to the head, while the whole is allowed to move upon the swivel independent of the flexure of the spring."

466,820. Battery Zinc and Method of Making the Same. John Beattie, Jr., Fall River, Mass.

The first claim is:

"An element for galvanic batteries, consisting of an alloy of zinc, mercury and magnesium."

466,825. Method of Electric Welding. Peter Gendron, Toledo, O

This invention consists in shaping the abutting ends of the material to have contact at points in proportion to the mass, heating them by a current of electricity, and subjecting them to end pressure.

466,832. Electric Motor Car. Elbert B. Phillips, Cleveland, O.

The nineteenth claim is:

"A motor having its field magnets and armature both mounted on a shaft, in combination with gearing through which the motor may drive said shaft, and means whereby the said motor may rotate the said shaft directly."

466,856. Electric Fuse or Detonator. Paul Ward and Edward M. Gregory, London, England.

466,858. Printing Telegraph. John E. Wright, New York.

466,865. Automatic Electric Heat Alarm. Morril S. Pierce, Westport, Leonard H. Desisle, Lamoine, and Orville C. Oliver, Eden.

466,870. Annunciator. David Heineman, Wabash, Ind.

466,914 Railway Electric Motor. Charles F. Winkler, Troy, N. Y.

466,937 Electric Converter. Gustav Pfannkuche, Cleveland, O.

Claim five reads:

"In a converter, the combination, with a series of insulated sheet metal sections, of coils wound on said core so as to have ventilating spaces between them and the core and between each other, the plates comprising said core having slots therein to produce ventilating spaces in the center of the coils."

466,953. Ammeter. Charles F. Brush, Cleveland, O

466,956. Bracket for Trolley Wire Supports, etc. Edward P. Russell, Newburyport, Mass.

466,972. Brush Holder for Commutators for Dynamo Electric Machines. Isaac H. Bartholomew, Northford, Conn.

466,973. Electric Elevator. William Baxter, Jr., Baltimore, Md.

466,981. Trolley for Electric Railways. John Kuehnle, Detroit, Mich.

Claim fifteen is given:

"In an electric railway car the combination, with a contact arm, of a tension device consisting of a movable rod, a yielding body for retaining the rod in a normal position, a connection between the rod and contact arm, and a pulley over which the connection passes."

467,023. Lightning Arrester. George W. Spittle, Campos, Brazil.

467,048. Electric Motor. John H. Palmer, Boston, Mass.

467,050. Electrically Controlled Car Switch. Burt I. Potter, Boston, Mass.

467,073. Dumb Waiter Signal. Frederick J. Zahner, Stanwich, Conn.

467,075. Electrical Heating Apparatus. Arthur E. Appleyard, Boston, Mass.

This invention consists in the combination of a resistance, a rigid holder of refractory heat-conducting insulating material, a metallic shell inclosing said holder, a handle detachably secured to said shell, and an outer metallic shell detachably secured to the handle by independent means.

467,078. Rheostat. Francis O. Blackwell, Boston, Mass.

467,085. Electric Insulator for Boilers Peter Decker, Norwalk, Conn.

467,102. Nautical Signal or Sea Telephone. Ernst Huber and Frederick J. Kneuper, New York, N. Y.

Claim forty-one is quoted:

"A casing for an apparatus for receiving, transmitting and indicating sound, comprising a body portion having chambers for the primary and secondary telephones, a chamber for the microphonic resounder, a chamber for the director, dial and hands, and means for suspending the said casing."

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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RAILWAY FEEDER AND TROLLEY WIRE,
ELECTRIC LIGHT LINE WIRE,
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AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR **WIRES,**
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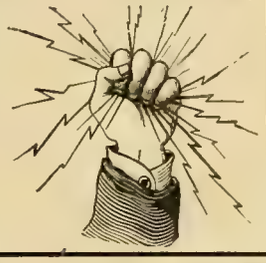

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In the office of a large electric company, a young man to keep Construction Ledger; must be first-class book-keeper, understand the electric railway and lighting business, and have had experience in charging out contracts. To one with the above qualifications a good position is promised.

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Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

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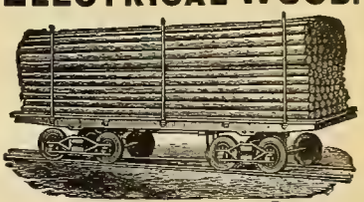

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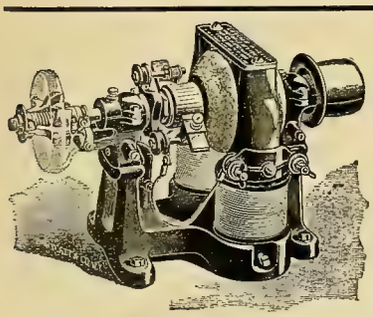

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ARC MOTORS,

$\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 3, 5 H. P. Sizes.

With Automatic Centrifugal Governor. No Switches.

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WORK ON SPECIAL DESIGNS SOLICITED.

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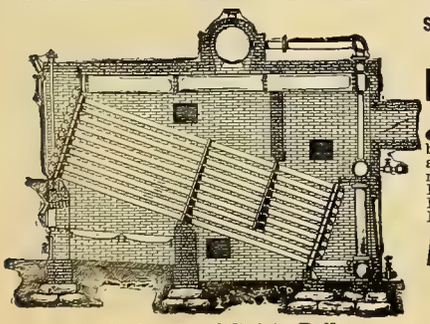

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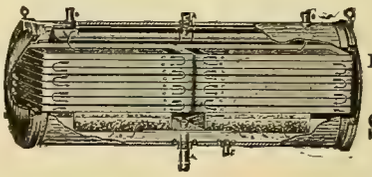

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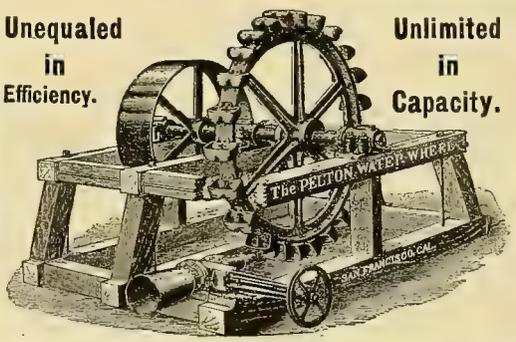

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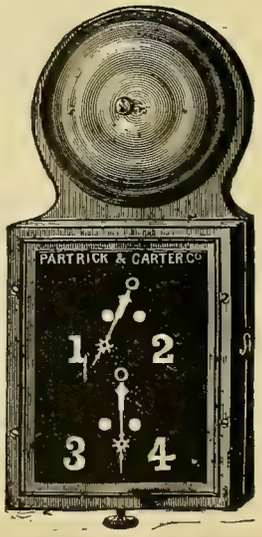

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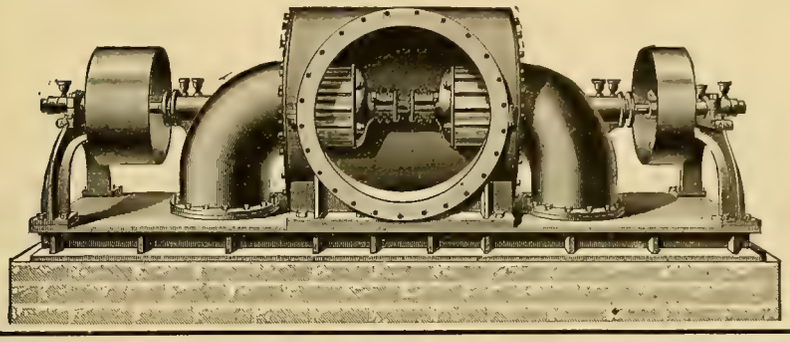

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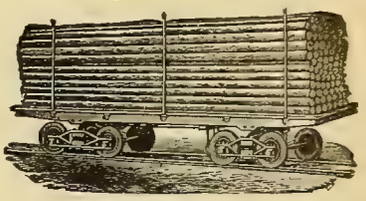

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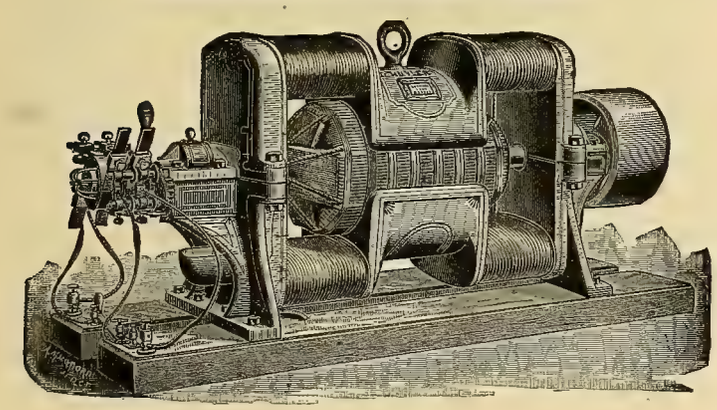

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NO MORE BURNED TERMINALS.

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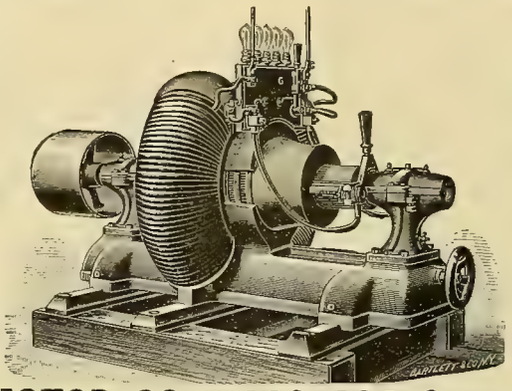
We call the special attention of Station Superintendents to the fact that our machines are absolutely unsurpassed for economy of electric current.



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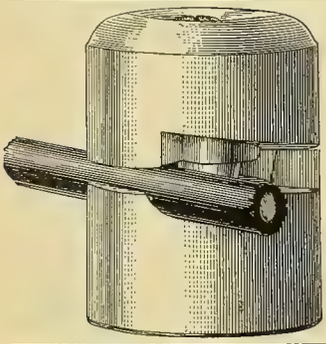

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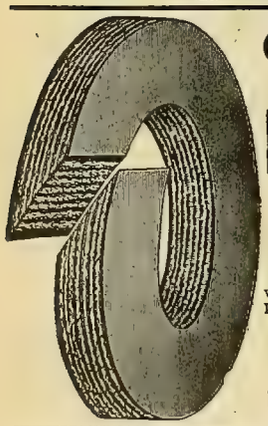

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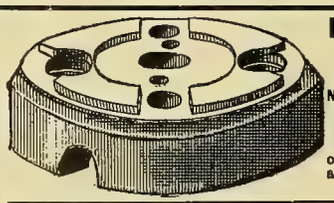

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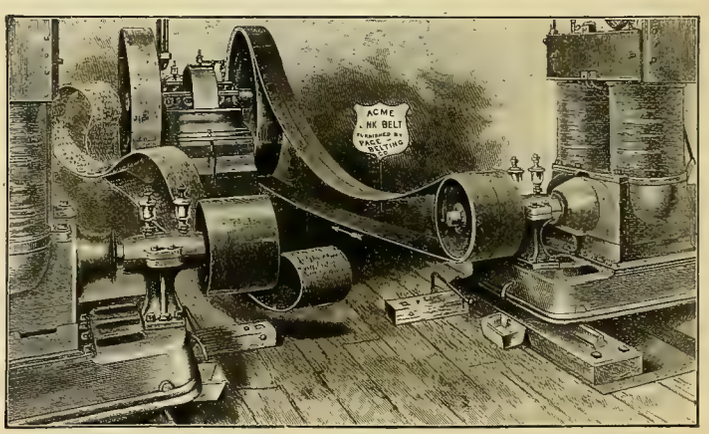

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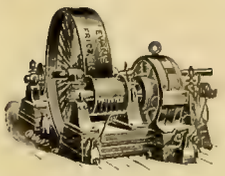

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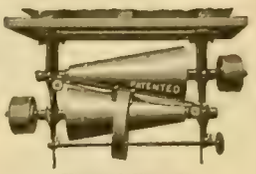

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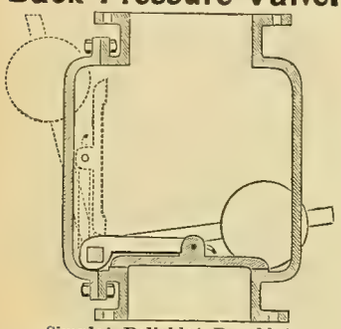
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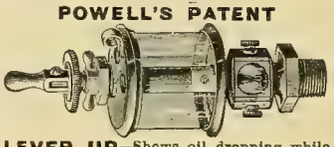
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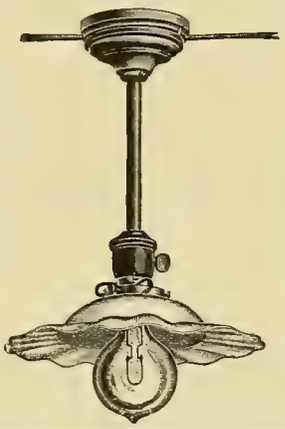

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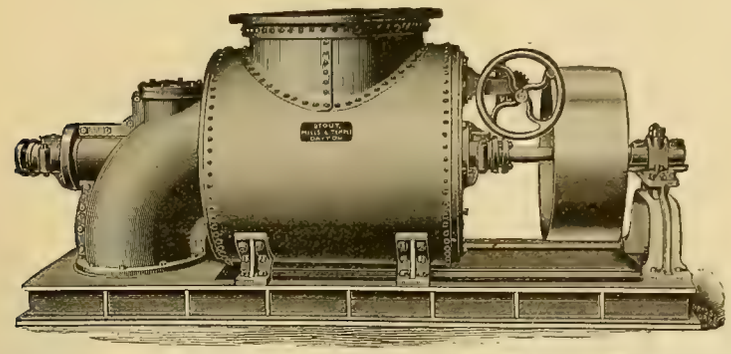

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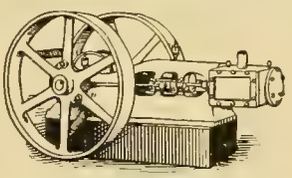

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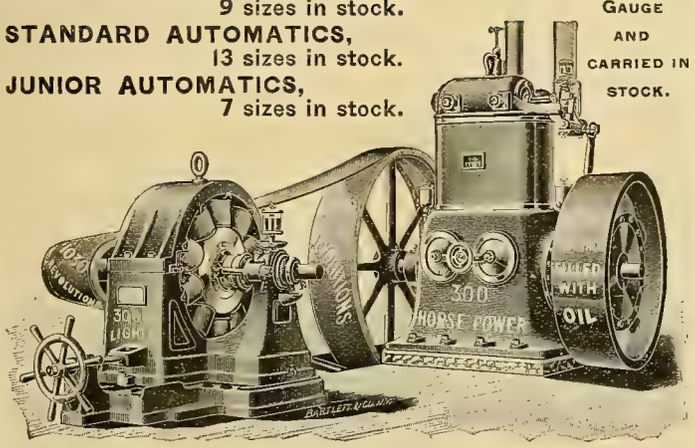

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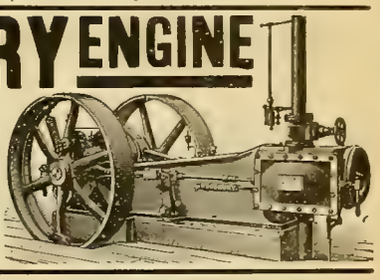

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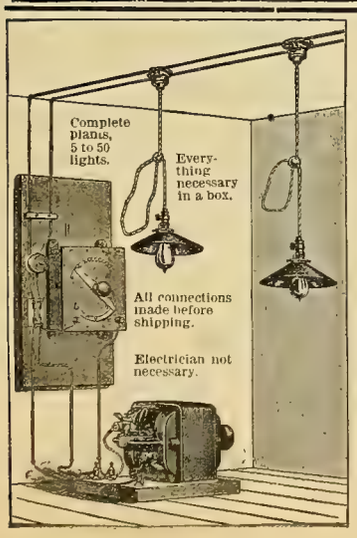

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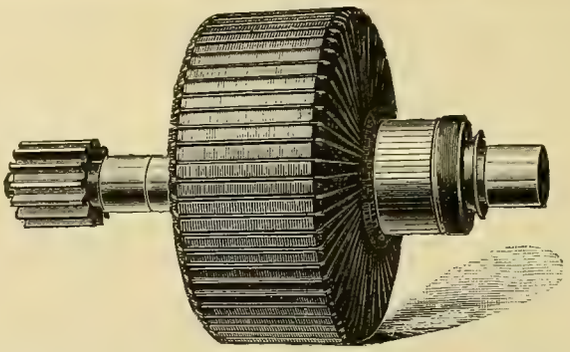

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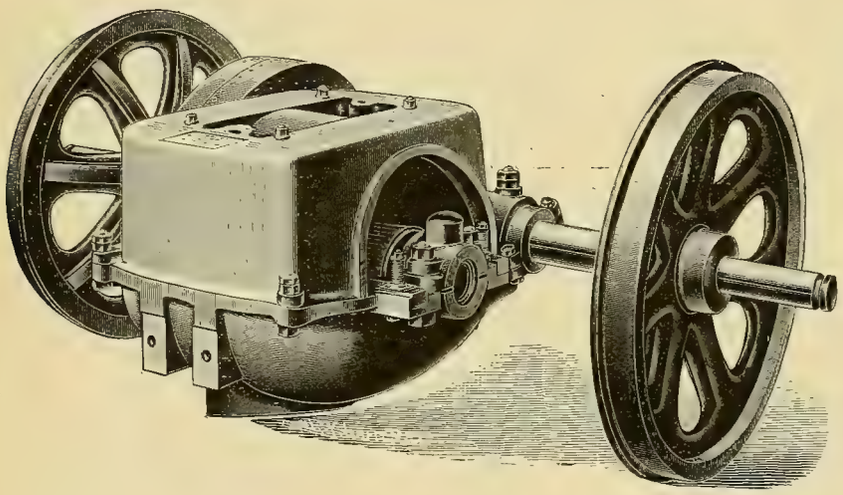

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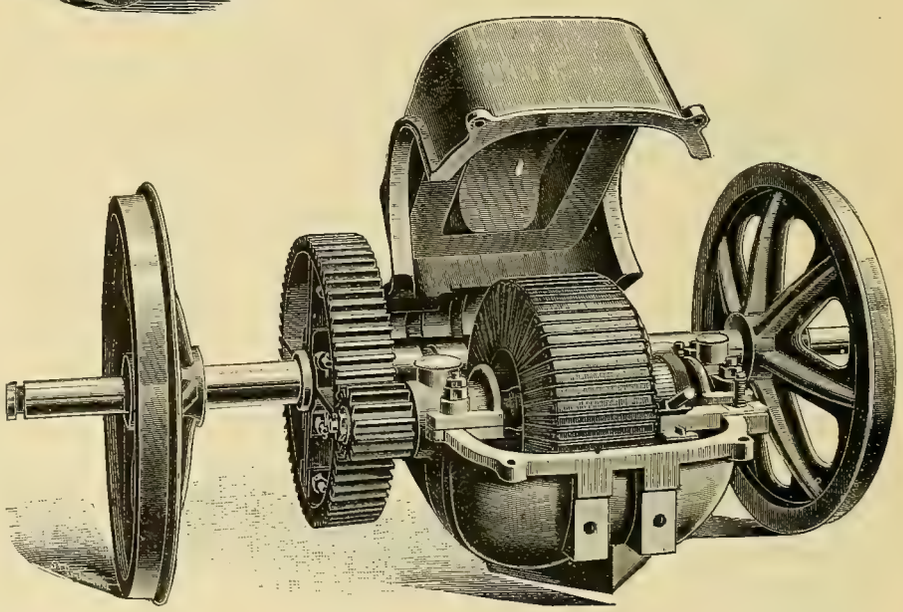

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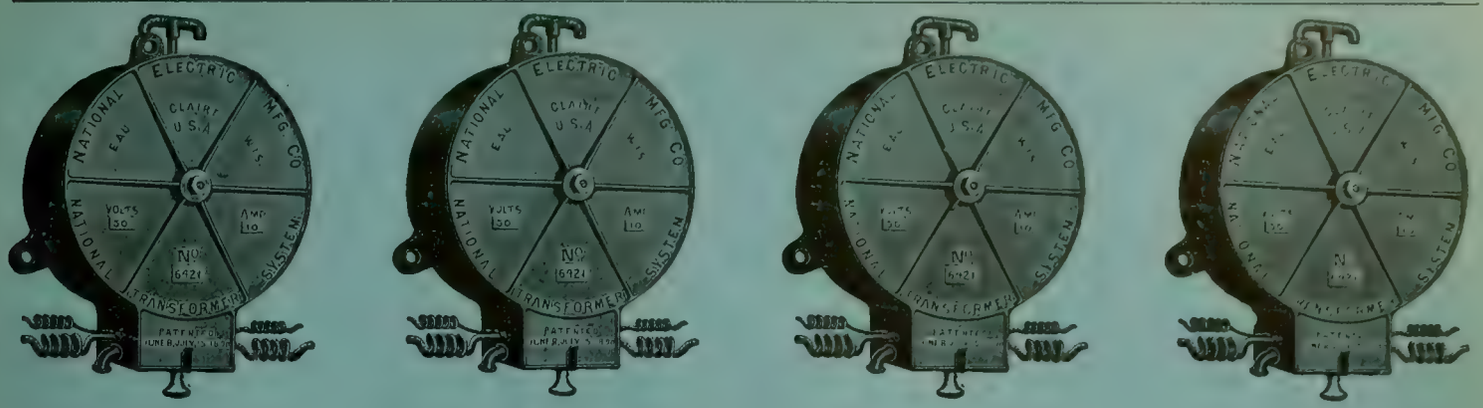

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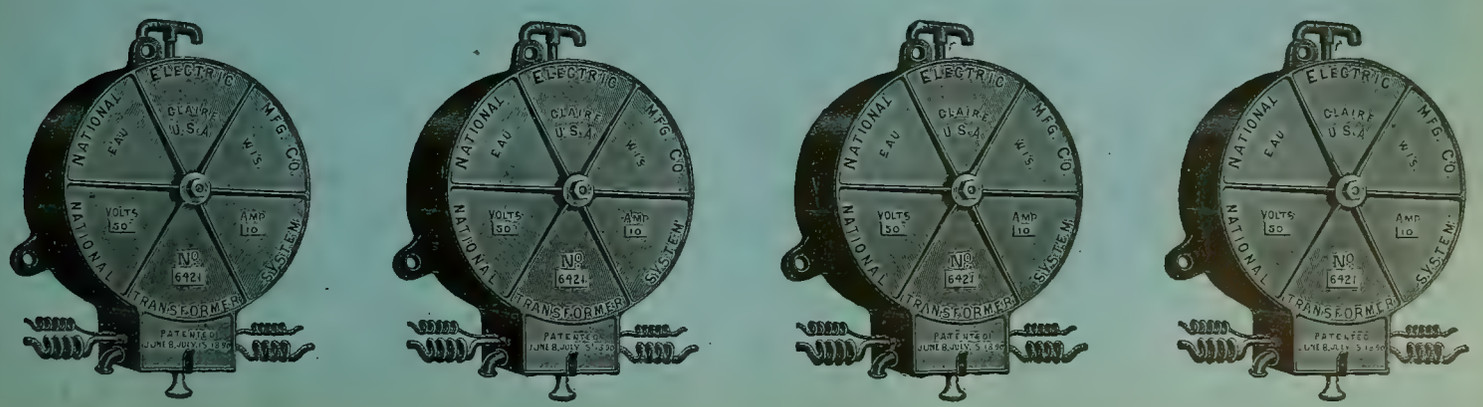

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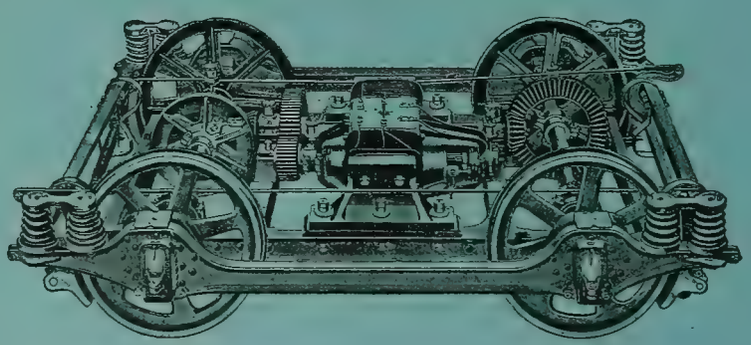

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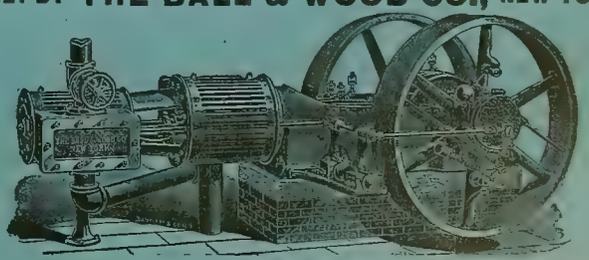

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Brookfield, Wm.
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Phœnix Glass Co.

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And the record they have made for themselves cannot be surpassed. Inquire in Rochester, Jamestown, Covington, East Liverpool, Muskegon.

The Jamestown Street Railway Company report as follows: JANUARY 6, 1892.

* * * * * * * * * * * * * * * * * *

On Sunday morning last it commenced snowing very hard, and so continued all day Sunday, Sunday night and Monday. We were obliged to put forth every effort to prevent blockading of the road, which we succeeded in doing.

* * * * * * * * * * * * * * * * * *

On Sunday morning we started your Generator No. 2 at 6:30 a. m, and continued to use the same until Tuesday morning at 3:30 a. m, when we shut it down. This Generator was in continuous service during the entire time, and was not even sanded, nor the brushes touched. It did not use to exceed one-half quart of oil. We consider this remarkable because of the hard work the Generator was doing. * * * * * * * * *

Yours very respectfully, GEORGE E. MALLBY, Superintendent.

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CLEVELAND, OHIO.

Sometimes you forget to order

CARBONS

When you should; your supply gets low, and

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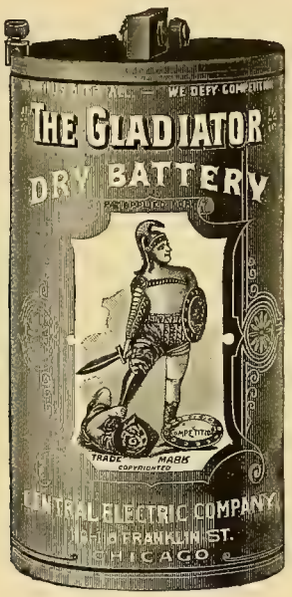
THE GLADIATOR DRY BATTERY.



The comparative tests of this battery with all other dry batteries show conclusive evidence of its superiority. Those who have used the battery in small quantities are now ordering it in large quantities, and its customers cannot speak too highly of its merits.

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No. 667.

Nos. 6259-6269.

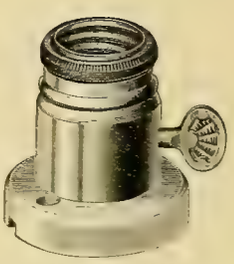
NO. 666

Standard Cat. No.	Old Cat. No.	DESCRIPTION.
6223-6233	1	Standard Keyless Socket
6235-6245	1½	Improved Keyless Socket
6247-6257	2	Standard Key Socket
6259-6269	2½	Push Button Socket
6297-6303	7	Standard Key Receptacle (porcelain or wood base)
6305-6311	8	Fancy Key Receptacle (porcelain or wood base)
6271-6277	8	Standard Keyless Receptacle (porcelain or wood base)
6279-6285	8½	Fancy Keyless Receptacle (porcelain or wood base)
667	667	Porcelain Weatherproof Socket
666	666	Hard Rubber Weatherproof Socket
233	233	Wooden Testing Socket
369	369	Wooden Testing Socket

No. 369.

No. 233.

Nos. 6271-6277.



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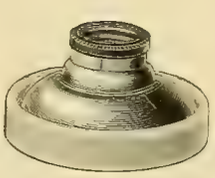
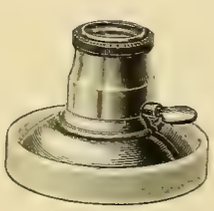


Nos. 6279-6285.



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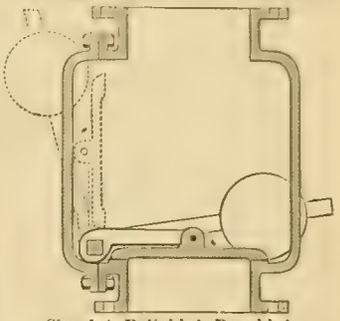

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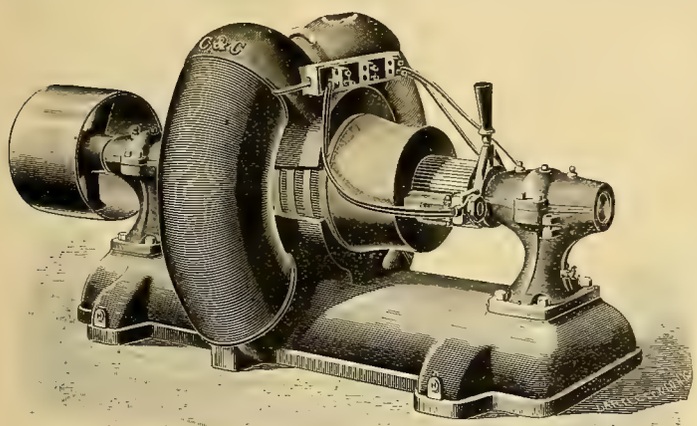

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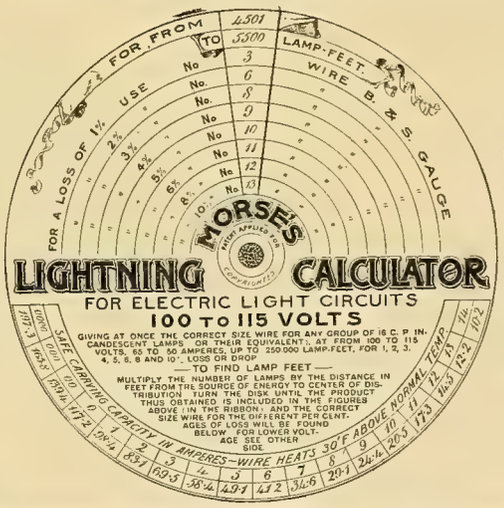

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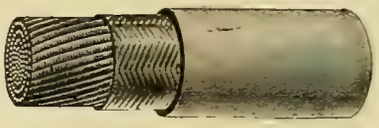

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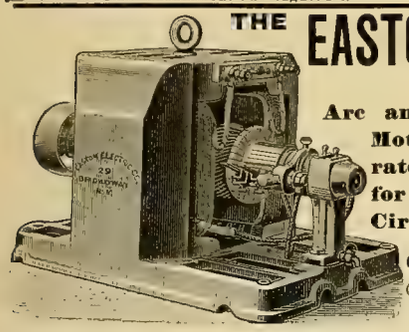

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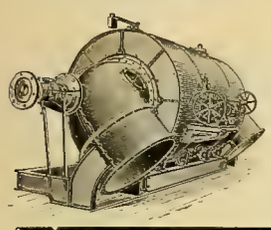

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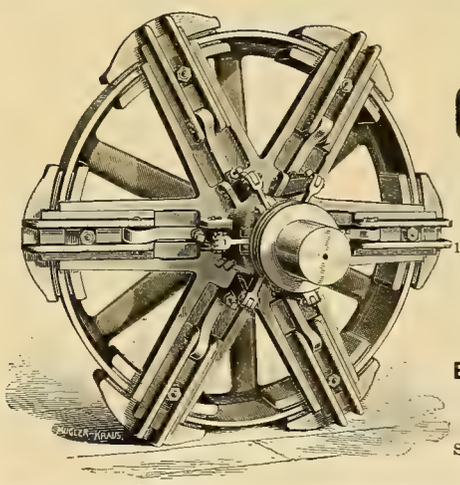

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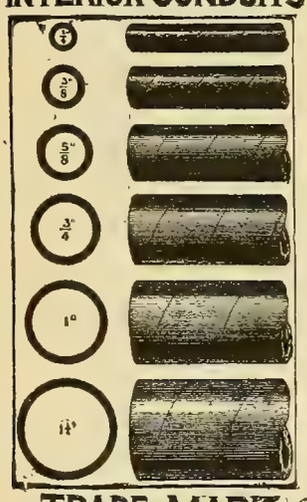

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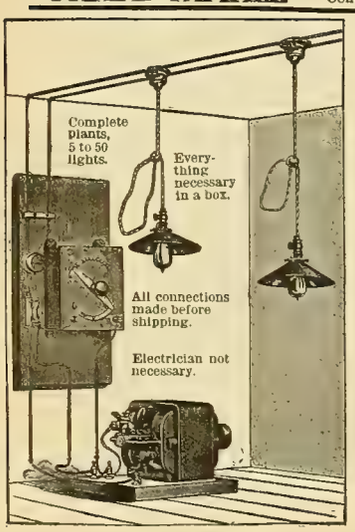

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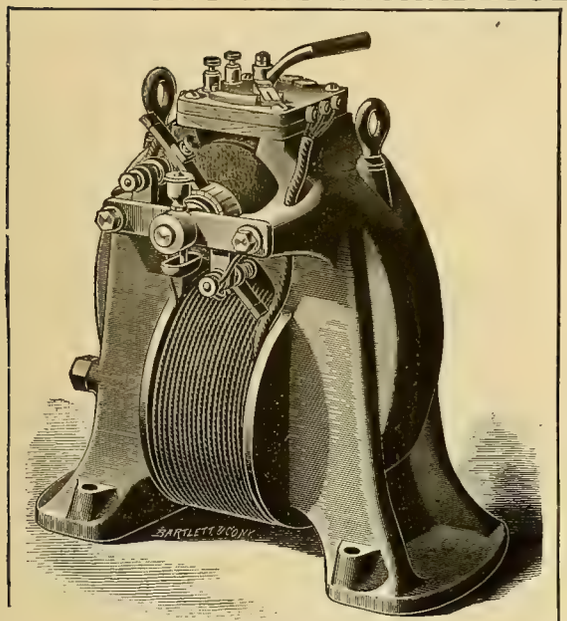

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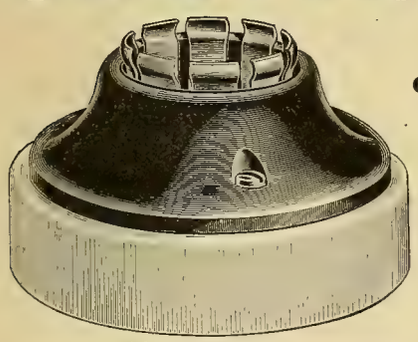

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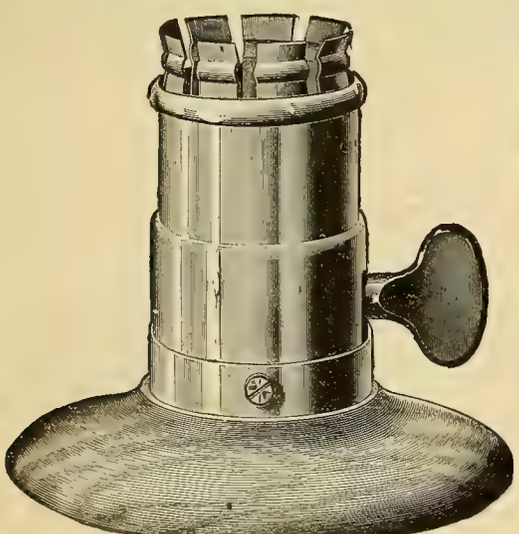

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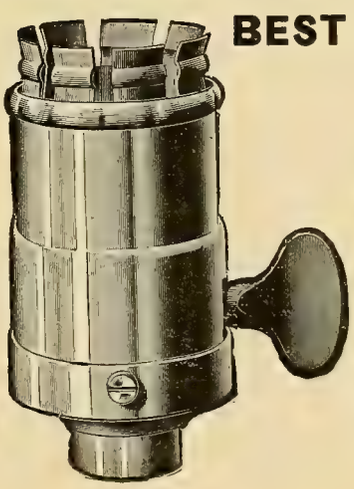

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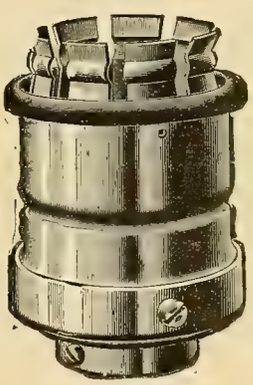

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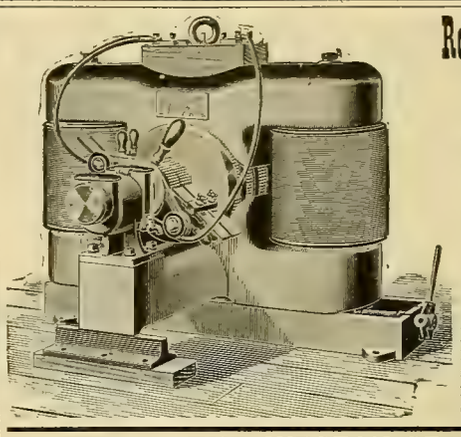

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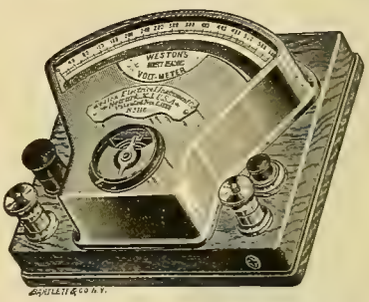

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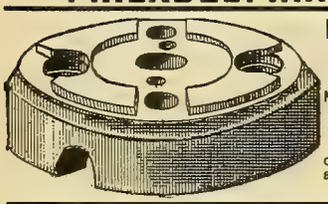

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Western Electrician.

EVERY SATURDAY.

Vol. X. CHICAGO, JANUARY 30, 1892. No. 5

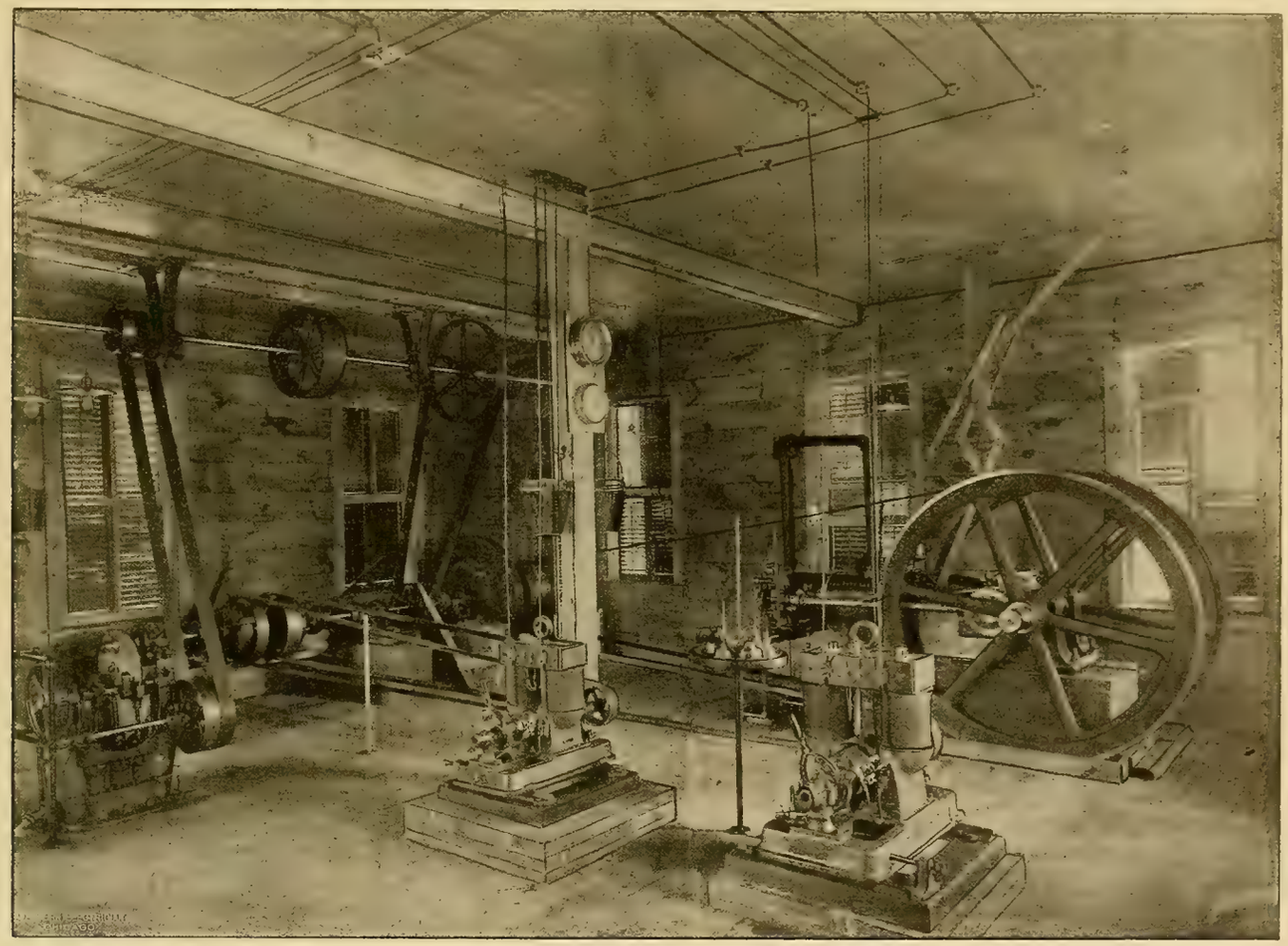
Electric Light Plant Operated by a Gas Engine.

In the accompanying illustration is shown an interesting electric light plant at Taylors-on Schroon, Warren county, New York. The plant was installed by Henry V. Parsell last summer. It is driven by one of the new fifteen horse power high speed Otto electric light engines, using gasoline as fuel. The engine is belted to a countershaft, from which the dynamos are driven through Moore & White friction clutch pulleys. This is the first electric light plant in the United States to use the improved form of Otto engine,

The dynamos are of the standard Edison type. The larger one is in use for the regular lighting service, while the smaller machine is employed to charge a battery of twelve "23M" Electrical Accumulator company's cells for running low voltage night lights. For special illuminations both dynamos are run in multiple on the 100 volt lighting circuit. The plant also comprises a Gould's triplex pump, which supplies the hotel and cottages with water from a large spring and reservoir near by.

The engine house is about eight hundred feet from the hotel; the wires are run on poles, and the lamps are located not only in the hotel and Mr. Parsell's private cottage, but also along the paths and drives on the grounds and on the lake dock. The wiring was done by Bateman & Pollard, New York.

The lights are steady and brilliant, and the cost of running is small. A little way from the engine house is a machine shop for experimental and repair work. It contains a lathe, tool-grinder and a forge, which, with their accessories, were furnished by Peter A. Frasse & Co., New York. This shop is operated by a five horse power Crocker-Wheeler motor, taking current from the main plant. A fine effect is produced by three powerful lights on a tower located on a hill back of the hotel These lamps are placed behind large lenses, which direct the beams of light to different points on the lake. The tower also carries a vane: which is fitted with an electrical device, the invention of H. V. Parsell, Jr., which indicates the direction of the wind at an instrument in the cottage.



ELECTRIC LIGHT PLANT OPERATED BY A GAS ENGINE.

Electricity at the World's Fair.

The section floor plans of the electricity building prepared by Mr. Keller have already been put to use. Some time ago Chief Barrett promised the commissioners from Great Britain and Germany that they should each have 20,000 square feet of space in the electricity building. This space has already been designated, and the large scale drawings have been forwarded to show English and German exhibitors exactly where it is located. All of the 20,000 feet will not be given on the main floor, however, in either instance. It has been decided that 13,000 feet of each country's space shall be on the ground floor, and the remaining 7,000 in the gallery, directly about. These figures represent about the relative proportion of the total amount of space on the main floor and in the gallery, so that the foreigners are put on exactly the same footing as American exhibitors. England has been given space in the northwestern section of the building, down stairs and up, and Germany will be in the northeastern corner.

It is proposed to classify the location of exhibits very largely by their character. Chief Barrett is anxious to make the display in the gallery no less attractive than that on the ground floor, and to this end will doubtless require that certain classes of apparatus be shown in that portion of the building. This will serve the double purpose of avoiding the concentration of the more attractive or popular exhibits in any one section of the building, while the greater part of the displays of any particular sort of mechanisms—measuring instruments, for instance—can be seen in close proximity. The foreign commissioners will be apprised of this arrangement, and will be asked to notify exhibitors accordingly. The idea will not be carried to such an extent, however, that a manufacturer who shows several kinds of apparatus will be compelled to make a divided exhibit. Thus, a house that manufactures both dynamos and telephones, for instance, would not be compelled to divide its exhibit on that account, but concerns showing either of these products exclusively would be required to place them in the spaces respectively set aside for them.

A statement prepared by the department of electricity about the middle of this month showed that 57 formal applications for space, aggregating 97,619 square feet, had been received. This includes only the formal applications sent in on the blanks of the department, and comprises only a portion of the space sought that is "in sight." It does not include foreign exhibitors or the Thomson-Houston, Edison and Westinghouse companies.

The specifications for the electric power plant at the World's Fair have been prepared by Electrical Engineer Sargent of the construction department, and will be sent out within a few days. There will be four power circuits, and each one will form the basis of a separate contract, so that it is possible that four different companies may engage

in the work. In all, 2,500 horse power will be sent out by electricity from the central station for power purposes exclusively. This amount of power will be divided as follows: Machinery and agricultural buildings, 800 horse power; manufactures and liberal arts building, United States government exhibit and naval display, and miscellaneous circuit on elevated railway structure, 800 horse power; mining building, 600 horse power; transportation building, 300 horse power. The generators, of course, must be installed in the great central station at machinery hall, and steam power will be furnished by the exposition authorities free. All generators must be of at least 50 kilowatts capacity, and the successful bidders must furnish and lay their own conductors in the subways or as otherwise provided.

The specifications for the arc and incandescent lighting will be ready within a week.

Mr. Keller's work on the section plans was interrupted last week by a severe cold which threatened pneumonia. He is back at his desk now, however, although scarcely well, as he is anxious to have the drawings finished as soon as possible.

Rice's Method of Regulating Railway Generators.

The object of the arrangement illustrated herewith is to establish such conditions in an electric railway system that upon an overload or short circuit the potential of the circuit will be automatically diminished and the motors operated at a lower pressure instead of being disconnected altogether, as has been the case when fuses or other devices for interrupting the main circuit are employed. Fig. 1 shows the arrangement, which was devised by E. W. Rice, Jr., of Lynn, Mass., as applied to a compound dynamo, while Fig. 2 is a diagram showing the connections for an extension of the application to a set of railway generators working in multiple to furnish currents to a constant potential system.

In Fig. 1 S S' represent, respectively, the series and shunt winding of the compound wound dynamo. The current from the armature of the generator G passes through the magnet M, and then out the line The shunt coil S' is connected, as usual, around the brushes of the generator G, or between the mains. In series with the shunt coil S' is placed a resistance R, which is normally shunted by the armature A of the magnet M. This armature in its unattached position establishes connection between the points c d, which are the terminals of the resistance R, as shown. The spring Z counteracts the attractive force of the magnet M upon its armature A, and

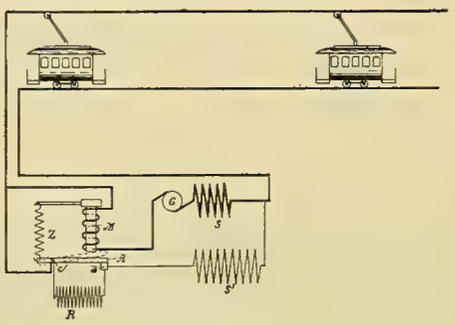


FIG. 1. RICE'S METHOD OF REGULATING RAILWAY GENERATORS.

this spring may be made adjustable in strength according to the conditions present.

The operation is as follows: The spring Z having been previously properly adjusted, the two windings S S', of the generator G act conjointly to energize the field magnets, and the strength of magnetization is increased or diminished, as usual, in accordance with the varying demands for current by the motor connected between the mains. When this demand has increased, however, to an extent which would, if satisfied, be apt to injure the generating apparatus, the attractive force of the magnet M overcomes the spring Z and attracts the armature A to the position indicated by the dotted lines. In this position of the armature A the short circuiting of the resistance R is interrupted or broken, and the current in the shunt winding S' has now to traverse the additional resistance R thus interposed. The magnetic field of the generator G becomes weaker, and the potential of the current supplied to the mains is thus automatically decreased by any predetermined amount. The armatures of the motor on the cars having now less counter electromotive force to produce, will lower their speed of revolution, while the demand for current may remain approximately the same, and thus the whole system is automatically slowed down until the demand for current between the mains has diminished to that amount which has been selected as the maximum at the normal potential which the generators can furnish with safety when the armature returns to its normal position of shunting the resistance R.

In Fig. 2 three compound wound generators G G^1 G^2 are shown with the regulating apparatus applied. Here the main current from each of the generators G G^1 G^2 traverses the magnets M M' M^2, respectively, before it reaches the main. The shunt windings S' S^3 S^5 are connected, one terminal of each winding to the main, and the other terminal of each winding to the other main. This connection in the figure is accomplished in multiple through the line f. The line k is kept closed only when each of the armatures A A' A^2 is in its unattracted position, as the contact points c c' c^2 are all arranged in series with each other. The resistances R are also arranged in multiple, one terminal of each resistance being connected to the line f and the other end of each of the resistances to the line e, which forms a common connection to one of the mains. It will be seen by this arrangement each and all of the resistances R are shunted or short-circuited by the line k when the contacts c c' c^2 are closed; but when an excessive current is demanded of any one of the generators G G' G^2, the corresponding magnet M M' M^2 included in their respective generator-circuits interrupts the line k, and consequently the short circuiting of the resistances R R' R^2, which resistances are now placed in series with the shunt-windings S S^3 S^5. In this way each machine is dependent upon the others connected in multiple with it and the maximum current output at normal potential of any one machine can never exceed that which has been selected as its capacity to insure safety to the apparatus. As in the case of Fig. 1, when the demand for current has reached the amount which the generators can furnish with safety the armatures A A' A^2 assume their normal or closed position for closing he line k and shunting the resistances R R' R^2. The switch s controls the circuit f for closing and opening the same, when desired. There is also shown in the figure an equalizing cable connecting the series winding of the generators.

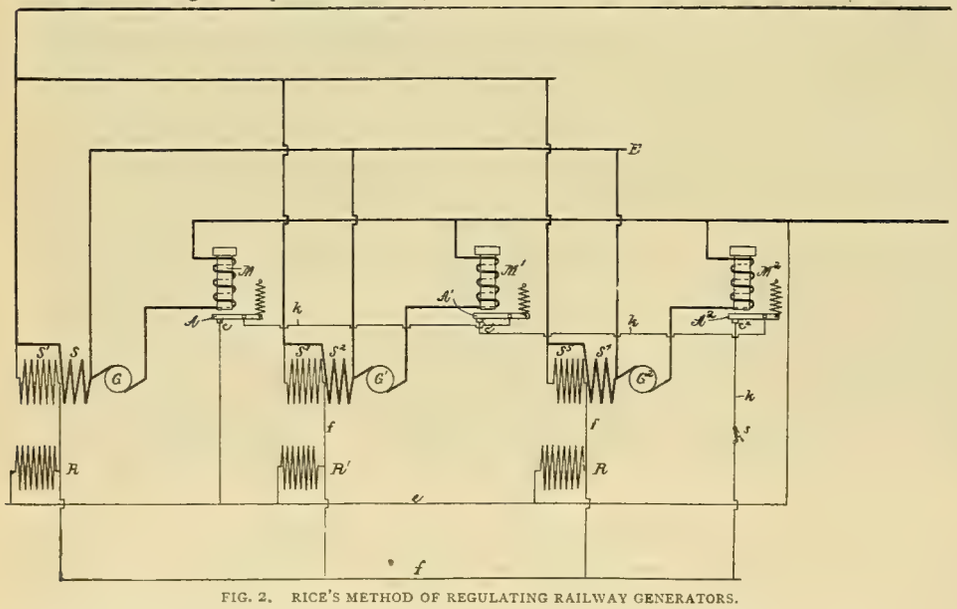


FIG. 2. RICE'S METHOD OF REGULATING RAILWAY GENERATORS.

Electric Power Transmission.[1]

By D. C. Jackson.

The subject for discussion announced for this evening by your committee is the advantage of multiphase alternating currents in power transmission. On account of the magnitude of the subject, I will confine myself to plants of a single type, i. e, plants in which power is transmitted and distributed for general commercial operations. The source may be distant or central. An example is to be seen in any commercial power plant where the power is sold to various manufacturers, and the motors have a capacity varying from five horse power upward. Another example is that of a mining plant where the power is utilized for various purposes, as driving the mill, ventilating, drilling, hoisting, pumping, etc., and motors of various capacities are again required, each operating under its own peculiar conditions. It is evident that the plant must be capable of extreme flexibility in distribution, and the electric pressure at the motor must be within the limit of danger to a careful attendant. Commercial plants of this type are increasing in number and importance, and experience shows that the increase would be even more marked, were it not for the difficulties and expenses entailed on long distance transmissions by the use of continuous currents. In the near future general engineering practice will look to this type of plant for its precedents in power transmission, and sound financial and economical construction will obtain. There are many plants that are so small or from which the product per horse power is so great, that efficient operation is unimportant. These plants can be installed with the prime object of fulfilling their duty, regardless of cost, yet, paradoxical as it may seem, the plants may be economical. Paradoxes must be left to the individual skill of the constructors, while we discuss the economical commercial plant.

That direct transmission of power by continuous currents, in this type of plant, must be limited in pressure and therefore in what may be called transmission radius, will be admitted by all. Beyond this limiting radius, the safety or economy in using continuous electric currents is doubtful, as resort must be had (1) to dynamos and motors respectively generating and utilizing excessive pressure, or (2) to motor generators used as converters. In either case the result is shown by experience to be unsatisfactory if not disastrous. Under ordinary conditions, the maximum pressure that can be used satisfactorily with a Siemens armature is shown by practice to be 1,250 volts in power transmission dynamos. A Gramme armature with its advantages in mechanical arrangement and insulation of the wires may possibly give satisfaction at 2,500 volts for power transmission, but the generation of large currents at 2,500 volts' pressure by continuous current dynamos is not likely to become general. Two high pressure generators can be safely worked in direct series or on the three-wire plan, as has been done in Switzerland and this country. By this means a considerable transmission radius is secured, but the motors must be in large units, and also worked in series or a step-down converter station is required. This arrangement is, therefore, inflexible, and does not come within our scope.

By an examination of current practice and of the results attained in existing electric plants, we are driven to the conclusion that 1,000 volts at the motors is the maximum safe pressure to be used in commercial power distribution. Where motors as small as five horse power are used, even this pressure should be divided by the three-wire arrangement or some other satisfactory method. The economical limiting distance for 1,000 volts at the motors is shown by practical experience to be about four miles. Under special conditions, particularly in small plants, this limit may be considerably exceeded, but only where the conditions will permit an excessive cost, either in installation or operation.

With these considerations, which I do not think will be seriously disputed, we arrive at the following conclusions: First, a commercial transmission plant which covers a radius of four miles or less can be economically and safely operated by continuous currents, with the pressure at the motors not exceeding 1,000 volts. Second, For transmission radii greater than four miles we are forced to the use of excessive and unsafe pressures, or to the use of transformed pressures. We will discard the former as being uncommercial and, therefore, poor engineering. It is well known that either continuous or alternating currents can be transformed, but with continuous currents, revolving motor generators or step-down stations of motors and dynamos are required, thus demanding impractical expenditures for installation and maintenance. In addition, the disadvantage of high pressure dynamos at the generating station must be faced. On the other hand, in the case of alternating currents, the conditions of transmission are favorable. At the generating station the dynamos can produce a low pressure of 100 to 500 volts, and by converters the pressure can be economically raised to such an amount as is required for efficient transmission. At the distributing end of the plant the pressure can be readily and safely reduced to any extent required for motors, lighting or other purposes. Here, however, is faced the problem of an alternating current motor. Its difficult solution has been industriously sought and is now apparently discovered in the multiphaser.

Where converter stations are demanded by the conditions, there seems no possible reason for assuming such difference in the mechanical efficiency of power transmission by continuous or by alternating currents, when the

1. Read before the Chicago Electric club, Jan. 18, 1892.

lines are similar and the pressure equal. The efficiency obtainable by alternating currents was illustrated at Frankfort, where a commercial efficiency of about 60 per cent. was obtained with a transmission radius of 110 miles. Doubtless the national love for a scientific novelty has led the Germans to over-estimate the originality and importance of the experiments with multiphase currents shown at Frankfort. It must be admitted, however, that the self-starting three phase motors exhibited at the Frankfort exhibition evidence a distinct advance in the use of electric currents to transmit power. The use of single phase alternating currents on the commercial transmission plant is admitted to be impractical. The conditions demand an efficient motor which is self-starting under load, controllable at the start, of dimensions and weight comparable with continuous current motors, of comparatively slow speed, and the cost of which is not excessive. The three phase motors exhibited at Frankfort showed all of these characteristics in a marked degree, according to the reports of their service. We are therefore assured that the multiphase alternating current motor is a practical success. Before such a motor can be entirely satisfactory in this country, the rate of alternations now used in commercial work will doubtless be reduced, at least for use on power transmission plants. It is even probable that the high rate of alternation used by the American companies has been an importans cause of our failure to apply the multiphaser, when first developed by Tesla, to extended practical work. It may be well to consider here the organization of a plant for the commercial electric transmission and distribution of power. Assuming the site and buildings for the generating station to be secured, the main divisions of the plant are:

First—A properly proportioned prime power plant, ordinarily actuated by water in long distance transmission.

Second—An economically arranged battery of electric generators, with proper regulating devices, capable of generating a pressure which is safe and easily handled.

Third—A substantial transmission and distribution line so designed and built that it neither costs excessively in construction nor requires an excessive outlay for operation, due to maintenance and power losses.

Fourth—Motors which can operate efficiently and reliably under the pressure at which current is furnished to them.

Examining the second and fourth requirements and the third, we find diametrically opposed conditions for long distance transmissions. To build a long line at a fair first cost, without entailing an excessive "drop," demands a high pressure. But we have seen that the dynamos must be of moderate pressure in order to be safe and economical, while the pressure at the motors should not exceed 1,000 volts. Therefore, to fulfill the second, third and fourth requirements at the same time the transmission radius must be limited to four miles, unless a compromise can be effected. With alternating currents the compromise is effected by the converter and all the requirements are fulfilled at once. The direct current transformer we have found impractical, and unless some of the requirements are sacrificed with a resultant loss of economy and reliability, continuous currents cannot be used. We thus see that for transmission radii greater than four miles alternating currents have evident advantages which make them pre-eminent. As the motor which has been developed is a two or three phaser, the line must be erected upon the three-wire plan. That this is not a material disadvantage is proved by the satisfactory service of numerous three wire short distance transmissions using continuous currents. The multiphase alternating current has some incidental advantages, several of which will doubtless suggest themselves to you. It seems reasonable to expect the operation of solenoid drills and similar machinery directly from the circuits. Incandescent lamps can be operated from the circuits as in the usual alternating system. Each large motor can be operated from an individual converter at a pressure of 500 volts, while smaller motors and lamps can be operated at a pressure of 110 volts or less.

We are now in a position to modify our conclusions as may be required, and make them definite, thus:

First—When the transmission radius exceeds four miles, with a satisfactory motor, which is apparently now at hand, multiphase currents (either two or three phase) have evident superiority over continuous currents for plants intended to transmit and distribute power for general commercial purposes.

Second—When the transmission radius does not exceed four miles continuous current distribution, without transformers, using a pressure not exceeding 1,000 volts at the motors, has the advantage of simplicity and efficiency.

Third—The advantages to be derived from the operation of incandescent lamps in parallel, solenoid machinery, etc., upon the motor circuits may in some cases confer superiority upon the multiphase currents, even within the four mile limit.

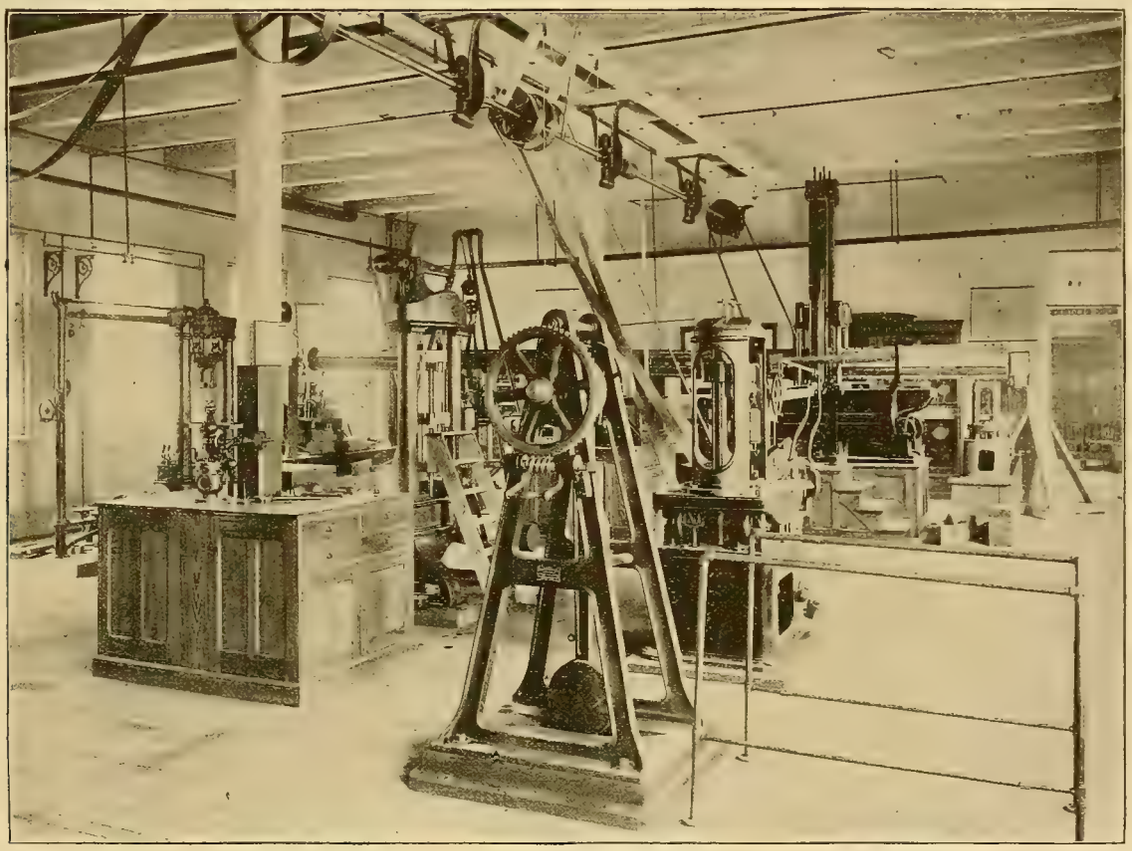
In this discussion you will doubtless find little that is new, but if the arrangement of what is already known leads you to appreciate more fully the importance of the multiphase current, I shall be well satisfied. Many inventors and writers who have dealt with the advantages of the multiphaser have made liberal use of mathematics. Some have developed theorems of evident truth as the result of their mathematical investigations, but many have derived conclusions evidently erroneous. The subject, like the minimum economical cost of plant, is one in which correct mathematical premises are elusive, and the best doctors disagree in their analytical deductions. From the standpoint of the practical electrician, the conclusions derived are evidently reasonable, and they are upheld by experience. I see no reason to believe that multiphase currents will seriously invade the fields now occupied satisfactorily by continuous and single phase currents, but it seems evident that the multiphaser has a field peculiarly its own in a certain type of power transmission plants.

Chicago Edison Company.

The stockholders of the Chicago Edison company held their annual meeting on January 19th and unanimously elected the old board of directors. The names of the directors elected are as follows: A. F. Seeberger, John D. Drake, Lambert Tree, R. C. Clowry, E I. Brewster, Byron L. Smith, Robert T. Lincoln, J. W. Doane, F. S. Gorton, A. A. Sprague, E. M. Phelps. The annual report of the company showed a surplus on hand of $243,000. The company was organized in 1887 with a capital of $500,000. That was increased in 1890 to $750,000, and during the year covered by the report a further increase of $250,000 was made and all taken by the stockholders at par. The company paid dividends at the rate of 8 per cent. per annum on the capital stock beginning Feb. 1, 1890, and aside from the plant situated on Adams street it has built a plant on Wabash avenue, between Twenty-sixth and Twenty-seventh streets, which was put in operation April 1st. The company has connected with the Adams street station 42,000 incandescent lights and of 1,242 horse power in motors. The Wabash avenue station has 11,600 incandescent lights and 55 horse power in motors.

Strength of Iron and Steel Electric Railway Poles.

The importance of determining the strength and deflection of steel and iron poles for street railway and lighting service has been long recognized by engineers as well as managers of lighting and railway companies. It has long been a question as to what was the best form of pole to give the greatest strength and least deflection. Builders of electric railways and the owners of these lines realize the importance of this work on account of expenditures required to correct improperly constructed lines and readjust the poles that have been carelessly put up. What is wanted is a pole that will act like a bow or spring, and keep a tension on the line at all times of sufficient amount to hold the trolley and guard wires in position at a fixed height above the tracks. A pole which at first may seem strong enough, but which is strained beyond its elastic limit, will bend and continue to bend after each adjustment, when sooner or later the pole will fail entirely and come down. In view of these well-established facts, Milliken Bros. of New York have been conducting considerable experimental work and tests at Cornell University, under the direction of R. H. Thurston. The first tests were made on Feb. 2, 1891, on a side pole as first made by Milliken Bros, with the lacing in the center extending only to a tie plate at ground level. The tests showed that the strain revolved arcund the tie plate at ground level and buckled the segments. It proved that by continuing the lacing to the butt of the pole and filling it with concrete, that the pole would develop much more strength and at the same time add little to its cost. This form of construction was therefore adopted for standard work. In order to get at the exact strength, and to compare them with other poles, five of these Milliken poles and three pipe poles were furnished for testing, and the University furnished a chestnut pole. A view of the testing room at Cornell during the experiments is herewith presented,



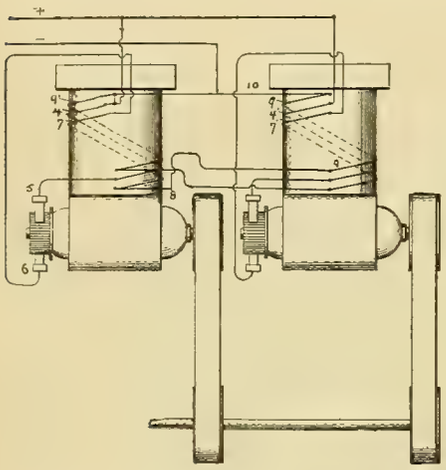
TESTING STRENGTH OF IRON AND STEEL ELECTRIC RAILWAY POLES AT CORNELL UNIVERSITY.

The result of these tests has been very satisfactory to Milliken Bros., and they have taken advantage of the experience at Cornell. The experimental work has already been described in the WESTERN ELECTRICIAN.

Hutchinson's Method of Coupling Motors.

The accompanying diagram will enable the reader to understand a method devised by Cary T. Hutchinson of New York, to equalize the work done by two or more motors, when they are connected to a common circuit and to a common load, both being belted, for example, to the same shaft. The same plan may be applied to the equalizing of the work done by two or more generators, as for instance when they are driven by separate engines and one revolves at a higher speed than the other, both being connected to the same circuit.

From the cut the manner in which motors may be coupled will be seen. The two motors illustrated are series wound machines, although motors with shunt windings may be used. The circuit of the motors is as follows: From the + side of the line through the main field magnet coil 4 to commutator brush 5, through the armature coil to commutator brush 6 to an extra field magnet coil 7 in the same direction as in the main coil, thence by wire 8 to an extra field



HUTCHINSON'S METHOD OF COUPLING MOTORS.

magnet coil 9 on the second motor in an opposite direction from the main field magnet coil, and thence by wire 10 back to the negative side of the supply circuit. It will be seen that the circuit of one of the motors is arranged so that the circuit passes through the main and extra field magnet coil in the same direction, and through an extra coil on the other motor in an opposite direction. If a larger number of motors than two is used, the number of extra coils will be correspondingly increased. With the two motors connected as above described, suppose that for any reason one motor has more current flowing in its armature than the other. To diminish this current (in order to make it approximately equal to that in the other motor) the counter electromotive force of the first motor must be increased. This is done by increasing the magnetic field by means of the extra field magnet coil 7, the effect of which is cumulative with the main field coil. At the same time the counter electromotive force of the other motor would be decreased by the extra coil 9 acting differentially with its main field magnet coil. On the other hand, if the first motor carries too little current, its counter electromotive force must be diminished. This is done by means of the extra field magnet coil 9^1 acting differentially with the main coil. The difference between the currents in the two motors will be practically proportional to the difference of the counter electromotive forces of the two, and, as in the arrangement described, this difference of current is used as the regulating magnetizing force, the adjustment or regulation will be automatic. When, for example, the current in the first motor branch and in the second motor branch are equal, the magnetizing effect of coil 7 is just balanced by that of 9^1 and 7^1 by 9; but if the current in the first branch is in excess of the current in the second branch the effect of coil 7 overbalances that of 9^1. For this reason the strength of the field and the counter electromotive force are increased and the current taken by the branch correspondingly diminished.

From an examination of the application described it will appear that when one of several electric motors is doing a proportional part of the work required in the system there is a balance established between the equalizing coils on the several field magnets; but when one of the machines is called upon to do more than its share, the ability of the machine to do its additional work is automatically increased in like proportion, and this is effected by an arrangement of circuits, whereby the difference of currents flowing through the equalizing coils of the machines is made to compensate or regulate.

Electric Damper Controller.

By the use of the device shown in the cut it is proposed to control automatically the combustion in a furnace or other heater by a thermostat in such a manner as to maintain a uniform temperature in the apartment in which the thermostat is located.

To accomplish the result a thermostatically controlled motor is combined with a simple valve which admits air to the heater below or above the fire grate as it is required to increase or diminish the temperature.

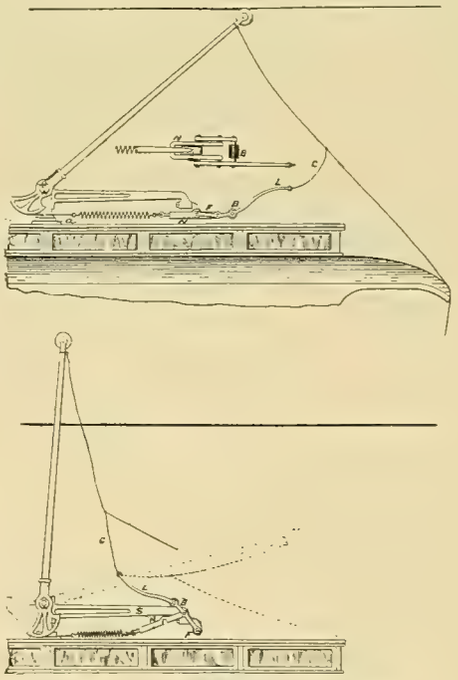
The valve for controlling the passage of air to the pipes consists of two concentric sheet metal cylinders, one fixed across the interior of the chamber, so that its ends encircle the air inlets, and the other mounted so as to turn freely within the first. The outer cylinder is provided with top and bottom openings, through which the air entering at the center passes to the upper or the lower pipe, as the case may be. The inner cylinder, or valve proper, is also provided with top and bottom openings through which the air passes to the opening in the outer cylinder.

For the purpose of operating the valve there is provided as shown in the cut, an electro magnetic motor controlled by a thermostat, located in the apartment the temperature of which is to be controlled. The motor consists merely of a lever, or walking-beam, fixed on the valve-spindle and provided at its two ends with pendant soft iron armatures. The armatures are arranged to rise and fall within the stationary solenoids through which a current is passed alternately, thus causing the armatures to descend one at a time and thus rock the valve to and fro. The thermostat is composed of a compound conducting bar arranged to vibrate between two contact points, so adjusted that it meets one or the other, according as the temperature reaches the maximum or minimum limit. F. E. Chatard of Baltimore, Md., is the inventor of this damper.

Another Device for Protecting Trolley Poles.

There have been presented in the WESTERN ELECTRICIAN descriptions of a number of devices, the object of which is to bring down the trolley pole below its normal position and thus prevent injury to span wires, etc., in the event of the wheel's displacement from the overhead conductor. That a demand exists for a reliable mechanism of this character is evidenced by the number of inventors now working at the problem. One of the latest efforts in this direction is illustrated by the accompanying diagram.

E. R. Harding of Winthrop, Mass., designed this trolley mechanism so that the spring upholding the pole



FIGS. 1 AND 2. ANOTHER DEVICE FOR PROTECTING TROLLEY POLES.

is automatically slackened in the event of the wheel jumping off the conductor.

A comparative study of Figs. 1 and 2 will enable the reader to obtain a clear idea of the operation of the device. In Fig. 1 the trolley wheel is shown in its normal operative position. Suppose now the wheel leaves the wire. In this event the lever L is pulled up by the branch trolley cord C. This action lifts the notched yoke N from the pin fulcrum F of lever L, slackening the trolley spring and allowing the pole to drop.

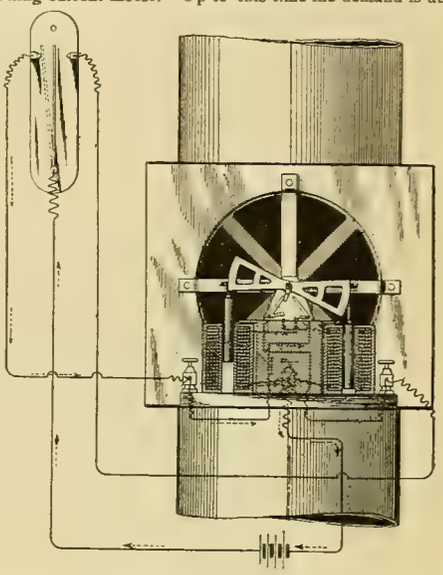
It will be seen that after the spring has been automatically deprived of its tension, as above described, it may be reset simply by the manipulation of the trolley cord.

To prevent injury of the trolley pole when it falls after jumping the conductor, a yielding buffer B, made of a cylindrical piece of vulcanized rubber, is placed upon a stud on the lever L. This buffer strikes the upper edge of the stationary supporting arm S which carries the latching mechanism, when the lever L is displaced in consequence of the jumping of the trolley arm, and when in this position it is ready to receive the blow of the falling trolley arm.

Notes on the Distribution of Power by Alternating Currents.[1]

BY WM. STANLEY, JR.

For a number of years the electrical public has been looking forward to the production of a commercial alternating current motor. Up to this time the demand is un-



ELECTRIC DAMPER CONTROLLER.

satisfied, and a motor of this type is a thing unknown to the practical engineer. It is true that alternate currents have been utilized in a few instances to actuate synchronous and multiphase motors, but the difficulties arising in these problems have thus far prevented their general adoption. We are aware that the practical engineer has become skeptical of realization in alternating current motors, and that, all statements to the contrary notwithstanding, he is apt to take inventors' certificates of their work "cum grano salis." For this reason in describing to you some of our work on alternating current motors, we shall simply invite your criticisms of the methods employed, their practical value, and their usefulness to the engineer, and shall leave your minds free to accept or reject them on this evidence.

It has appeared necessary to us that any system of power distribution by alternating currents of electricity to be commercial should be operated on the existing systems of current supply, viz., the multiple transformer system of standard frequency.

In order to produce a motor to fit these conditions we have studied an ordinary continuous current motor when supplied with alternating currents, for it is evident that if the electrical reactions produced by alternating currents in a motor are similar to those produced by continuous currents the problem would be a comparatively simple one. In pursuing this problem many difficulties have arisen requiring special investigation and treatment, so that while the finished motor operates about as well on alternate as on continous currents, the steps by which these results were attained have been both difficult and laborious.

The motor now to be described is the invention of William Stanley, Jr., and John F. Kelly, and is the outgrowth of a motor described by them in the electrical papers some time since, in which a condenser is used in the field circuit. The present form makes use of the condenser and embodies several important improvements.

In general the motor is of the two or four pole type, although the number of poles is not restricted, having a well laminated field and armature. The field coils are of comparatively few turns which may be placed on the poles as in the ordinary type of the direct current motor, and are connected either in series or multiple through a condenser to a source of alternating current.

The armature is of a specially wound closed circuit type, having an ordinary Gramme commutator, on which bear two brushes placed on the neutral line or lines. These brushes are connected to the source of alternating current supply. The transformer furnishing current to the shunt type of motor has two secondaries, one of which supplies the field with a constant current, while the other supplies a variable current to the armature.

Before taking up the description of the motor in detail, let us see the effect of applying an alternating electromotive force to a continuous current shunt wound motor.

We will consider a motor wound with 3,000 turns on its field, which when in circuit furnishes the necessary magnetizing power of 500,000 C. G. S. lines of magnetism

1. Read before the Chicago Electric club, Jan. 18, 1892.

through the armature. Just as in a transformer the reactive effect of the magnetism on the primary coil develops a counter electromotive force of self induction, so also the effect of the field magnetism on the field coils develops a counter electromotive force which practically annihilates the impressed electromotive force, and by preventing nearly all the current from flowing through the field circuit greatly reduces the magnetism.

It is of course possible to apply a sufficiently high electromotive force to give the required field magnetization, but a brief calculation shows that under the conditions assumed this electromotive force would be about 9,000 volts, a pressure entirely out of the question. The magnetization set up through a given circuit is approximately proportional to the product of the number of turns and the current, viz., the ampere turns, which product may of course be obtained with a fewer number of turns and a larger current. This has an important bearing in reducing the applied electromotive force on the field. Instead of 3,000 turns suppose we take 250; to give the same magnetization the current will have to be twelve times as great, and calculation shows the necessary electromotive force to be about 750 volts Fortunately it is not necessary to apply this as an impressed electromotive force from the transformer, for by inserting into the field circuit a condenser of proper size, dependent on the number of alternations, the reluctance of the circuit, the turns, etc., there is developed an electromotive force between the condenser terminals that always opposes the electromotive force of self-induction in time and value, and destroys all effects of self-induction, allowing the same amount of current to flow as if the circuit were supplied with a continuous current, neglecting of course losses due to extra apparent resistance by hysteresis and Foucault currents. By inserting a condenser in the field circuit any low electromotive force, as 100 volts, may be used to magnetize the field, thus obviating the use of high potentials. The employment of the condenser has also the advantage of reducing the lag of the current behind the applied electromotive force, a result, which would take place if a field electromotive force of 750 volts were used, and no condenser was in circuit. Thus two of the difficulties of operating a motor by alternating currents are overcome. First: That of obtaining the required magnetization to flux the field without employing a high electromotive force; Second: That of causing this magnetization to occur at the proper time, viz.: in phase with the electromotive force applied.

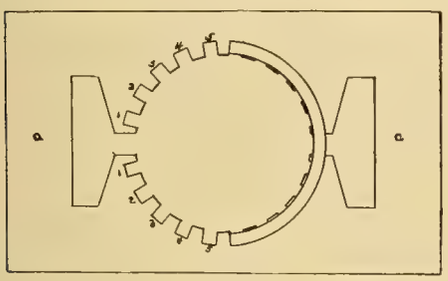


Diagram of Stanley-Kelly Motor Field.
1,1; 2,2; etc. slots in field poles for Short Cir. winding.
a,a, position of field coils. WESTERN ELECTRICIAN CHI.

Imagine a motor magnetized as described, having an alternate current applied to its armature; there will be a lag of the current in the armature behind its electromotive force as was the case of the field current. To give the maximum amount of power and torque for given values of currents in the field and armature they must flow in unison, for if there be a lag between the field magnetization and armature current, during that part of an alternation in which the currents coincide, the pull will be in one direction, and during that part of the alternation in which the currents are opposed, the pull will be reversed. To overcome this difficulty we have wound about the armature parallel to the direction of the field magnetization a number of short circuited coils sunk in slots in the field poles.

This short circuited winding is only acted upon by the current in the armature coils, and as a short circuit in the secondary coil of a transformer destroys the self-induction of the primary circuit, so the currents induced by the armature current in the short circuited coils reduce the self-induction of the armature coils, and consequent lag in the armature current, and bring it in phase with the applied electromotive force. Clearly the electromotive force applied to the field and armature coincide (because they come from the same transformer), and as there is no lag in either the field or armature current it is evident that the field magnetization and armature current must coincide, and that the torque of the motor must always be in one direction. Thus another difficulty is removed. Aside from the difficulties mentioned many others have arisen requiring much special attention. These have mostly been remedied by the careful designing and proportioning of the various parts, although the problem of getting a good, durable and cheap form of condenser has been a long study by itself.

If a motor made as described be supplied with alternating currents it will start from rest with the same torque as if supplied with continuous currents. If it is run free of load the current in the armature will be small, and as the load on it is increased the current in the armature will increase in like proportion. In short, it will behave exactly like a continuous current motor.

Supplied thus with a motor for alternating currents, meeting all the requirements demanded of a continuous current motor, we are required to show the advantages of the alternate system of motor supply.

It is not necessary to impress on you the advantages of the alternating current system of distribution over any other yet devised, and while this system as at present used has greatly advanced the distribution of electricity from central stations, it is nevertheless a fact that the greatest difficulty in distributing from large stations is the cost and maintenance of the working feeders. The cost of feeders for distributing current from large stations is often greater than the cost of the station equipment, and the feeders are even then inadequate to the demands made upon them.

For the moment it will be advisable to assume the responsibility of designing a station and system of distribution which shall furnish the required current for the heart of a large city; and in assuming that a single station is to be equipped to deliver current for one hundred thousand 16 candle power lamps, and for ten thousand horse power of motor service, we are assuming conditions which will approximately fill the requirements of many large stations that are now entirely unable to meet the demands made upon them.

Assuming conditions of this magnitude, we are to find out if they can be met by apparatus now devised by the engineering profession. There are at present in this country several builders of engines who can furnish triple expansion engines of 1,000 horse power each. With each of these engines 10,000 16 candle power lamps can be run. A station designed for twenty such engines would require no special engineering skill, except as to the supply of its fuel and the removal of its ashes. Imagine a station equipped with twenty such engines capable of simultaneously developing twenty thousand horse power. To each engine let there be directly belted two 5,000 light (250,000 watt) dynamos, each dynamo operating at 5,000 volts electromotive force, there will then be forty dynamos, from each of which a single feeder connected through a modern switch-board will be led out. Each feeder when fully loaded will then carry 50 amperes at, say, 5,500 volts. We estimate that forty such feeders can be made to deliver a maximum load of 100,000 16 candle power lamps, and from 10,000 to 15,000 horse power for motor service.

It can be shown that with a potential of 5,000 volts the cost of copper mains for distances not exceeding 2,000 yards from a station is comparatively insignificant, so that if this voltage be applied it will greatly reduce the outlay for and care of the underground work.

Thus far our problem is simply one depending upon the necessary capital forthcoming to construct the work and purchase the apparatus. The question next arising is, How shall the 5,000 volt alternate currents generated be safely transformed? The first thing to do is to lease a number of cellars, say ten, lying at the heart of the electric service. Each cellar is to be entered by two or more feeders; connected to the feeders by and through proper switch-boards are large transformers of at least 50,000 watts, or 1,000 lights' capacity each. If the cellar or sub-station is to furnish its surrounding territory with 10,000 lights, ten transformers of one thousand lights capacity each would be installed—the primaries of these transformers to be connected to a common feeder entering the sub-station, whose duplicate is at hand in case of accident to the mains. From the secondaries of these sub-transformers circuits at 1,000 volt-potential lead through a switch-board to the service mains.

The advantages of this method of distribution over the ordinary single conversion method is very great. Not only is there a separate transformer insulation between the station and the consumer, with abundant opportunity to test and keep clear the underground work, but as the load upon the station is indicated at each sub-station, the attendant can insert or remove the transformers from circuit according to the variations of load. As the efficiency of the system will depend largely upon the efficiency of the apparatus exterior to the station, and to some extent upon the efficiency of these sub-station transformers, it may be well to give a few figures on the losses found in electro-magnetic apparatus, such as transformers or motors, when they are actuated by alternate currents.

Neglecting the losses that occur in large masses of metal carrying alternate currents, such as thick copper mains, it can be shown that alternate currents principally waste energy when they are called upon to produce strong magnetic forces, and that these losses are a serious matter unless proper precautions are taken to avoid them.

An extended series of tests on many samples of the best steel and iron determines that when the magnetization exceeds 30,000 C. G. S. lines per square inch, the losses in the iron increase much more rapidly than the magnetization obtained, and that the most economical point to work good iron magnetically is at a loss of about one watt per pound. This of course is not an inflexible rule, but it is a safe and fairly accurate conclusion. Under this rule, therefore, if a transformer or motor magnetized to the proper degree has a flux conveying core that weighs one hundred pounds, then so long as it is in operation it will continuously lose 100 watts. If the core magnetized weighed 250 pounds, there would be a continuous waste of 250 watts, etc.

Let us apply these figures to the efficiency of these sub-station transformers.

The core of a 20 light transformer weighs from 40 to 100 pounds, and wastes from 45 to 120 watts, or at least two watts per lamp.

A 100 light transformer core weighs 100 pounds, and wastes continuously 100 watts, or one watt per lamp.

A 300 light transformer core weighs 200 pounds, and has a minimum loss of 200 watts, or .66 watt per light.

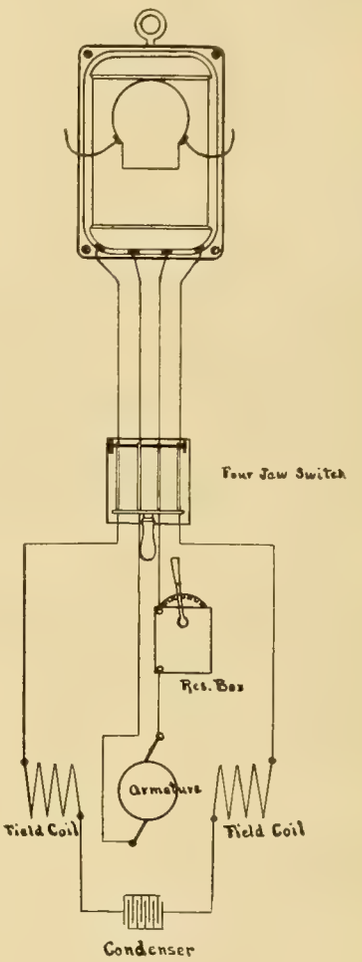
A 1,000 light transformer core will lose about 500 watts, or .5 of a watt per light, so that the iron loss in ten sub-station transformers of 1,000 lights capacity each, or 10,000 lights capacity total, would be 5,000 watts or 1 per cent. of their output. The loss in the copper circuits of these transformers would not exceed 1 per cent., and thus the total efficiency of the large sub-station transformers would be approximately 98 per cent. at full load, and 93 or 94 per cent. at one quarter load.

There is no particular difficulty in building these large transformers to have this very high efficiency.

Finally, in summing up the subject we wish once more to emphasize the complete flexibility of the alternating current system of light and power distribution. In the station the advantages of the alternating system at once make themselves apparent by the simplicity of equipment.

Granting that the efficiency of the alternating current dynamo does not exceed that of the direct current machine, it is at least fair to assume them on a par. The number of feeders are few, their size small, and the consequent first cost insignificant, as compared with feeders for direct current to transmit the same amount of energy.

Aside from first cost the cheap maintenance of subways should be considered. The efficiency of the system from station to consumer may readily be 90 per cent. for very considerable distances, if properly designed.



Connections for Stanley-Kelly A.C. Motor.
WESTERN ELECTRICIAN CHI.

Lastly to be considered is the complete adaptability of motors on feeders furnishing current at great distances from the source of supply, which with direct currents is an impossibility, for if direct currents were used the electromotive force necessary to run the motors would be up in the thousands of volts, in order that the cost of the mains should not prohibit their being laid. This is a higher electromotive force than can be used with commercial success, and is also attended with great danger.

On the other hand, with the alternating current the transmission of energy may be at high voltages, and its use as light and power may by transformation be at as low an electromotive force as 100 volts. Consequently, use the alternating current system where any considerable amount of light and power are required.

Pittsburg Electric Club.

President Morris W. Mead of the Pittsburg Electric club has appointed the following committees for the government of the club. House committee, N. H. Byam, chairman, H. F. Albright and F. H. Ketchum; entertainment committee, E. H. Heinrichs, chairman, W. McC. Ramsey and E. B. Thompson; membership committee, John Campbell, chairman, D. W. Dunn and H. McL. Harding,

At a recent meeting of the board of directors, Ernest H. Heinrichs, of the Westinghouse Electric & Manufacturing company was elected librarian and historian of the club.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE Chicago Electric Club has taken up the subject of the establishment of an Institute of Technology in Chicago and has arranged for a special meeting at the headquarters of the club when the project will be discussed. It has been arranged to have a paper on the subject read upon that occasion by a member of the club who has devoted much time and thought to the project and thoroughly investigated the work in other cities. The club has also received assurances from prominent citizens not identified with the electrical interest that they will participate in the discussion and lend their support to the movement. These gentlemen fully appreciate the importance of the work undertaken by the club and the benefits that the city would derive from the establishment of such an institution as that contemplated. In fact, all who have been approached upon the subject by the club officials have signified their approval of the undertaking, and their desire to co-operate with the club in bringing the subject prominently before the people of Chicago. It is not, therefore, too much to expect that Chicago will soon have an Institute of Technology and one that will reflect credit on those identified with its establishment.

PARTICULARS of an interesting electrical installation in a large Milwaukee brewery are given on another page. It is claimed that this plant when completed will be the largest isolated electric power plant in the United States, and very likely the largest in the world. It will therefore possess a peculiar importance as a conspicuous example of the value of electricity as a medium for the transmission of power in large factories comprising several buildings. The advantages to be gained by centralizing the power in manufacturing plants of this character are so obvious and have been so frequently pointed out, that it is hardly necessary to detail them here. The transmission of steam in pipes for long distances is very uneconomical, as is also the driving of long lines of heavy shafting. Both of these objections are obviated by the use of electric motors, which can be disposed about the building to the greatest advantage. When all these desirable results can be obtained by the introduction of electricity at an actual saving of money, as careful figuring on the Milwaukee plant indicates, it should not be long before the example of this brewing company is followed by other large concerns similarly situated. There can be but little doubt that the successful operation of the plant under consideration will have great influence on manufacturers who require the application of power at distances considerably separated.

THE Chilean imbroglio has proved to have many features that are serious enough, but the published correspondence between Secretary Blaine and Minister Egan has brought to light one incident, of especial interest to electric light men, that has a ludicrous aspect. It seems that under date of August 8th Mr. Egan reported that on May 5th the intendente of Concepcion arbitrarily arrested all persons connected with the electric light plant because of a failure of part of the system of lights to work. Among the prisoners was H. C. Stevenson, an American citizen. He was thrown into jail and placed in irons for an hour and a half, when the intendente ordered him released. To prevent like occurrences in the future Mr. Egan brought the case, on his own motion, promptly before the government, obtaining in August a letter of regret from the minister of foreign affairs, and a payment of $2,000 to Mr. Stevenson. The idea of clapping everybody connected with a lighting plant in jail the moment the lamps failed to work is very funny, and seems to be peculiarly Chilean. American central station managers who remember the trials of the early days of electric lighting have reason to be thankful that their ill fortune did not go to the extent of including a residence in Chile.

TO the outside world Chicago is a city with no overhead wires, and this is undoubtedly true of the business section of the city. But in the outlying districts there are pole lines in plenty, and more overhead work is in process of construction. The common council has just passed what is known as the Calumet electric railway ordinance and the projectors of the Calumet system propose to extend their overhead lines throughout miles of territory so as to connect the suburban towns of Pullman, Grand Crossing, and South Chicago. All this affords a striking illustration of the fact that the Chicago city fathers are gradually becoming reconciled to the overhead trolley wire. It is well enough for some of the less progressive municipalities to hold off and wait for what they call the ideal system. Chicago, though, cannot now afford to countenance delay. The city must have faster street car service in those districts where heretofore the slow going horse car was thought to be sufficient, and the modern electric equipment is at present the only thoroughly practical substitute which can be offered. The passage of the ordinance above referred to suggests a most pertinent question. Overhead wires are, under this ordinance, permitted within the city limits. For this reason, then, where is the justice in not allowing similar privileges to those companies that control the horse car lines now in operation in that district of the South side between Eighteenth street and the World's Fair grounds? The objections now urged against the overhead conductor, for instance in Brooklyn, are danger and the disfigurement of the streets. To harp at this time on the danger of a 500 volt wire securely swung over the street and in full view, is not only extremely ridiculous but such talk is in reality absurd when one takes into consideration the fact that high tension arc light wires are, and have been for years, permitted within easy reach in our stores and other public places. As to the æsthetic objection, it is somewhat difficult to see just how Indiana avenue, or Twenty-sixth street, or Thirty-ninth street, would be disfigured by a tastefully designed center pole line with buried feeders. A construction eminently practical and withal symmetrical and located on that portion of a street rarely used by vehicles, the center pole equipment offers advantages which, it would seem at this present time of need, are too great not to receive the most careful consideration.

THE severe snowstorm which visited the country last week was expected by many to block the electric railway service but this was not the case. Reports from all parts of the country show that the service on electric lines was far superior to that formerly furnished when the companies depended upon animal power, and there was a general rejoicing on the part of the advocates of electric traction. There is really no reason why electric lines should not be kept open in winter as well as in summer. True, it may require an extra expenditure of time and money, but the companies will find this an excellent investment, as it will tend to increase public confidence in the electric system. A case in point and one which shows that the enterprise displayed by street car companies is not always thrown away, is reported from Rochester, N. Y. There the electric system has almost entirely superseded the old horse cars. The bob tails have been replaced by handsome vestibule cars and the city is now furnished rapid transit service. The new management has displayed commendable enterprise and on several occasions has shown a readiness to do everything possible to promote the comfort of its patrons. Last week it kept cars running all night and an extra force of men was engaged in clearing snow and ice from the tracks so that in the morning the public found the system operating with the same regularity as in midsummer. This was a new experience to the people of Rochester and no doubt they appreciated the efforts of the company. The flourishing condition of the company indicates that such is the case.

IT is a matter of common remark among electrical men who have watched the preparations for the electrical equipment of the World's Fair, that if the power and lighting service are to reach the immense proportions outlined for them the work of installation should be begun at once and pushed with unremitting industry. In fifteen months from this date the great exposition will be thrown open to the public, and this, certainly, is none too long a time to satisfactorily install a plant which, it is estimated, will represent an equivalent of 25,000 horse power, and which will comprise dynamos of a dozen or twenty different types. This point becomes the more apparent when it is considered that an invitation to foreign exhibitors to install generating machinery will be extended. The specifications, which have yet to be issued, must go across the sea, be figured on by the great European companies, the bids returned to Chicago, the contract awarded, and the successful bidder notified, before one stroke of work can be done. It is true that the fifty contracts may be so divided at the outset among American and foreign countries that only a portion of the work will be retarded in this manner, and it is also promised that a large portion of the lighting specifications will be issued within a few days; but the fact remains that common prudence dictates the greatest diligence on the part of all connected with the work, if the installation is to be completed in time.

The construction department of the World's Fair has been criticised for delay in this matter, but of late the task of getting out the specifications has been pushed with praiseworthy zeal, and, as announced in the World's Fair department of this issue, the power specifications are now about to be issued. The need of prompt action should be realized by all companies that propose to bid on any portion of the work—and what wide-awake American manufacturer of dynamos does not?—with the result of sending in the bids as quickly as possible. Only by the active co-operation of all concerned can the electric lighting and power plans be thoroughly carried out.

While on this subject it may be well, also, to remind the authorities of the exposition that, if electric railways of any magnitude are to be installed within the grounds, they must soon come to a decision as to what they want, and how they are to get it.

Big Electric Power Plant.

What is said to be the largest isolated electric power plant in the United States is now being installed at Milwaukee for the Val Blatz Brewing company. The Blatz company has one of the largest breweries in the country, the size of which may be judged from the fact that the plant occupies one entire city block and portions of five others. By the installation now in process of construction all the machinery will be operated by power electrically transmitted from one station. In all there will be 23 motors aggregating about 380 horse power. These will include two 50 horse power motors in the brewery proper, three of forty horse power each—one in the grain elevator, another in the bottling establishment and the third in the malt house—and one of 30 horse power. The motors will drive mash tubs, elevators, pressure fans, bottling machines, grist mills and grain conveyors—in short, all the varied machinery employed in the different departments of a great brewery.

The generating plant will consist of two Mather generators that are calculated to have a combined capacity of 340 horse power. They are wound for 500 volts. The engine, which is now nearly completed, will be a Nordberg cross compound condensing puppet-valve machine, capable of an output of 450 horse power. The cylinders are 20x36x40, and steam will be carried at a pressure of 100 pounds. This engine will also drive an 800 light Mather dynamo for lighting the buildings. The switchboards will be of marble, and all the conductors will be incased in lead cables and laid in the existing underground tunnels connecting the departments. These tunnels are built of masonry, with arched roofs, and are five feet wide and six feet high. A separate building has been erected as a power house for the electrical plant.

The contract for the entire electrical equipment, after considerable competition, was awarded the Mather Electric company on December 17th, and a portion of the plant must be in operation early in March. The entire plant is to be completed some time in May. It will take the place of five steam engines, one of 175 horse power. The conveying of steam long distances in pipes and long lines of shafting will also be avoided by centralizing the power and transmitting it by electricity. The brewing company will, moreover, save money by the operation, although the initial cost of the new plant is, of course, considerable. The installation is one of great interest, and its development will be eagerly watched.

Electric Street Lighting in Chicago.

The importance of lighting the boulevards leading to the World's Fair by electricity has frequently been urged in this journal, and it is gratifying to observe that the aldermen are at last giving the subject serious attention. At the last meeting of the finance committee of the city council Alderman Madden brought up the question of extending the electric light plant. He called attention to the necessity of lighting the boulevards leading to the World's Fair grounds, Jackson boulevard and other thoroughfare with electricity. He thought that the substitution of electricity for gas would be economy for the city. Alderman Cullerton feared that there would be such heavy demands on the available financial resources of the city that there could not be as large a sum appropriated this year for extending the electric light plant as there was last year. Some one then suggested that the lighting of certain streets be contracted for with some of the electric companies which have obtained franchises from the city. There was a general discussion on this point and finally Alderman Madden presented a resolution calling on City Electrician Barrett to submit a report dealing with the question of the extension of the electric plant, the desirability of entering into contracts with the electric companies for lighting certain thoroughfares, and the state of the negotiations between the South Park commissioners and city authorities for the lighting of the boulevards leading to the World's Fair with electricity. The resolution further calls for a detailed statement as to the expenditure of the city for electric lights, the number of such lights, their location, and their distribution among the three divisions of the city.

The general tone of the discussion indicated that no appropriation would be mnde this year for the extension or the city's plant, but that arrangements would be made with the electric companies for lighting certain districts. It is understood that the South Park commissioners will establish a plant in Washington Park and erect the lamps and lay the wires along Michigan boulevard to Thirty-fifth street on Grand, Oakwood, and Drexel boulevards, if the city will agree to maintain the plant, and in time agree to assume the responsibility for the cost of the plant. Prof. Barrett has already furnished the South Park commissioners with plans for the work indicated.

Chicago Electric Club.

There will be a special meeting of the Chicago Electric club, Wednesday evening, February 3d, when there will be presented a most interesting programme. Francis W. Parker will read a paper on "The Necessity and Present Opportunity for the Establishment of a Technological Institution at Chicago, with a Laboratory and Museum of Mechanical Arts in Connection Therewith."

The importance of this subject will no doubt at once present itself to every one interested in educational work. The interest that has been manifested by prominent residents of Chicago not identified with the club, and the readiness shown to co-operate with the organization in this movement, should insure the support of every member of that body. The following named gentlemen have promised to participate in the discussion, following the line indicated in the particular departments assigned them:

B. E. Sunny—"The Attitude of the Electrical Interest Toward Such an Institution."

Hon. John. A. Roche—"Benefit to Public Works and Municipal Corporations."

A. H. Revell—"The World's Fair and Such an Institution."

W. J. Chalmers — "The Interest of Manufacturing Industries."

J. J. P.Odell—"Financial Prospects."

Dr. William R. Harper—"The Attitude of the University of Chicago with Regard to Technological Education."

Invitations have been issued to a limited number of persons interested, and refreshments will be served in the course of the evening.

Inasmuch as the regular meetings of the club are held Monday evenings, special attention is called to the fact that this meeting will be held on Wednesday evening, February 3d.

Liability of Telegraph Companies.

The old question of the liability of telegraph companies on the contracts printed in fine type on their blanks has again been raised, this time in Canada. The point came up in the Court of Appeals at Montreal. The case was that of Laurence against the Great Northwestern company. While Lionel Laurence was in New York one of his employees sent him a dispatch saying: "Writing you to-night." The sentence was made to read: "Waiting you to night." Consequently Mr. Laurence made an unnecessary trip from New York to Montreal, and sued the telegraph company for $200 damages. The court in the first instance awarded $30, the actual cost of the trip from New York. The company appealed from this decision. The proof established the fact that the error was due to the negligence of the employes of the company, but the appellant set up the plea that dispatches were sent under a contract which declared that it would not be liable for damages resulting from errors unless the dispatch was repeated, and then only to the amount of fifty times the price paid for the message. Such a contract the court declared to be contrary to public policy, and any contract by which a party sought to fix the punishment for his faults was illegal. The judgment was confirmed.

Referring to this decision, Colonel Clowry, general superintendent of the Western Union company, said: "I do not understand that this affects the rules in the United States. Decisions have been rendered for and against the validity of the rule several times, but the subject has never reached the higher courts, to my knowledge. I do not see how our Canadian business will be affected much by this decision. We do not have many complaints in the transmission of messages now."

Telephone Prospects.

At the recent annual meeting of the Central Union Telephone company in Chicago it was shown that the gross earnings of the company increased during the year $125,000. The number of instruments in use showed a net increase of 1,934. The net earnings of the company amounted to $378,840, which is equal to 5.74 per cent. on the $6,600,000 capital stock.

President Henry B. Stone said that there had been marked improvement during the year in the friendly relations between the company and its patrons. The company has no fights on its hands, and there is pretty general accord between the company and the telephone subscribers. This has been a prominent point in the policy of the management, he said, and has shown good results in better treatment at the hands of aldermen and other officials from whom franchises and other concessions have been asked. The point is appreciated that in the next few years the limit of a number of important patents will be reached. The company is operating with that point fully in view, President Stone stated, and is steadily reinforcing and strengthening its hold, so that no decided shock is expected on account of the termination of patents. The company sees that it is facing a possibility of competition, but it is believed that it is being so thoroughly entrenched in its position that capital will have to be more than usually daring to attempt competition.

"With the personal knowledge that I have of the telephone business," said President Stone, "I will say that there are a great many places in which I would more quickly put money than I would into a competitive telephone company. I might be foolish enough to put money into a mine perhaps—there would be at least one chance of getting it back—but I wouldn't be foolish enough to put money into a company to compete with the old telephone companies."

The Central Union Telephone company was organized in 1883, and has now become the most important telephone company in the West. Its territory comprises a number of western states, including nearly all of Illinois outside of Cook county. The following named directors were re-elected: C. H. Brownell, R. C. Clowry, C. R. Cummings, M. G. Kellogg, H. B. Stone, John F. Wallack, J. Russell Jones, John E. Hudson, and F. H. Griggs. The old executive committee and the following named officers were chosen: Henry B. Stone, president; W. S. Chapman, secretary.

Important Electric Railway Franchise in Chicago.

The common council of Chicago passed what is known as the Calumet electric railway ordinance on January 18th by a vote of 41 to 18. This is said to be one of the most extensive franchises ever granted by the city council. Miles of territory are covered by the ordinance and it brings into close connection the suburban towns of Pullman, Grand Crossing and South Chicago. The route practically covers all the principal streets in the south end. At one point the line begins at the intersection of South Chicago avenue and Seventy-fifth street and runs along the avenue to Ninety-fifth street. At another point it begins at the intersection of Ninety-third street and Stony Island Avenue and runs south to Washington avenue and there crosses the property of a number of railway companies in a westerly direction. It then takes a turn to the northwest and comes out on Cottage Grove avenue by the way of Ninety-third street and then travels north and south on Cottage Grove avenue. At another point it begins at Cottage Grove avenue and Ninety-third street and branches out to South Park avenue. At the intersection of Ninety-third street it strikes Stony Island avenue and goes south as far as One Hundred and Third street. It also extends along Michigan avenue to One Hundred and Nineteenth street.

The Cottage Grove avenue, Michigan avenue, Madison avenue and South Chicago avenue lines are to be completed and in operation within a year. Two years are given for the building and operating of the remaining tracks. Single tracks are all the franchise calls for. The usual provisions for the protection of the city are embodied, and the company is directed to file a $25,000 bond with the city comptroller.

Incandescent Lamp Filaments from the Root of the Rice Plant.

Philip Hickley of Evanston, Ill., claims that incandescent lamp filaments possessing the desirable qualities of long life with the capability of high incandescence can be produced from the roots of certain plants belonging to the order of graminæ and the genus oryza, and particularly of the species sativa, commonly known as "rice plant." This plant is a native of tropical countries, but has been introduced and cultivated extensively in higher latitudes, and a great many varieties are known. Mr. Hickley has experimented with the roots of a number of varieties of the rice plant, and among them he finds that the roots of that variety known as the "Italian" will produce excellent filaments. The root of this plant is of suitable size and length for filaments and requires but little shaping to prepare it for use. In its structure it is remarkably dense and free from pores. It possesses great toughness, combined with flexibility, permitting it to be readily shaped to the desired form without in the least injuring its texture. There is sufficient variation in the size of the roots to permit their being used for the various sizes of filaments.

Early on the morning of January 19th fire destroyed the Robison electric street railway barns at Toledo. It was a high brick structure and contained thirty-five electric motor cars. The fire spread from an overturned coal oil lamp with great rapidity, and by the time the department reached the spot through the heavy snowstorm which was raging the interior was a mass of flames. The loss is estimated at something like $150,000.

Direct Current in Long Distance Transmission.[1]

By Alex. Dow.

It is part of the program for this evening that I shall advocate the use of direct currents for long distance power transmission. I have taken this task with pleasure, believing that I have a strong case to present to you, but I beg you will remember that what I may say in favor of direct or against alternating methods is said from the standpoint of the engineer, and that as an engineer I must recognize the necessity to the world of each and every line of development now open to electricity. There is no electrical phenomenon which we can afford to say is trifling, and not worthy of careful investigation. But a few years ago the alternate current transformer was merely a scientific toy; to-day it is as practical a piece of engineering as the locomotive. Until now the condenser has had but a limited application in telegraphic work. To-day it promises to become as important to industrial electricity as the transformer. I do not know but that the next few years may see Holtz or Wimhurst static machines built on as large a scale and used as extensively as magneto-electric machines are now.

Therefore I must consider the power transmission problem as it stands this evening, and leave to those who are prophets, and sons of prophets, the prediction of what its future will be. And if I, in my remarks, appear to indulge in predictions, it is only guessing, not prophecy. I am entitled to guess, although not New England born, but I "don't never prophesy unless I know."

Of the physical properties of the alternating current as they affect its use in power transmission, the most prominent are the following: First, its production by the generator and delivery to the motor without the use of a commutator; second, the facility with which it can be transformed in its electromotive force either upward or downward by the use of simple apparatus. These points are in its favor. Third, we notice that inasmuch as an alternating current has its periods of zero electromotive force its mean effective value is not the same as its maximum value. It follows that insulation of apparatus where alternate currents are used must be calculated to withstand a higher potential difference than that available for virtual work. Fourth, we observe that the alternating current in its relation to conductors does not conform to Ohm's law in the elementary form, but to that law as amplified by the introduction of factors of periodicity, range of pulsation, and inductance. The practical result of this is that to convey, under similar conditions, an equal amount of energy the alternating current requires more copper than the direct current. This fact is not appreciated by the public, although it is familiar to engineers. Before the public the alternating current has been advertised as the current requiring little copper, whereas it may and does sometimes require, under practical conditions, 40 per cent. more copper than the direct current. The fifth physical property which we notice is nearly allied to the fourth. It is merely the fourth property in a special application. It is that in circuits of great inductance, such as the winding of electro magnets, the alternating current is retarded in its development to such an extent that a great potential difference or a large current is required to produce magnetic effects which could be produced by direct current with much less apparent expenditure of energy. It is quite true that the expenditure of energy is apparent only, but that does not affect the fact that the windings, if the potential difference is to be kept low, must be of a conductor large enough to carry an enormous current without heating; or that, if the current is to be small, the insulation must be designed to withstand a great potential difference. A parallel observation is that the variable state of an electro magnet, which only exists at the moments of charge and discharge in a magnet excited by direct current, is continuous when the magnet is excited by an alternating current, and that the loss of power by hysteresis goes on continually in such a magnet.

Now, we must consider in the planning of any given transmission whether the good points of the alternating current do not outweigh the others which are to its disadvantage. In incandescent lighting this question has been answered in practice, and every day continues to be answered. We know that the answer given by practice is sometimes wrong, else we would not see direct current lighting stations located on the outskirts of towns and attempting to light their area at the cost of a large annual interest on copper; neither would we see alternating stations located in the middle of densely populated districts and sacrificing efficiency on the greater part of their work in order that they may secure with the same system the revenue from a few distant lights. Still the problem is being solved, as such problems mus tfinally be, by the daily progress of the world.

But the conditions of lighting do not correspond with those of power transmission. The advantages which outweigh the disadvantages of the alternating current for lighting purposes are not of so much value under other conditions. Thus, dispensing with the commutator on the alternator in a lighting station and substituting therefor a small self-exciting dynamo to charge the field, is a method both convenient and efficient. Then the lighting transformer, even at its lowest efficiency, is not such a wasteful device that it has not its proper use. But when we come to consider the transmission of power to a distant motor, the problem of how we are to excite the motor is a serious one; and when we look at the combination of alternator, exciter, step up transformer at the generating station, plus step-down transformer, exciter and alternator, and some means of giving the alternator field its initial charge, all of which must be provided at the motor station, we are compelled to consider whether the simple, self-exciting direct current generator and the equally simple direct current motor are not to be preferred, even with their commutators, and the disadvantage that the electromotive force to be used on the line, must be employed also in the generator and the motor. And it is just those considerations that have so far retarded the development of alternating power transmission. For while the transmission of power by direct current has grown up, parallel with the development of direct current lighting, to tremendous proportions (as witness the use of motors on the circuits of all direct current stations, the magnificent developments of the electrical street car system and the transmission of power to be found in all our manufacturing and mining districts), there is, so far as my knowledge goes, only one alternating current transmission of power in the United States which can be considered to have passed the experimental stage. That is a transmission in Colorado by the synchronous method, which is doing the work well and satisfactorily. Perhaps my statement that there is only one transmission is too sweeping. I make it subject to correction. I once incurred the wrath of a whole community in Nebraska by thoughtlessly saying in public that there was only one tree in town. Whereas it was well known to all reputable residents that besides the tree which was in evidence on the Court House square, there were also two cottonwoods growing out on section 35. I don't wish again to cause similar offense by unqualified statements.

There is nothing wrong with the synchronous method of transmitting power by alternating currents. True, it is necessary to start the motor by some exterior power; but if proper arrangements are made, the starting is no more difficult or tedious an operation than the starting up of a large Corliss steam plant. I think that the fifteen minutes before seven o'clock, which is usually devoted by a mill engineer to getting his engine and shafting into proper motion for the day's work would be sufficient, if proper arrangements were made, to start a synchronous motor. True it is, also, that the synchronous motor when overloaded "lies down" and declines to do any work at all until the load is reduced to what it considers its capacity. The same statement is correct, as every Sunday school child knows, regarding the model of animal power, the camel; and as any old soldier can tell, concerning that much maligned carrier, the army mule; but it has not been imputed unto those animals for wickedness that they would not pull more than they thought they should; it has merely passed into a proverb as "the nature of the beast." Then the synchronous alternating motor has an excellent quality in which it is only equaled by the plain shunt wound motor of the every day electric light station. It regulates perfectly as to speed, keeping in step, within the limits of its capacity, with the generator which drives it.

And the synchronous motor is not the patented property of one inventor or corporation; it has belonged to the world ever since Dr. Hopkinson's experiments at North Foreland. There is not a company manufacturing alternate current machinery which would not gladly take an order for any number of synchronous power transmissions. The reason that there are not an indefinite number of such transmissions in use is that the direct current motor stands ready to do the work under all conditions that have yet come up in practice. There is no long felt want waiting to be filled by a new method. The owners of water powers to-day who are considering electric transmissions can have their wants supplied by machinery of a type with which the electrical world is familiar, and whose capabilities have been proven by long experience. Not that the synchronous method will not have its uses. It certainly will. Its possibilities are recognized by all engineers, and its day will come; but, remember, the direct current motor has not reached its highest development. Its future is in good hands, and it will always, even under conditions most favorable to the alternator, be a competitor that cannot be disregarded.

There is another system of alternate current power transmission being developed, which has been aptly named the "multiphase method." It is a beautiful application of electrical laws, interesting to the lover of mathematics as much as to the engineer, for it has vast possibilities for analysis and the production of graphic representations. It is not entirely new to the practical electrical community. It has been applied to meters and to certain small motors for some time.

The motors designed for multiphase currents are self-starting, self-exciting and not necessarily synchronous, so that they are free from difficulties which attend the synchronous method. They still are vexed with impedance and hysteresis—twin enemies of alternate apparatus, but not without hope. The lines along which the development of these motors must proceed are plainly marked out and they are certain to have their place in the future of power transmission. To-day they have no place. The brilliant experiment at Frankfort has not given us a commercially valuable method.

The absence of detailed data regarding all apparatus of this class limits me to some general observations, the first of which is that the weight efficiency of the class appears to be low—that it takes a multiphase machine much larger than the direct current machine required to do equal work. This we would anticipate from the use of the multiphase current in field magnets at low electromotive force. While the actual power absorbed is not excessive the current out of step with the electromotive force is very large.

The next observation is that some multiphase designers are working on the problem of conversion of multiphase to direct currents. This seems a complicated process, but may have a commercial value, and indicates recognition of the desirability of direct currents.

The last observation is that the multiphase motors and other motors excited by alternating currents are apparently going to make their next step toward practicability by the assistance of condensers. This will cause a development of the condenser along commercial lines, akin to that which has produced the lighting transformers of to-day from the laboratory induction coil of yesterday. And in this will be a benefit to electrical apparatus at large.

Now, to examine the difficulties under which direct current machines are said to labor. First of all, there is the old story, the commutator, which, it is said, is a source of trouble at high potentials. I have made it my business to inquire regarding the behavior of every high potential commutator which I could hear of. The list, outside of the commutators of arc machines working up to 3,000 volts or so, is a small one, but I have heard of at least two commutators working with 5,000 volts and 10 amperes which give no trouble, of an indefinite number of commutators working at 1,500 volts and 20 amperes which give no trouble, and of about a dozen working at 1,500 to 2,000 volts and 40 amperes which give no trouble. The record appeared to be the same all through. The commutator did not appear to be the weak part of the machine. You see none of these machines are very large ones. The reason I didn't get data about machines with outputs greater than 75 kilowatts is that I couldn't find any such machines working at high voltages. It is only lately that there have been large dynamos put in use in this country for any purpose, though there are now many at 500 and 1,000 volts. When a power transmission needs large machines of higher electromotive force the machines will be ready, and the commutators will not give trouble.

Then we have the objection that high potential differences must be handled in direct current machines if economy of copper is to be secured on the lines. The alternate current transformer has the advantage in this respect, in that it is a stationary piece of apparatus whose construction admits of high insulation without material reduction of efficiency. And therein lies the certainty of the future development of alternating methods of transmission. There will come a few cases when the copper in the line will be a large factor in the total cost of the plant. These cases are far between. I have ascertained the proportion that copper bears to the total cost of line construction in a number of plants employing such electromotive force as is common in direct current work. I am speaking of overhead lines now, the cheapest method of construction, and I find the percentage of copper cost is very small. Thus, in the cost of a mile of pole line, built in a workman-like manner, with ordinary insulation, two wires being strung, the proportion of copper was 30 per cent. The remaining 70 per cent. redresented poles, fittings, insulation and labor of construction. The proportion which this 30 per cent. of cost of pole line bore to the whole cost of the plant was very small. I have looked over the bills of actual expenditures on a number of pole lines, and over the estimates made by responsible contractors for many others, and I find that where a good line is built according to the idea of line construction generally prevalent in the United States, that the copper is a comparatively small item of the line, and proportionately less in the whole cost of plant. But we cannot figure in power transmission work on using overhead lines; not even in the mountains where there is no esthetic sentiment to force the wires below the ground. The telegraph lines through the mining districts and others where water powers abound break down every winter under pressure of storms. I don't think that any overhead construction which we could well design to cost less than undergrounding would withstand the winter storms of the Rocky Mountains or Sierra Nevada. To put it in other words, snow-sheds to protect our transmission line would cost as much as regular underground construction. And no mining engineer will tolerate the shutting down of his air compressors or hoisting plant by each and every winter storm. So that for those permanent power transmissions which are certain to be developed in the near future, we may expect to install just such conductors as we now find safest and best in our great cities. The same necessity of guarding against breakdowns, which causes the miner to pay high prices for the finest steam machinery that is manufactured, and to transport it at enormous cost, and maintain it by the best of care at its point of use, will determine the construction of the very best electrical lines that can be designed. In these conditions the cost of copper in proportion to the whole cost of plant will be infinitesimal, and any method which introduces complications with a view to saving copper, will only receive consideration under exceptional circumstances.

I need not show to this assembly the visionary nature of schemes to carry the water power of Niagara to New York or Chicago. We will any of us undertake to do this if we receive the order from a responsible person, but we will each and all of us abstain from taking stock in the manufactories which depend on the transmitted power, and we will do this because we know that power transmitted means power lost in transmission, and that a difference of even three or four or five per cent. in the cost of power means the control, or the loss, of the market for manufactured goods in these days of sharp competition. The same commercial necessities which built up in the wilderness Rochester, Minneapolis and the towns on our own Fox river, away from the markets of their product, but near to cheap power—that same commercial necessity will limit the distance to which electrical power will ever be transmitted. It is not a question of engineering. It is a question of dollars and cents to the manufacturer.

1. Read before the Chicago Electric club, Jan. 18, 1892.

The use of crude oil as fuel has become so general in Chicago that the fire underwriters have adopted special rules governing the storing and handling of it. Thus far but little information has been obtainable on the relative merits of oil and other fuel. Many central station managers would be glad to secure reliable data upon this subject.

L'Elettricita of Milan, Italy, has opened an international prize competition for a new electric battery, which must be practical, simple and commercial. The competition will remain open until August 31, 1892. The inventor who will have satisfied the required conditions will receive a prize of 2,000 francs.

Electric Power Transmission.

The Chicago Electric club devoted its meeting on Monday evening, January 18th, to the discussion of electric power transmission. A paper by D. C. Jackson, C E , of the University of Wisconsin, treating of this subject in a general manner, was presented. There were also arguments for the alternating and direct current systems respectively presented in papers by William Stanley, Jr., of Pittsfield, Mass. and Alex. Dow of Chicago.

An interesting discussion followed the reading of these papers, which are presented elsewhere. Following is a stenographic report of the discussion:

F. B. BADT: Inasmuch as I have been selected as judge and as I have only just returned to town and have not had an opportunity to examine the papers submitted I will ask a little assistance in the way of further discussion. It should be remembered that this discussion is to be based on the arguments presented and not the system itself. In considering this subject I have several suggestions I would like to make. We have heard a great deal about long distance transmission, and the various conditions under which these transmission plants should be erected and operated. In order to get clear ideas, however, on the subject, I think we ought to discriminate, and to subdivide the various transmission plants into classes. The simplest transmission plant is one where one unit will transmit power to another unit at short or long distances. For instance, we may have water power and we may wish to transmit fifty horse power to a mill. There is required one motor at the mill and one generator at the power station. There is the simplest problem in power transmission, and we may find that in this case one of the modes of transmission may be best adapted for that purpose. There is a second case similar to this, where, however, instead of using single units, on account of the large amount of power to be trans mitted, we might prefer batteries of generators and motors. For short distances, direct current machines in multiple; for longer distances it might be desirable to have generators and motors in series, and by using certain devices produce a perfectly self-regulating system.

Then we have the third case of central distribution; in cities, for instance, where we have a central station, and want to distribute power to consumers. That is a different case entirely, and we would have to use small motors, We are limited in our electromotive force much more than in the former cases, for two reasons; in the first place it would be dangerous to introduce high electromotive force directly into the premises of consumers, and in the second place, it would not be practical to build small motors for high pressure.

Then the fourth case is a combination of number one or two with number three—for instance, where a city wishes to utilize a water power say ten miles distant, it would be necessary to transmit this power to the center of the city, and reconvert it for central distribution. You can easily see that each of these cases would require special consideration, and that what may be a first-class solution for one case may not answer for another case at all.

There is another point which I think requires close investigation and that is the question of the cost of copper. The statement was made that by employing high pressures you reduce the cost of the feeders considerably. So we do as far as copper is concerned, but how about insulation. If we use high pressures we reduce copper materially, but the problems of insulation becomes very difficult. We have all read about Mr. Ferranti's experiments in London, and I think that he found that this question of underground high pressure mains is not so easily solved as he anticipated when he started. Now in the combination of cases one and two with three a double conversion is necessary, and it would be well to consider whether in such a system it would be desirable in certain cases to use the direct current motor transformers, or to use the alternating system.

The statement was also made that drills, for instance, should be attached direct to the power circuits, and that motor transformers have been abandoned as impracticable. I can state from my own experience that they have not been abandoned; that they are successful, and that, for instance, in the case of a percussion drill, 1,000 volts may be used in transmitting power from the water power to the mine, and then have this high pressure transformed in a motor transformer into low pressure, which it would be safe to introduce into mines, and change at the same time the direct current into a current suitable for running these reciprocating drills—a pulsating current.

At the same time I would like to hear something about the laws governing electric installations as to the minimum first cost of installation and operating expenses. It was stated, I believe, that certain factors would cut a small figure if water power were considered. Now in reading up the experiences of people who have utilized water power we may find that not only the cost of fuel; that is to say, the comparative value of power delivered from water power and power generated in the place of application by steam, should be considered. For instance, we find water power, which nature has already prepared for use, in a power station. We may put up a station very economically, but in many cases the harnessing of the water power and the preparing and building of the dam, will swell it to such a considerable amount of money that the interest on the money invested will eat up the earnings.

C. H. WILMERDING: I agree with Mr. Badt that in each case there is a special system which should be adapted to the requirements. As far as I know, constant potential power distribution is the practical thing for to-day. It may be that there are alternating motors on the market that are satisfactory; I have never seen any that would do the work. The only alternating motor I ever saw that ran satisfactorily at all heated up to such an extent that they had to shut down after a four hours' run. It caused the whole place to smell of the insulation.

In the matter of underground distribution and the relative cost of the copper in underground work, I think Mr. Badt's point is well taken, that when it comes to the relative cost for large conductor or a small conductor underground the difference is not very great, because of the cost of insulation with the higher pressure. At the same time you cannot use a low potential underground without considerable insulation. You cannot do away with it altogether.

ALEX. DOW: Here is about the answer I should give to Mr. Badt's question: First, one unit and one unit: It is a plain water power. A single machine to run a single mill. That is a transmission that is going to come into everyday use; we have quite a number running now. It must be subdivided into three conditions: First of all, you have a case where your machinery must be run at a constant speed, such as where you are driving cotton or paper mills, where the speed is an important factor in the operation of the machinery. Then you have much more frequent conditions, where the speed is not at all important, but a constant pull is required. For instance, take a motor used to pump out a mine. That condition I can define as varying speed, constant torque.

Now there is a third condition, where the load is absolutely constant, speed and torque the same; running a stamp mill say, where you have so many dead weights to lift and drop. The load is the same day in and day out; the speed is the same.

If you wish up to any reasonable distance to run with either constant torque and varying speed, or constant torque and constant speed, you need not look farther than a constant current motor. I do not mean a direct current motor, which may be a constant potential motor. I mean a constant current motor, an arc machine glorified. There are people who will produce such machines to day as fast as you can order them, up to say 125 horse power, and they will do your work perfectly. They will give no trouble, and the amount of current that you will have to supply copper for may be ten, twenty or forty amperes as you may wish. That question I considered as settled. But when you want constant speed with varying torque the regulation of both generator and motor is very important. And right here I want to say that the regulation of the generator on a water power plant is a serious thing. It is almost impossible to keep the water wheel from running away. You can't swing your load off and on. If, however, it is positively necessary that your speed should be constant while you vary your load as you please, and you have solved the problem of water wheel regulation, then a constant potential method will be best, and possibly the synchronous alternator may come in to good advantage.

To the condition of several units the same general rules apply. The constant current machine does not couple up well in series when you get above 4,000 volts. It becomes uneasy as we know in arc stations. I think that the constant potential, compound-wound dynamos will probably fill the bill best. I do not place the limits for direct current as low as some of our friends do, because I do not think that 1,000 volts is the practical limit of direct current work at constant potential. I think where you have a large mining plant, where your work is done in the substantial manner that is generally acceptable to mining engineers, that it will be possible to employ electromotive force higher than 1,000 volts. There you have the same problem that you have to-day in street car work, simply with a higher voltage; and the same machinery, within certain limits of loss on line, will do the work. Beyond those limits modified machinery will do it, and I think the modification will be away from present methods of over-compounding. I think it possible that machines more like the simple shunt generators with straight or drooping characteristics, and with the loss in line provided for by something like a motor generator, will be the standard of the future for specially long distances.

When it comes to central distribution there isn't anything to compare with the direct current multiple arc method. In a case where your distributing station is in the business center you will find that nine times out of ten it will be better economy, in securing distant business either to start a sub-station and operate it by a compensating method, or to start another station. Each problem can be settled only on the commercial basis in a particular town. The actual facts in nine cases out of ten are that a central station, direct current, is furnishing light and power through the same mains, and I do not think the conditions are going to change much. But if your generating station is necessarily "eccentric" then the alternating current comes in. The most prominent station of this class in the world is the Ferranti station. There they have the advantage of cheap fuel, cheap real estate and facilities for getting rid of the refuse and a convenient method of placing their mains all the way into the heart of the city. The engineering of that station from a commercial point of view is good.

I notice that our friend Mr. Tobey, in referring to alternating sub-stations, provides for an attendant. If you are going to provide for an attendant to take care of your transformers, you might as well have moving transformers as stationary, so that the motor generators may come in on that basis.

As to the cost of copper, I have tried to get that out with special reference to such conditions as will arise in power transmission underground. I got some figures to-night from Mr. Degenhardt, and I put the problem to him in this way: We want two No. 00 wires—a very likely size for power transmission; we want to pull them into a conduit, so we can get them out and in; and supposing we had to work under ordinary conditions for any ordinary distance, what proportion would the copper in that conduit per foot bear to the total cost of installation? Mr. Degenhardt gave me such a figure as he would give to a customer asking the same question. He did not make it too low nor too high; he says 13 per cent. I verified the figures, and found he was about right.

In the Brooklyn central station, a 220 volt system, the drop in the feeders is 10 per cent., and the station is making money. That is a good point to note. The total cost of the copper in the underground system is stated on the best authority to be about 25 per cent. of the cost of the undergrounding. The proportion that figure bears to total cost of the plant is small. They might have cut the loss in transmission down to 5 per cent. and not have made a very big difference. But considering the short period of full load in such a station it would not have been good engineering.

W. S. TOBEY: An interesting question in this connection is that of the high insulation required for running alternating currents at high voltages. I believe Mr. Badt will agree with me that in the Ferranti station in London, although the company had great trouble in running at 10,000 volts, the insulation gave satisfaction at 5,000, which was the figure I named, not an excessively high electromotive force, and that we have been able to get insulation for those high voltages, as high as 5,000 volts; it is merely a question of repeating work that has already been done. Of course the Ferranti cable is an exceedingly expensive one. But there are, I suppose, at the present time, cables that will stand 5,000 volts all right.

In Mr. Dow's paper he remarked that more copper was required for alternating currents than in direct currents in the same cases. I am not positive in regard to the actual figures, but I presume that is the case, as Mr. Dow has had a great deal of experience in that line; but at the same time I think in making that statement he was considering systems using the same electromotive force, either in alternating or direct currents.

MR. DOW: Under similar conditions.

MR. TOBEY: Of course we would not consider the alternating currents, because we would use in this case 25 times the electromotive force, or nearly that; instead of 210 volts we would use 5,000.

In Mr. Dow's paper he spoke of direct current stations being located at the outskirts, and alternating currents in the center of the lighting district, which is of course true, and it might in some cases be repeated. But I think in most cases for a large city, the alternating current will be used. The direct current system, of course, has had a long start over the alternating current, and having got a foothold it is hard to get away from it in many cities and centers of distribution. Considering a case in Chicago, for instance, it would undoubtedly be very satisfactory from a commercial standpoint, to have a station situated on the outskirts of the town, where fuel could be supplied cheaply and readily, together with water for engines, etc., to a better advantage than in the center of the thickly populated district. Of course in alternating motors there is always a hysteresis loss which we have to contend with, and that loss depends solely upon the quality of the iron which we are using in these motors, and is something which cannot be gotten rid of entirely. That of course is a detriment which does not occur in the direct current motor.

In Mr. Dow's paper he spoke of using high electromotive force on his motors, as high as 3,000 volts, I think. These motors, no doubt, give satisfaction, but there are a great many cases, in fact nearly all, where we would not care to put such high motors on the market generally for commercial purposes. We know that serious troubles have arisen from the motors on arc light circuits on account of the high electromotive force that is in use with them. It seems to me that it would be a great advantage to have a form of motor where this electromotive force can be reduced. In this motor which I have described, although there is a condenser electromotive force of say 750 volts, immediately upon touching the terminals, the balance of the condenser is destroyed so that we do not have an electromotive force of 750 volts passing through the premises. The great disadvantage in using high potential direct current circuits for distribution is our inability to take light from the same circuit which supplies the motors, and this of course in itself necessitates the running of another circuit in the same section, for the distribution of light.

At the Frankfort Exposition the experiments, although perhaps not entirely satisfactory, were of great interest to engineers, and I think Mr. Dow will agree with me that had we undertaken to transmit direct, under the same circumstances, it would have been much more of a failure—in fact something we could not use at all.

I have not considered the use of multiphase motors, or synchronous motors, because we are all more or less familiar with them. We were simply considering the conditions we have to meet at the present time, that is, in the transformer system. Then the synchronous motors require special apparatus and machinery, of course, to operate them. And the matter of having an attendant at sub-stations of course is a slight objection. But one attendant where 10,000 lights are in operation is not such a great expense. I think if the direct current transformers were used we could not get along with any less.

MR. BADT: I suppose we could continue this discussion not only for hours, but for weeks and months. When I mentioned the few points on which I wished to hear a discussion I purposely neglected to mention one case, the main case. I may say that at least nine-tenths of all power transmission in use in the United States to-day is for street railway purposes, and not a word has been said to-night concerning the adaptability of direct or alternating current motors for that purpose. We all know of course that at present the direct overhead system is the only one that is relied on. Now it seems to me that there is a great future for the multiphase motor. Just think of a car motor that has no commutator, where the armature is attached to the car body, no gears, and the revolving field mainly consisting of a large mass of iron keyed direct to the car axle. It seems to me to be almost simplicity itself, and I think great strides will be made in this direction in the near future. As a matter of fact I know that some of the leading electricians in this country are working in that direction. At the same time, as I understand my position here to-night, I am not called upon to pass upon the merits of any special system, but upon the merits of the papers to which we have listened to-night, and that it is for me to decide whether Mr. Dow or Mr. Tobey presented the best arguments. I think I shall have to declare Mr. Dow guilty for this reason: He has

n almost every instance admitted that the alternating motor and generator or alternating system might be advantageously used. He said the direct current systems were all right, and were in use, but that there was no reason why the alternating system should not be used under certain conditions in every instance. For that reason I think Mr. Tobey rather got the best of the question in his paper and in the discussion, over Mr. Dow; therefore, gentlemen, I declare Mr. Dow guilty, and it is for you to pass sentence on him.

The Law of Hysteresis.[1]

By Charles Proteus Steinmetz.

Part I.

In number 137, of December 17, 1890, of the *Electrical Engineer*, I published a short article under the title "Note on the Law of Hysteresis," where I showed that in a set of determinations of the loss of energy due to hysteresis by reversals of magnetism, for different magnetizations, made by Ewing, this loss of energy due to hysteresis can fairly well be expressed by the equation:

$$H = \eta B^{1.6},$$

where H is the energy consumed by hysteresis during one magnetic cycle, in ergs per cubic centimeter, B the magnetization in lines of magnetic force per square centimeter, and η [2] a numerical coefficient, in this case = .002.

Considering that even the simple law of magnetism—that is, the dependence of the magnetization B upon the magneto motive force F (for instance, in ampere turns per centimeter length of the magnetic circuit)—has until now defied all attempts at mathematical formulation, it appeared a strange feature that the apparently much more intricate phenomenon of hysteresis, or rather of the consumption of energy by hysteresis, should yield to analytical formulation in such a simple way, to be directly proportional to the 1 6th power of the magnetization. At the same time the coincidence of Ewing's tests with the curve of the 1.6th power was near enough to be considered as something more than a mere incident, but at least as a clue to a law of hysteresis, the more as this law held not only for low and medium magnetization, but even for very high saturation, without showing any kink at that point where the magnetic characteristic goes over the bend or "knee," and thereby entirely changes its shape, nor any marked tendency of deviation of the extremest observed values from the calculated curve.

In Fig. 1 and table I, I give from the article referred to, the calculated curve of hysteretic loss, as a drawn line, with Ewing's tests marked as crosses, and in dotted line the curve of magneto motive force F, corresponding to the different magnetizations, as abscissæ.

In the table I:

F = the M. M. F. in absolute units.

B = the magnetization in lines of magnetic force per square centimeter

H_{obs} = the observed values, and

H_{calc} = the calculated values of hysteretic loss, in ergs per cubic centimetre,

$H_{calc} - H_{obs}$ = the difference between, both in ergs and in percentages.

Table I.

F.	B.	H. obs	H. calc	$H_{calc} - H_{obs}$	$= \%$
1.50	1,974	410	375	+ 35	+8.5
1.95	3,830	1160	1082	+ 58	+5.0
2.56	5,050	2190	2190		
3.01	7,180	2940	2956	— 16	—.5
3.76	8,790	3990	4080	— 90	—2.3
4.96	10,590	5560	5510	+ 50	+.9
6.62	11,480	6160	6260	—100	—1.7
7.04	11,980	6590	6690	—100	—1.5
26.5	13,700	8690	8310	+380	+4.4
75.2	15,560	10,040	10,190	—150	—1.5
				Av: ± 98 —	± 2.6

To study more completely this phenomenon of hysteresis and of the energy consumption caused thereby, I endeavored to make a number of determinations with different magnetic circuits and at different magnetizations.

To be enabled to carry out these experiments, I am highly obliged to Rudolph Eickemeyer of Yonkers, N. Y., who, being greatly interested in the laws of the magnetic circuit and having done considerable work himself in this branch of electrical science, not only put the large facilities of his well-known factory at my disposal, but also guided the experiments with his valuable advice. A part of the instruments used in the tests are of Mr. Eickemeyer's invention and covered by his patents.

To be able to deal not only with the small amounts of energy which the reversal of magnetism in a tiny bit of iron wire sends through the ballistic galvanometer, but to reduce the determinations to readings of considerable power-values, and where a much greater exactness can be reached, and at the same time to determine the dependence of the hysteretic loss of energy upon the velocity of the magnetic cycles, I decided to use alternating currents, at least as far as this could be done, whereby the determinations of the energy consumed by hysteresis is reduced to a simultaneous wattmeter, voltmeter, ammeter and speed reading.

At the same time this electro-dynamometer method has the advantage that the magnetic cycle is completed in a steady, continuous motion, while in the ballistic method the magnetic cycle is completed by sudden changes in the magnetization, which jumps from point to point, to enable the production of the induced current. This feature introduces an error into the ballistic method, for if a magnetic cycle is gone through by sudden changes, a larger amount of energy may be consumed than if the magnetization varies steadily in harmonic vibration.

Suppose, around a magnetic circuit, an alternating current of N periods per second is sent in n convolutions.

Let C = the effective strength of the current.

E = the effective electromotive force induced in the circuit by self-induction, after subtracting the electromotive forces induced by the self-induction of the instruments,

W = the energy consumed in the circuit, after subtracting the energy consumed by the electric resistance,

Then, l being the length and s the cross-section of the magnetic circuit, all in centimeters, amperes, volts, watts, etc.,

Let B = the maximum magnetization in lines of magnetic force per square centimeter,

H = the loss of energy by hysteresis per cycle and cubic centimeter; it is

$$W = l\, s\, N\, H \times 10^{-7}$$

hence

$$H = \frac{W}{l\, s\, N} \times 10^{-7}$$

the hysteretic loss of energy, and

$$E = \sqrt{2}\, \pi\, s\, B\, N\, n \times 10^{-8}$$

hence

$$B = \frac{E \times 10^{+8}}{\sqrt{2}\, \pi\, s\, N\, n} \quad (1)$$

the maximum magnetism.

For higher frequencies, 80 to 200 periods per second, the alternating current was derived from a one horse power 50 volt Westinghouse dynamo. This was driven by a 3 horse power Eickemeyer continuous current motor. By varying the excitation of the motor field and varying the electromotive force supplied to the motor, the speed and therefore the frequency of the alternating current could be varied in wide limits. At the same time, supplied with constant electromotive force and like all the Eickemeyer motors of unusually small armature reaction, this electro motor kept almost absolutely constant speed under varying load, the more as it never ran with full load.

For low frequencies, this bipolar continuous current motor was used as a bipolar alternating dynamo, as shown in a patent of Stephen D. Field. On the continuous current commutator two sliding rings were mounted and connected with opposite commutator bars. In the ordinary continuous current brushes a continuous current was sent in, which set the machine in motion as an electro motor, while from the sliding rings by two separate brushes, alternating currents were taken off. By varying the electromotive force supplied to the motor, the electromotive force of the alternating current was varied, while a variation of the motor field gave the variations of the frequency. The curve of electromotive force was very nearly a sine-wave, the ratio of maximum electromotive force to effective electromotive force found = 1.415, while the sine-wave requires 1.414—that is, exactly the same.

To determine whether the change of the shape of the alternating current by varying load and varying excitation had any influence upon the readings, the variations of the alternating electromotive force were produced:

1. By varying the excitation of the field of the Westinghouse dynamo.
2. By running the Westinghouse dynamo fully excited, feeding the secondaries of a bank of converters, feeding from the fine wire coils of these converters the fine wire coils of another bank of converters, and taking current off from the secondaries of these converters, connected from one to six in series.
3. By changing the electromotive force by means of a Westinghouse converter of variable ratio of transformation.
4. By loading the dynamo when small currents were used for the tests.

But after having found that all these different ways of varying the alternating electromotive force gave no perceptible difference whatever in the readings, I afterward used the most convenient way to vary the excitation of the dynamo field, and, where higher electromotive forces were needed, to increase the electromotive force by an interchangeable converter, which gave the ratio: 1: 1, 2, 3, 4, 5.

For the determination of the frequency a direct reading speed indicator (horizontal ball governor, acting upon a spring) was used, which was carefully calibrated.

For the electric readings instruments of the electro-dynamometer type were used, zero reading—that is, the movable coil was carried back by the torsion of a steel spring to zero position.

These instruments were specially built for alternating currents, with very low self-induction and low internal resistance, using bifilar German silver wire as additional resistance.

In the ammeter the range of readings was from 3 to 40 amperes, the internal resistance = .011 ω.

The normal inductance (that is, electromotive force of self induction induced by one ampere alternating current, flowing through the instrument with a frequency of 100 complete periods per second) = .045 ω.

In the voltmeter the range of readings was from .5 volts upward, but to avoid the necessity of corrections for self-induction sufficient additional resistance was used to decrease the correction under 1 per cent., and then the lowest readings were from 3 to 6 volts.

The internal resistance of the voltmeter is = 2.5 ω, its normal inductance = 4.12 ω.

In the wattmeter the resistance of the coarse wire coil (fixed coil) was = .026 ω, its normal inductance = .073 ω.

The internal resistance of the fine wire coil was = .25 ω; its normal inductance = .33 ω.

In most of the readings sufficient additional resistance was used to make the correction for self induction of the fine wire coil negligible. Only in a few readings where it exceeded 1 per cent. it was taken in account.

For small currents an Eickemeyer ammeter was used, which, while reading from .7 to 3 amperes, though built originally for continuous currents, had already been used by me for alternating currents, and had been checked for its constancy of readings several times, and always found to give no perceptible difference in its readings for continuous currents and for alternating currents up to over 200 complete periods per second, the highest frequency I could reach.

Its internal resistance is = 1.1 ω; its normal inductance = 2.3 ω.

Several sets of readings for different frequencies were taken on an old Westinghouse voltmeter converter. The fine wire coil and one of the 50 volt coils were left open. Into the other coarse wire coil an alternating current was sent in series to the ammeter and the coarse wire coil of wattmeter, while the voltmeter and the fine wire coil of the wattmeter were connected in shunt around the whole circuit.

Hence a correction had to be applied for the self-induction of the ammeter and the coarse the wire coil of the wattmeter and for the resistance of the circuit. Only in a very few readings this correction amounted to somewhat more than 10 per cent. Generally it was much smaller.

The instruments were calibrated several times, and their constants found to remain constant.

The speed indicator was calibrated carefully and its corrections added.

Each reading consisted of an ammeter reading, a voltmeter reading, a wattmeter reading and a speed reading.

Before and after each set of readings the zero positions of the instruments were determined, and only those sets

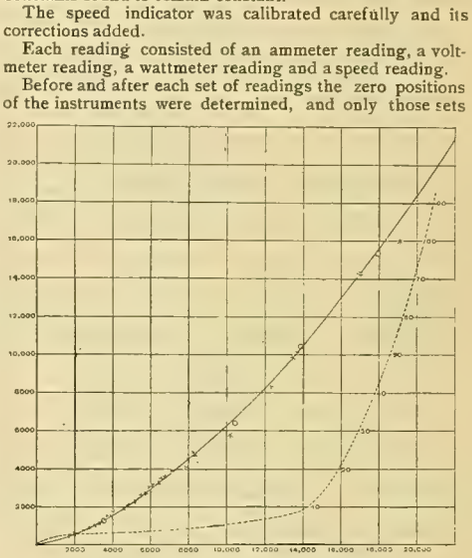


Fig. 1. The Law of Hysteresis.

of readings used where the zero position had remained constant.

Before and after each set of alternating current readings a continuous current was sent into the circuit and a few readings for different currents taken. Voltmeter and ammeter readings combined gave the resistance of the circuit, and both combined with the wattmeter readings gave a check for the instruments, here being watts = volts × amperes. Only those sets were used again where an entire agreement was found, and with the alternating current first readings with small currents, then with large currents, then again with small currents taken, so that I believe every possible care was exercised to avoid any errors in the tests.

Thomson-Houston Factory in Chicago.

Referring to the project for the establishment of a Thomson-Houston factory at Pullman in Chicago, the *Lynn Press* says: "It has not yet been decided about the proposed Pullman works, but there is every reason to expect that they will go up soon, as the immense demand for the company's apparatus from the western states could be better met with there than at present where the machines have to be shipped long distances with consequent annoying delays and heavy freight bills. If there was a place of manufacture at Pullman or Chicago the demand for that part of the country could be supplied direct from there, leaving the works here free to supply the eastern and southern trades. There would be no lessening of work here as the demand for the T-H apparatus is constantly increasing, and the Lynn factories have more than they can do now to fill orders."

The Supreme Court of New Jersey has set aside the Trenton city ordinance by which the Trenton Passenger Railway company obtained permission to erect poles and wires for propelling cars by electricity, stating that the statute under which the ordinance was supposed to act "does not stipulate anything about poles or wires in the streets." The decision is a serious interruption of the company's plans for its system.

1. Read before the American Institute of Electrical Engineers, New York, January 19, 1892.

2. If any quantity has a right to be called "magnetic resistance," it is this coefficient η, for η is the coefficient of conversion of magnetic energy into heat, while as "electric resistance" we define the coefficient of conversion of electric energy into heat.

The term generally denoted "magnetic resistance"—that is, the inverse value of magnetic susceptibility—does not deserve this name at all, but is more properly called "reluctance."

1. This formula holds rigidly only for the sine-wave, but as shown in the following, the currents used in the tests were at least very near sine-waves. Besides, a deviation from the sine shape would not alter the results at all, but only slightly change the coefficient η.

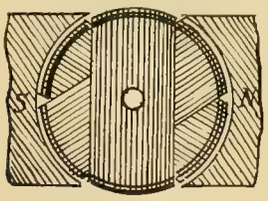
C. E. L. Brown and Carl Hering.

To the Editor of the WESTERN ELECTRICIAN:

I presume that you have noticed my letter of October 12th and Carl Hering's comments in No. 19 of the *Electrical World*. Inclosed you will find the answer I wrote to that paper, and in a letter dated November 30th they acknowledge the receipt of it in the following words:

"*Dear Sir:* We have your favor of the 16th inst., and note what you say about Carl Hering's comments, etc. The matter has been turned over to our editorial department, who, we presume, will use the same at the earliest possible moment. It will certainly be given attention. and used if possible. Very truly," etc

More than a month has now elapsed and yet my letter has not been published, so that I have the impression that it will never appear. Mr. Hering (if I am right, one of the editors of the *Electrical World*) is a special friend of



FAC-SIMILE DRAWING OF PATENT NO. 381,998, SHEET 3, FIG. 14.

Dobrowolski, and published during the Frankfort Exhibition, a series of articles about the Lauffen experiment in which he made it appear that to his friend Dobrowolski the installation and its success, was solely due; and further he gave the impression that it was especially the three phase current that made the transmission possible. In this I think I see the explanation of their not liking to publish my letter. C. E. L. BROWN.

Following is the letter to the *World* to which Mr. Brown refers, dated Nov 18, 1891:

"*To the Editor of the Electrical World*: Sir: I should like to make a few remarks on Carl Hering's comments on my letter of the 12th of October last. I would first draw his attention to the concluding paragraph of that letter, and secondly, refer him to Mr. Tesla's patents for the three phase current, filed October 12, 1887, Nos. 381,968 and 382,280, and his further patent No. 390,414 filed April 23d of the following year, of the existence of which patents he seems to be ignorant. For his further edification I inclose sketches, which are facsimile copies of drawings in the patents above referred to. I think that he should then see that I have done full justice to the true inventor of the three phase current system. Yours faithfully," etc.

The sketches referred to are reproduced in the accompanying cuts.

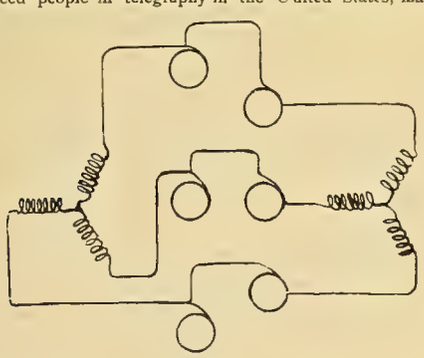
Porcelain and Glass Insulators.

To the Editor of the WESTERN ELECTRICIAN:

I find in the columns of your esteemed contemporary, the *Electrical Engineer* of New York, an editorial commenting upon F. W. jones' appeal to porcelain manufacturers, concerning the introduction of porcelain insulators for overhead electric lines, in place of glass insulators

The editorial ends with the following remark: "With the need so well recognized and with the ability to supply it so well manifested, there should be little delay on the part of porcelain manufacturers in this country, in finding a new market in the telegraph field."

The writer laid this matter before a number of experienced people in telegraphy in the United States, many



FAC SIMILE DRAWING OF PATENT NO. 390,414, SHEET 2, FIG. 3.

years ago, and the main argument then was not the question of price, but the doubt whether porcelain insulators would be preferable to glass insulators for the reason that it was claimed that certain insects would use opaque insulators for their abode while they would avoid transparent insulators which the light of day could easily penetrate.

These "old timers" claimed that opaque insulators, of either porcelain or other material, had been used quite a number of times, but that these lines always showed a great leakage to earth due to dense webs built by these insects under the bell of the insulators.

As the writer does not know whether this is true from his own experience, he lays this before the readers of your paper, hoping that somebody will either verify the above statements or that they may be referred as a fable to the nursery.

I might mention another advantage of glass insulators of a certain type There is undoubtedly to day a tendency in the United States toward using oil insulators for high potential currents. It seems to me that in such a case a transparent material would be preferable to porcelain, as the contents of the cup containing the oil could be more easily inspected, and the cups refilled

Truly yours, F. B. BAIRD.

Incandescent Lamp Litigation in Australia.

The case of the Brush Electrical Engineering company against Kingsbury was heard in the New South Wales Equity Court before Justice Manning in November. It was an "application for an interlocutory injunction to restrain the defendant, H. H. Kingsbury (trading as H. H. Kingsbury & Co.) from importing or otherwise dealing, in, except with the consent of the plaintiff, electric lamps known as Thomson-Houston lamps, or any other incandescent lamps, the plaintiff company claiming the exclusive right to use or sell, or to restrain the use or sale without their consent, of incandescent lamps constructed on the principle of the Edison patent." The judge held that the plaintiff was entitled to relief, and the injunction was granted, with costs.

National Electric Light Association.

Great interest is being taken in the approaching convention of the National Electric Light association, at Buffalo, February 23d, 24th and 25th next.

The papers to be read will treat on every valuable subject from "How to Fire a Steam Boiler" to "Electric Lighting from a Financial Standpoint," including the steam engine, dynamo. switch-boards, overhead and underground wiring, motors, etc.

The Progress of the Trolley.

The extent to which the overhead electric railway has gained in favor with the people can be evidenced in no better way than through an inspection of the books of the leading companies. Taking, for instance, the Detroit Electrical Works, Detroit, Mich., one of the youngest concerns, which has, comparatively speaking, only recently entered the field, a glance at the number of sales listed would have a tendency to surprise one not conversant with the progress of the trolley system.

During the year 1891 the Detroit people furnished equipments for roads in Kokomo, Ind., Athens, Ga., Augusta, Me., Aurora, Ill., Chicago, Ill., Grand Rapids, Mich., Eau Claire, Wis., Galveston, Tex., Gloucester, Mass., Charlotte, N. Y., Cleveland, O., Lawrence, Mass., Salem, Mass., Nashville, Tenn., Springfield. Ill., Saginaw, Mich, Kansas City, Kan., and Worcester, Mass.

Roads in the following named places were equipped with generators: Athens. Ga., Chicago, Ill., Galveston, Tex., Gloucester, Mass., Nashville, Tenn., Kansas City, Kan., and Kokomo, Ind.

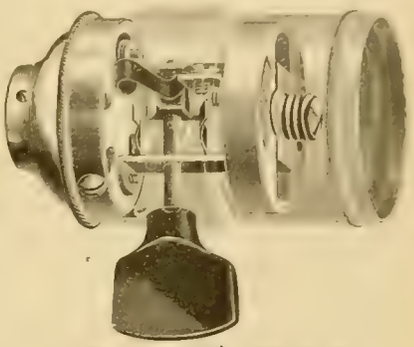
At a number of these places mechanical difficulties of the severest kind were encountered, such as the climbing of heavy grades and hauling a number of trailers on rapid schedule time. As an instance of what has been accomplished, the record made by fifteen of the 40 horse power Detroit equipments on the Merrimac Valley road at Lawrence, Mass., might be cited. Since the first car was started, Aug. 31, 1891, it is stated that there has not been a single case of burn-out of armatures, fields, rheostats or switches. Yet from August 31st, up to the end of the year, the motor cars made a total mileage of 111,444½ car miles, and during the greater part of this time operated under extremely severe conditions as the line was very popular, and carried large crowds. The loads per car averaged, on good days, between 100 and 138 people; yet these loads, and additional trail cars as fully loaded, were carried up grades of over nine per cent., with the pressure as low at times as 190 volts, without any damage to the apparatus.

At Aurora, Ill., 40 horse power motors pull heavy loads on cars weighing 9,000 pounds each, up seven per cent. grades, and at a speed that is greater than is ordinarily met with, even on grades of less per cent. with lighter cars.

At Grand Rapids, Mich., the 30 horse power equipments were, during last summer, put to exceedingly heavy service, yet the results were most gratifying. In general the year has been one of great improvement, and with the Detroit Electrical Works in particular, it has resulted in the elimination from its apparatus, of the few troubles which were incidental to pioneer work. As the equipment is now manufactured, the motors can be put to the severest work possible without fear of burn-out or mechanical damage. The new form of shrouded bevel gears gives a most substantial construction, and as the teeth are cast, the hard shell of the casting is utilized as wearing surface, thereby getting the greatest possible wear. The improved railway generator has done most satisfactory work. This machine has one of the slowest running armatures of any in this country, making 620 revolutions per minute. But owing to the fact that the Detroit company builds all parts of the generator with a wide margin for safety, these generators can be run at 25 or more per cent. beyond their rated capacity without fear of any damaging results. This company has now in hand some new forms of apparatus for the year 1892, which it feels satisfied will be found most acceptable to street railway people. Large additions to the Detroit factory are now being made, which will result in trebling its capacity.

The Crown Electric Manufacturing Company's New Socket.

A socket which presents several new features of improvement has recently been brought out by the Crown Electric Manufacturing company of Bridgeport, Conn. The socket is simple in construction. The center screw is secured so that it cannot turn in putting the lamp on or off. The ratchet on the contact block is so arranged in connection with the controlling spring that it makes a sure and quick break in contact, and it is claimed that this arrangement prevents absolutely any sparking and the burning of the terminals. The parts are so constructed

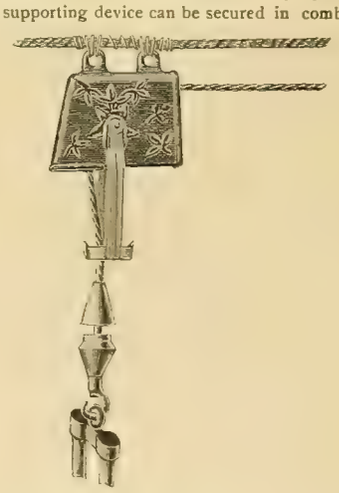


CROWN ELECTRIC CO'S. NEW SOCKET.

that there is no danger of short circuits, there being an abundance of room in the necessary mechanism of the socket. The sockets are made in any style suitable for any lamp now in use. The Crown Electric Manufacturing company guarantees all its goods, which are tested before leaving the factory.

Wood's Arc Lamp Hangers.

The lamp hanger illustrated herewith is a combination of Fletcher's sleet-proof pulley and a supporting bail or catch for holding the lamp. The position in the cut is that of lowering the lamp. It is evident that a sufficient pull upward would bring the first cone above the annular projections on the bails; these would drop into position between the cones, holding the entire weight of the lamp and hood, and taking all the strain off the rope and pulley wheel. When it is desired to lower the lamp the cord is pulled until the lower inverted cone is brought above the bails. This cone is loose and slides freely on the stem connecting the hook with the top cone. Now when the cord is released the grip of the bails against the lower cone causes it to slide partly into the upper cone, which is hollow. In this position both cones will invariably pass the bails and allow the lamp to descend. The whole device is sleet proof and very simple. It is made by the Electrical Supply company of Chicago and the company explains that the supporting device can be secured in combination



WOOD'S ARC LAMP HANGERS.

with or separate from the pulley. It can be attached to any Fletcher pulley by simply driving out the wheel pin and using a longer bolt, which is sent with the bails.

The Ferdinand street station of the Boston Electric Light company was destroyed by fire early on the morning of January 23d. The loss is estimated at $200,000. The fire broke out about three o'clock, and was under control in an hour. The property destroyed consisted of twenty-four dynamos valued at $5,000 each, five 150 horse power engines, one 100 horse power engine, and one 300 horse power engine. Ten minutes after the fire was discovered the main floor fell with a crash, and carried with it the valuable machinery.

CORRESPONDENCE.

New York Notes.

NEW YORK, January 23.—There was a break in the cable to Brazil on Tuesday, and notices to that effect were sent to those having cable business with Brazilian ports. The interruption in the service was between Maranham and Para. According to the Anglo-American Telegraph company business communications would not be seriously delayed, because the land lines of the Brazilian government are available for the transmission of cable news from Maranham as well as from other points touched by the cable.

The search lights of the monitor Miantonomah were tested on Sunday night. The spectacle excited considerable curiosity. Captain Kane of the Brooklyn navy yard, said that the Miantonomah was testing her search lights for the first time, and the experiment had been made on Sunday because it was desired to have the monitor ready for fight as soon as possible.

A lengthy suit has just been decided against the Western Union Telegraph company. The case in question is that of James E. Goodsell, which has been in the courts since 1882. Mr. Goodsell owned the National Association Press, which gave newspaper service throughout the Atlantic and Pacific Telegraph company until it was absorbed by the Western Union. The contract of the National Press was continued by the Western Union, which company, after about a year, refused to perform the service it contracted to perform for a term of ten years. Two judgments were obtained and overthrown, one for $240,000 and the other for $250,000. The case was finally referred to Frederick Coudert. As a result of this reference a judgment was given for $60 000 to cover both money loss and damages. Both sides appealed from this decision, but the Court of Appeals affirmed it. With interests and costs the sum now amounts to about $70,000, which the Western Union company must pay to Mr. Goodsell. This judgment had also been affirmed by the General Term before it went to the Court of Appeals.

There is a controvery on between the Board of Underwriters and the Edison Electric Illuminating company, and the question in dispute relates to the grounding of the neutral wire. It has been brought to the attention of the board, by means that could not be ignored, that the Edison company had permitted its neutral wires to be grounded in direct violation of a rule of the Underwriters'. Other electric lighting companies were loud in their complaints that special indulgence had been shown to the Edison company. It was charged by some of the other companies that the Underwriters had been aware of the violation of this rule by the Edison company, and part of the motive for present activity by the Underwriters is said to lie in their desire to convince the other companies that no discrimination will be shown in respect to this matter. When the Underwriters appointed a committee to visit the Edison company, this committee was met by the assertion that grounded wires were not dangerous. The committee, on the other hand, found itself overwhelmed with evidence said to prove that if the Edison company was obliged to take up its ground wires and connect them with a metallic circuit a very large expense would be involved. Superintendent William A. Anderson of the Board of Underwriters, said on Wednesday, that he had become convinced that there was an honest difference of opinion between the Underwriters and the Edison company, and that the investigation now in progress would, no doubt, be thorough, and would lead to a satisfactory conclusion. The committee, he said, had submitted certain questions to the Edison company, and the company had professed its willingness to answer them. He understood that nothing had yet been sent to the committee by the Edison company by way of reply to these questions, but that the committee expected replies within a short time, and as soon as it should get possession of them a meeting of the board would be called to consider the matter as it may then be presented. The position of the New York Underwriters is that the grounded wire is dangerous, and alike harmful to property and to life. This opinion is not generally shared by underwriters, and in several of the large cities the grounded wire is allowed. Under the rule of the board against grounded wires, no insurance can be carried on buildings in which the wires are not properly laid. The controversy between the Underwriters and the Edison company threatens to be prolonged, because, from whatever point of view it may be regarded, considerable amounts of money will be involved in its determination.

The Western Union Telegraph company's new building at Broadway and Dey street was thrown open for inspection on Thursday. The general operating department on the seventh and eighth floors was, of ccurse, the chief point of interest. Each floor measures 75x200 feet with windows on all sides. At night light is furnished by 600 incandescent lamps. There are accommodations for upward of 1,000 operators on the eighth floor, and 500 on the seventh floor.

The Court of Appeals has handed down a decision which has a most important bearing upon the question as to whether electric light companies are manufacturers or not. The case referred to is that of the Brush Electric Illuminating company, appellant, vs. Edward Wemple, controller. A member of the firm of attorneys handling the case for the electric company explained the point involved in the appeal. In 1890, he said, the electric company paid, under protest, to the state controller about $10,000, the amount of several years' accumulated state taxes and penalties. The company petitioned the controller for a resettlement of taxes and that official entered an order denying the request. The attorneys for the company claimed that it was a manufacturing corporation within the provisions of Chapter 542 of the Laws of 1880, as amended by Chapter 361of the Laws of 1881 and Chapter 151 of the Laws of 1882, and in consequence of those laws was exempt from the payment of state taxes. The controller contended that as the company was not engaged in producing any material thing it was not a manufacturing corporation within the meaning and extent of those laws, and therefore was not exempt from the payment of such taxes. The company appealed to the General Term, from the controller's order declining a re-settlement and that court sustained the decision of the controller. From that decision the company appealed to the highest court and that court has now by its decision sustained the contention of the electric company's attorneys.

The latest report as to Cyrus W. Field's condition are to the effect that while there were undeniable symptoms of pneumonia the disease has apparently taken no stronger hold on Mr. Field. It is stated that there is no change for the worse, and the patient is resting comfortably.

On January 20th the board of directors of the Westinghouse Electric & Manufacturing company declared an interim dividend of 1 per cent. on the preferred stock of the company for the fractional part of the quarter ending Dec. 31, 1891. The dividend is payable at the office of the company, 120 Broadway, on and after Feb. 1, 1892. The transfer books will be closed at 3 P. M., January 25th, and re-opened at 10 A. M. February 5th.

The directors of the North Hudson county railway at a recent meeting in Hoboken decided to adopt the trolley system on its surface roads from the Hoboken boundaries to Union Hill, and to place a modified trolley plant on the Central avenue elevated road.

Another Sound steamer, the New Hampshire was launched last week at Harlan & Hollingsworth's yards. The boat will be put into service next May on the Stonington line, and will be lighted by 600 incandescent lights.

W. F. O.

Kansas City, Mo.

KANSAS CITY, January 23.—Attorney James Harkless has brought suit against the Western Union Telegraph company for the $200 penalty provided for by a state statute in the event of a telegraph company neglecting to deliver a message. On Thursday Attorney Harkless sent a telegram from Washington, Missouri, to Union, Missouri. There is no station in Union, and the agent charged 25 cents extra for delivering it at that place from the next nearest station. He supposed the station was only one mile away, but it proved to be five miles and the message was not delivered.

The meeting of the officers and stockholders of the West Side Electric Street Railway company of Kansas City, Kan., was held last week. The directors chosen are: C. F. Hutchings, C. S. Clarke, W. N. Coler, Jr., W. S. Nelson, B. F. Moats and L. W. Keplinger. The officers chosen: President, W. N. Coler, Jr.; vice-president, B. F. Moats; secretary and general attorney, C. F. Hutchings.

Mayor Hannan has approved the much talked of Thayer-Enright franchise for the proposed system of electric street railways of Kansas City, Kan, the mayor's suggestions having been embodied in the ordinance. The proposed line is nearly seven miles in length within the city limits and will be a very valuable road, as it passes through the choicest residence portion of the city, and its spurs reach out to all the important industries in the two cities.

The line begins on North Fifth street at Roswell avenue and as mapped out extends through the residence distruct on the north side, past the court house and down Seventh street to the viaduct, over which it passes; then it continues through Armourdale to the city limits at the Southern bridge and thence to the western limits of the city of Argentine. At Seventh and Ohio avenues a branch will extend to the Grandview portion of the city, and another, on Kansas avenue, will run west to Argentine boulevard; still another, on Miami avenue and Pyle street, will run to the Phœnix packing house. The franchise is one of the most valuable ever granted by the city, and having been so long before the council the city's interests have all been carefully protected. This is the first road built in the city which is really an independent Kansas City, Kan., road, all the others leading out of the city.

There appears to be no doubt that the company backing the enterprise is in earnest. The $5,000 forfeit has been deposited. Work will be begun in thirty days, and the whole line will be completed and running inside of ten months. The estimated cost of the road is over $250,000.

The Stock Yards & Northwestern road also seeks a franchise for over five miles of street railway in Kansas City, Kan. This would be an electric line also. The "L" road is before the council with an application for an amended franchise allowing it to substitute electricity for steam. Counting the two lines for what they ask, there is in the city more than thirty-seven miles of street railway, a showing which but few cities of the same size can make.

Two regular trains have been added to the service of the Northeast electric line. More will be put on soon. Frank McDonald has been appointed assistant to the president of the road, and will have general supervision over the train service. Superintendent H. F. Farrar will exercise control of the mechanical and electrical departments.

Citizens of Kansas City, Kan., are to have cheaper electric light service at an early date. On or about May 1st there will be a general reduction to consumers of incandescent light. Manager Friedburg of the Consolidated Electric Light & Power company states that a new schedule will be adopted at the time specified, and gave the following figures as about what would be adopted:

Consumers of one to three lights 75c per month each.
" " four to six " 70 " " "
" " seven to ten " 60 " " "
" " eleven to twenty " 62 " " "
" " twenty to forty " 60 " " "

This will be the cheapest service in the West, and even in the far East no such prices prevail. Manager Friedburg argues that his company will then furnish so much more light by reason of the reduction that more money will be made than at the higher rate.

The recent storm considerably interfered with the operation of the Northeast electric road. When it was time for the first car to start the trolley wire was heavily coated with ice, the result of a heavy sleet, and the current could not be taken therefrom. A heavy car carrying several hundred pounds of coarse salt was run out on the track. Then two files were fastened together in the shape of the letter V and were riveted to a pole. Two of these scrapers were made and four men mounted to the roof of the car and held them against the wire in advance of the trolley. Orders were given that nobody should touch the car unless he wore rubber shoes, but one careless man climbed to the car roof and received considerable of a shock in consequence. The heavy grades on the Northeast road make a scraper powerless, but Superintendent McDonald's scraper and salt car worked successfully.

G. M. P.

PERSONAL.

Thomas G. Grier, Chicago started on Saturday for Pittsburg and Philadelphia to be absent ten days.

F. S. Terry, manager of the Electrical Supply company, Chicago, has recovered sufficiently to return to his office.

L. W. Collins has retired from *Electricity* to accept a position with the *Electrical Engineer* of New York city.

M. H. Sullivan, formerly with the Edison General Electric company, has assumed charge of the editoral department of the *Street Railway Gazette*, Chicago.

William Bracke, president of the Consolidated Electric Storage company, has been in Chicago for some days on business connected with his company.

H. K. Gilman of the Great Western Electric Supply company, Chicago, has recently returned from a somewhat extended trip to New York and Boston.

W. D. Packard, secretary of the New York & Ohio company, Warren, O., was in Chicago on Saturday last en route for St. Paul and other Northwestern points accompanied by his wife.

John I. Beggs, manager of the Central District Edison General Electric company, Chicago, visited Appleton, Wis., last week for the purpose of attending the meeting of the local Edison company.

According to the London *Times*, it is probable that the title which Sir William Thomson will take will be that of Lord Kelvin, from the name of the beautiful river which flows past the foot of the college grounds at Glasgow, and on which his windows look out.

NEW INCORPORATIONS.

Deposit Electric company, Deposit, N. Y.; capital stock, $12,000; to manufacture and use electricity for light, heat and power.

Sanders Electric Light company, Portland, Ore.; capital stock, $200,000; to manufacture and sell electric lamps and machinery of all kinds; E. W. Allen, Portland, Ore.

Home Lighting & Fuel company, Parkersburg, W. Va.; capital stock, $250,000; manufacturing and distributing gas and electricity; Van Winkle & Ambler, Parkersburg, W. Va.

Electrical Conduit company, Long Branch, N. J.; capital stock, $300,000; to purchase and acquire certain patent rights on improvements in underground electrical conduits and conductors, etc.

Waterloo-Cedar Falls Construction company, Waterloo, Iowa; capital stock, $200,000; building an electric railway between Waterloo and Cedar Falls, Iowa; Central Loan & Trust company, Des Moines, Iowa.

Universal Power company, New York City, N. Y., capital stock, $15,000; produce and supply power by utilizing the forces of nature and transmission of such power by electrical and mechanical combination.

Everett Terminal company. Everett, Wash.; capital stock, $500,000; to operate railroads, telephone and telegraph lines, electric light plants, gas and waterworks; B. S. Grosscup, Fidelity Trust Bldg, Tacoma, Wash.

Consolidated Brush & Novelty company, Paterson, N. J.; capital stock, $50,000; to manufacture composition and other materials for electrical and novelty goods, etc.; Robert Williams, First National Bank Building, Paterson, N. J.

Amethyst Water Works & Electric Light company, Monta Vista, Colo.; capital stock, $100,000; to furnish pure water for domestic use, manufacturing, mechanical and electrical purposes in the counties of Hinsdale, Saguache and Rio Grande, Colo.

South Florida Electric company, Bartow, Fla; capital stock, $2,500; building, and equipping and operating within the state of Florida telephonelines, call bells, fire alarms, electric light, plants and electrical apparatus and machinery; Frank Clark, Bartow, Fla.

Creede-Amethyst Electric Power & Water company, Denver, Colo.; capital stock, $100,000; to construct and operate by electricity or other power a railroad and telegraph line from Jimtown to Creede or Amethyst in Saguache county, Colo., and from these towns to the mines.

Logan Telephone, Water & Light Supply company, Logan, O.; capital stock, $25,000; connecting Athens, Logan and Columbus and intermediate towns by telephone, constructing and operating waterworks and supplying light by electricity, natural or artificial gas; William P. Price, Logan, O.

Palomar Mountain Water company, New York city, N. Y. (incorporated in West Virginia); capital stock, $5,000,000; storing and distributing water for the irrigation of land in the county of San Diego, Cal., also supplying cities and towns with water, constructing and operating electric railroads, etc.; F. D. Rounds, 3482 Pine street, New York city, N. Y.

Salem Electric Light & Artificial Ice company, Limited, Salem, Washington county, Ind.; capital stock, $15,000; to light with electricity streets, alleys, and all other open air places and public and private buildings, to apply electricity and electric currents for the use of power for domestic and industrial purposes, to heat public and private buildings and manufacture ice and furnish cold storage; Eugene Haim, Salem, Ind.

ELECTRIC LIGHTING.

The superintendents of the three electric light companies of Rochester, N. Y., are conferring with the aldermen and city electrician in reference to laying the wires underground on Main and State streets.

Frank Bros., one of the Chicago firms sued by the Brush Electric company for alleged infringement of patent, have made answer in the United States court claiming that they are not now using lamps that can be considered an infringement. The defendants believe that the Sperry lamp is not an infringement.

The Philadelphia Illuminating company has filed in the Court of Common Pleas a bill against Director Windrim restricting him from awarding contracts for electric lighting during 1892, on the ground that they have not been given to the lowest bidders. The contracts were awarded to the Brush and other companies.

The recent water famine in Chicago, when the supply was shut off because the intake pipes had become clogged with ice, affected the electric light companies to some extent owing to their inability to procure water to supply the boilers. Fortunately the period of greatest scarcity occurred in the forenoon, when but few lights are burned. Those of the Chicago Arc Light & Power company's lights supplied from the Thomson-Houston station on Michigan avenue were shut down from 7 to 8:30 A M.

ELECTRIC RAILWAYS.

In addition to passengers the electric cars at Asheville, N. C., carry mail and express matter and tobacco

A company with $100,000 capital has been organized at Connellsville, Pa., by John L. Gans to build an electric road.

W. Carhill, D. E. Edwards and Henry Gund, after inspecting electric railways in various western cities, have decided to put in an electric system at La Crosse, Wis., in the spring.

It is reported, that work on the electric road at Cape May, N. J., will commence February 15th, and that the road will be completed in time for the pleasure travel of the coming summer.

The Galveston City Railway company carried 3,120,000 passengers in 1891, with net earnings of $60 000. During a large part of the year the lines were torn up to substitute electricity for animal power.

Interest has again been awakened in the construction of an electric line from Aurora, Ill., through North Aurora and Batavia, to Geneva, the county seat. There is every reason to believe that the line will be pushed in the early spring.

At a special session of the city council of Clinton, Ia., the State Electric company was relieved from its obligation to build tracks on Third street and Tenth avenue, and the time was extended in which the prescribed lines must be in operation.

An electric system to supplant the present horse car line at Walla Walla, Wash., is now practically assured, and the company has an option upon the Isaac flouring mill property, by which it intends to run the generators by water power.

Two electric cars collided in Allegheny City on the night of January 22d. The accident happened on the Manchester line, and although the passengers were badly shaken up, no one was injured. It is claimed that striking employes caused the accident by throwing over a switch.

The Short Electric Railway company has been awarded a contract by the Minneapolis Street Railway company for the equipment of the extensions to be made this spring, which will include 120 gearless motors. The Consolidated Street Railway company of Grand Rapids, Mich., has just placed an order with the same company for twenty 40 horse power gearless equipments to be used on the lines which are being changed to electricity.

The People's Electric Street Railway company of Sandusky, O., has completed the track laying from the Soldier's Home for a considerable distance toward Milan, but has temporarily suspended work on account of want of material and inclement weather. The power will be furnished by the Sandusky Electric Light company. The project to build the line direct to Milan will soon be taken up, and it is more than likely the road will be built by the first of July, as great interest is exhibited in the project.

During the great snowstorm last week the Rochester, N. Y., Railway company kept its snow sweepers and plows working all night clearing the tracks. As a result the lines were operated without delay the following morning, a novelty that greatly pleased the people. A local newspaper says: "It was generally remarked this morning that the excellent street car service was something almost unprecedented during a heavy snowstorm. At noon to-day the street car starter reported that every line was in full operation and all cars running closely on time. 'Yes,' said the starter, all our lines here in the city are running right up with the schedule. I don't believe better or more regular time could be made in midsummer. Even the Charlotte line is clear of snow, and there goes a car on that line,' added the starter, pointing to a Charlotte car headed for the lake, 'which is one minute ahead of regular time. Cars were ahead of time on that line last night at midnight.'"

The annual meeting of the Rochester Railway company was held last week. The following named gentlemen were chosen directors for the ensuing year: H. Sellers McKee, Murry A Verner, Pittsburg; Horace Magee; T. De Witt Cuyler, Richard W. Clay, Edward E. Denniston, Philadelphia; Benjamin Graham, New York; John N. Beckley, William S. Kimball, Arthur G. Yates, Hon. Frederick Cook, Marsenus H. Briggs, George W. Archer, Rochester. The directors elected the following named officers: President, John N. Beckley; vice-president, Benjamin Graham; secretary, Chas. A. Williams; treasurer, Frederic P. Allen; executive committee, Frederick Cook, H. Sellers McKee, Murry A. Verner, T. De Witt Cuyler, Horace Magee, Benjamin Graham, John N. Beckley. After the election some changes were made in the by-laws of the company, and at the conclusion of business the directors took a trip over the lines in a special car. The affairs of the company were found to be in a most satisfactory condition.

TELEGRAPH.

Storms prevailing in the vicinity of Pittsburg on January 13th played havoc with Western Union and Postal wires, and much inconvenience was caused.

In the British revenue returns for the quarter ending December 31, 1891, the telegraph service receipts amount to £645,000, as against £615,000 for the corresponding period of 1890, the increase being £30,000. For the first three-quarters of the current financial year the telegraph service receipts amount to £1,910,000, as against £1,840,000 for the three corresponding quarters of the preceding year. The increase in this case is £70,000, or 3 2 per cent.

It is stated that the great Northern Telegraph company of Canada, which some years ago entered into a contract to operate the Montreal and Dominion line for ninety-nine years, will hand over all its franchises to the Western Union company, which will in future operate the two Canadian systems. Should the Western Union obtain control of the Canadian lines a vigorous fight, it is said, may be anticipated with the Canadian Pacific company.

MISCELLANEOUS.

Electricity will be utilized in the new steel works at Newburn, England, for welding and lighting.

In a recent lecture in Chicago, Dr. Richard S. Rosenthal, teacher of languages, said: "In teaching the correct pronunciation of foreign languages the phonograph has been found to be unexcelled; in fact, the ideal teacher. The lessons recorded on the instrument by cultivated natives are perfect, and as the listener can have each sentence repeated hundreds and thousands of times, he is assured of attaining a perfect pronunciation and intonation of any and all foreign languages. Where is the living teacher who can accomplish this?" Dr. Rosenthal then invited the audience to the phonographs on the stage with their varied language lessons, and the lecture closed with twenty-four phonographs conversing in a babel of tongues to the groups gathered about each instrument.

TRADE NEWS.

Wm. Brookfield, 83 Fulton street, New York, is turning out a fine grade of standard screw glass insulators for a number of electrical stations in the far west.

The Waddell-Entz Electric company, Bridgeport, Conn., reports that the test of its storage battery made during the past forty-five days in a car of ordinary capacity, over a distance of 2,982 miles, has resulted very satisfactorily.

According to General Manager H. A. Clark of the Eastern Electric Cable company, Boston, more orders for wire for use in mining work have come in thus far this month than were received during any three months of the past year.

The Standard Paint company, 2 Liberty street, New York, is presenting its friends with a very unique vest pocket calendar, printed upon tortoise shell. The demand for the little novelty has been so great that the fifth edition has been ordered.

The Mitchell Manufacturing company of Fitchburg, Mass., expected to place incandescent lights in its factory, but after submitting the Ward arc lamp to a number of tests it was decided that better results could be obtained by using this well known lamp.

The Engineering Equipment company, 143 Liberty street, New York, has taken the agency for the metal electric light pole, which is manufactured by the Syracuse Tube company of Syracuse, N. Y., for the territory known as the Atlantic seaboard states, also for Ohio.

The Electric Construction & Supply company of New York is doing the largest January business since its organization. Prominent among its numerous orders is one for 156 arc lights for Leidman & Co., Brooklyn; one for 90 lights from Adams & Co., Buffalo, and another for 34 lights from E. F. Jeffery, New York.

The success of the Densmore typewriter has been so marked that arrangements are being made to double the capacity of the factory at once. This machine, which is manufactured by the Densmore Typewriter company of 202 Broadway, New York, has been upon the market but a few months, but the demand is so great that the company is unable, it says, to supply half of its orders. This is certainly a remarkable record, and speaks well for the excellence of the machine.

Not long ago Queen & Co., Philadelphia, placed on the market a new style of electro dynamometer which has met with great favor. By the adoption of an agate bearing instead of fiber suspension as formerly used, the element of torsion is eliminated, and greater accuracy obtained in consequence. These instruments are extensively employed as absolute standards in measuring both direct and alternating currents, and are especially suited for use in central stations as checks for the ordinary commercial ammeters.

Much practical information of a valuable character is contained in the circular entitled, "Notes on Power Plants for Electric Railways, Electric Lighting, etc.," just issued by Westinghouse, Church, Kerr & Co. The publishers announce that "it is our intention within the next twelve months to prepare a careful digest of the most intelligent practice in the important department of engineering which is the subject of this pamphlet. Such a digest will cover a mass of minor detail, which, in the aggregate, bears even more upon the dividend earning capacity of a power plant than the major items of the engine and boiler."

The C. & C. Electric Motor company of New York has opened an office at 201 Madison street, Chicago, and henceforth the western business of this flourishing company will be managed from this point. The western manager is E. E. Mandeville, who is favorably known to the electrical fraternity in the East and who will undoubtedly succeed in increasing the company's business in the West very materially. At present Mr. Mandeville's office occupies only a small portion of the space that will ultimately form the western headquarters of the C. & C. company, but after May 1st the entire store, which is 175 feet deep, with the basement, will be devoted to the company's business. A large number of the company's well-known dynamos and motors will be carried in stock, and the offices and salesroom will be attractively fitted up. No supplies will be carried, and the office will be exclusively devoted to the sale of C. & C. dynamos and motors.

The Chicago Rawhide Manufacturing company recently sold to the American Cutlery company, Chicago, an immense rawhide belt 115 feet long and weighing over 500 pounds. This belt had been in use but a few days when a fire caught in the engine room, entirely destroying the belt. An order was immediately given for its duplication, and the Rawhide company has it nearly ready to be put in place. One of the many advantages claimed for these belts, either of large or small size, is the fact that they show no static electricity. With a dry leather belt of

this size much trouble would be experienced from this cause, but the rawhide belt retains its moisture, and does not slip on the pulley. Users of large belts, who have been compelled to place a device under the pulley, with a number of fingers carrying copper wires connected with a ground, will appreciate the advantages of a belt free from this defect. The Rawhide company has sold a large number of belts to electric light and street railway companies, all of which are said to be giving perfect satisfaction.

BUSINESS.

The Security Insulator company of New York, has already received an order to furnish a large central station in the western part of New York state with its insulator.

The Standard Paint company of 2 Liberty street, New York, has opened a western office at 542 Rookery, Chicago, with P. H. Hover in charge as western manager Mr. Hover is an energetic and capable business man, and is sure to increase the western business of his company.

J. G. Beckerleg has received a diploma from the Piedmont Exposition just closed at Atlanta, Ga., for the superiority of his back pressure valve. Several estimates have recently been made for electric light and street railway systems and a number of sales have been made of the larger sizes.

The Ries Electric Specialty company of Baltimore, Md., was awarded the first premium and medal at the electrical exposition recently held at Augusta Ga., for its regulating socket for alternating current incandescent lamps. The Ries socket is being generally adopted throughout this country and abroad, and on all sides heard good words for the company.

The Easton Electric company, Brooklyn, N. Y., has just completed an installation of two thirty light Easton arc dynamos, with forty Easton arc lamps, and forty Bern stein 25 candle power series lamps, on seven circuits, for the Diamond State Iron company of Wilmington, Delaware. The iron company is said to be proud of its purchase from the Easton company as it is of the new mills.

Editor WESTERN ELECTRICIAN:

For the information of our customers will you please state in your columns that H. M. Underwood is no longer associated with either the Knapp Electrical Works, Chicago, or the Safety Insulated Wire & Cable company, New York. KNAPP ELECTRICAL WORKS,
Per M. A. Knapp, Manager.

At the annual meeting of stockholders of the Crocker Wheeler Electric Motor company, New York, the following named officers and directors were elected for the ensuing year: S. S. Wheeler, president; F. B. Crocker, vice-president and treasurer; D. H. Jeffery, secretary; R. N Peterson, S. S. Wheeler, F. B. Crocker, David Crocker, A. F. Higgins, W. B. Baldwin and F. M. Jeffery, directors.

The Hine Ellminator company, of 106 Liberty street, New York, reports a good trade notwithstanding the general depression in the machinery trade. Orders have come recently from the following concerns: Watertown Steam Engine company, East Liverpool Waterworks, East Liverpool, O ; E. C. Atkins & Co., Indianapolis, Ind ; Austin Water, Light & Power company, Austin, Tex., and Fairbanks, Morse & Co., St. Paul, Minn.

William Hood, the Chicago representative of the Accumulator company, has recently installed in his office, under the Grand Pacific hotel, a small Van Duzen gas engine to be used in illustrating the advantages of a combined gas engine and storage battery plant for isolated lighting. The Van Duzen gas engine has poppet valves, is direct acting, and has many advantages claimed for this work.

The thirty page catalogue for 1892 issued by the Eickemeyer & Osterheld Manufacturing company, Yonkers, N. Y., contains a great deal of interesting matter. It may be mentioned that this firm has recently had its apparatus put to a severe test in Lynchburg, Va., where there has been considerable snow and ice. It is interesting to note that a car fitted with the Eickemeyer standard double connected motors was used when it was desired to make a start and clear the track. The first connected car, it is said, made an ascent of a 11½ per cent. grade on Fifth avenue without the use of sand.

A very flattering indorsement of the belting manufactured by the Chicago Rawhide Manufacturing company has just been received from the East The company owning the City of Paris, the fine Atlantic liner, some time since ordered a small rawhide belt to be used in connection with the electric lighting plant on this steamship. Soon afterward another order was made, and, later another, until now the entire plant is equipped with this belting. A shipment of a large invoice of a new rawhide packing for hydraulic pumps, has also been made to this vessel by the Chicago company. The use of rawhide belting for the running of generators is attracting wide attention, its uniform tension and lasting qualities being but a few of its many advantages.

It is now practically assured that the business of the Sioux City Engine Works will be re-organized, and it is further reported that sufficient capital will be placed at the disposal of the company to conduct the business upon business methods. The old management admits that it is long since the business outgrew its capital. In spite of all obstacles, however, the sales were doubled in 1891, and at the beginning of the present year, the company had a large number of contracts upon its books, a large and valuable stock of material on hand, and excellent business prospects for the future, the only thing lacking being sufficient working capital. It is now expected that the funds will become available within ten days or two weeks.

The Pelton Water Wheel company, San Francisco, has recently furnished the Commercial Mining company of Arizona a power plant which affords a good illustration of the results that can be obtained from a small quantity of water under a high head, also showing the value which may be placed upon a water power even under such extreme conditions. The plant consists of a 4 foot Pelton wheel which runs under a 1200 foot head at 690 revolutions per minute, developing 45 horse power, using a nozzle tip 53-100ths of an inch in diameter, and also a 24 inch Pelton wheel running under the same head at 1380 revolutions, developing 20 horse power with a nozzle tip 35-100ths of an inch in diameter. These wheels are to run a concentrating and smelting plant including rock breaker, blowers, pump, etc. The pipe line is 20,000 feet in length, the upper end being 5 and 6 inch casing and the lower end 5 inch lap-weld pipe. All the water supply that can be counted on during the dry season is a flow of about 30 cubic feet per minute. The large expenditure here made in pipe line for a comparatively small amount of water, will indicate what can be done with water power even under what may be considered most unfavorable conditions.

The firm of Fraser & Chalmers, Chicago, manufacturers of mining machinery, and steam engines, has shown its readiness to recognize the merits of electricity as a power transmitter and is about to fit up the foundry and boiler shop and pattern shop in its Twelfth street works with an electric power plant. The equipment will consist of two 80 kilowatt generators, one 25 horse power, eight 10 horse power and eight 5 horse power motors, distributed throughout the various buildings. The generators and motors will be wound for 250 volts. One advantage which is expected to be derived from the use of this potential is that while the electromotive force on the motor circuits will be kept down below any possible danger mark, yet by connecting the two dynamos in series a pressure of 500 volts will be obtained which will permit of testing the various electrical machines, the motors for which are usually wound for the higher potential. Fraser & Chalmers have had this plant under consideration for some months, and the competition among the various motor companies has been keen. The C. & C. Electric Motor company, New York, was awarded the contract for the installation. It is understood that part of this plant is to be in running order within sixty days and the entire installation is to be completed within ninety days.

Experience with the Short gearless motors in actual service during the past three months has been an educational influence, not only on railway people but upon the manufacturers of electrical machinery. There is beginning to be a realization that the gearless motor is entirely feasible and economical in operation. The two 15 horse power gearless motors which operated a car at the Pittsburg convention were sent to St. Louis immediately after the convention, and attached to a long 36 foot double truck car, which was placed in regular service on the road. The Lindell Railway company has been watching for an opportunity to make a test of the power consumption of the gearless motor car as compared with that of other long cars operated by double reduction motors. On Dec. 30, 1891, and Jan. 2, 1892, tests were made under conditions so closely alike that the results are considered reliable. At 4:26 P. M., December 30th, the gearless car started from the barns on its regular trip, which was one of the heaviest of the day. At 4:55 P. M. on January 2d a double reduction car started on practically the same trip. On the outbound trip the gearless car carried twenty-five passengers and the double reduction carried forty-three, and on the inward trip the gearless carried ninety passengers, and the double reduction one hundred and three. The gearless car as before stated, was 36 feet long; the double reduction car was 44 feet long, but the difference in the weight of the motors made the cars very closely of the same weight when empty. One-quarter minute readings were made of both current and voltage on each car. On the outward trip the gearless motor took an average of 17.49 amperes, 459 volts and 10.76 horse power; the double reduction car took 21.79 amperes, 447 volts and 13.6 horse power. The gearless car made the half trip in 29¾ minutes, while the double reduction car made it in 32½ minutes. On the inward trip the gearless motors took an average of 28.32 amperes, 448 volts and 17.1 horse power, and the double reduction an average of 29 82 amperes, 442 volts and 17.67 horse power. The gearless car made the half trip in 37¼ minutes, and the double reduction in 38½ minutes. The gearless averaged 14.19 horse power for the round trip as against 15.56 horse power for the double reduction car. It may be noted that the double reduction motors with which the gearless motors were compared were of the oldest and most efficient type in the market, and are conceded by all to take less current than any other motor of the kind.

ELECTRICAL PATENTS.

Issued January 19, 1892.

467,153. Automatic Damper Controller. Ferdinand E. Chatard, Baltimore, Md.

467,160. Holder for Telephone Receivers. Richard Dent, Grand Rapids, Mich.

467,169. Filament for Incandescent Electric Lamps. Philip Hickley, Evanston

467,192. Electric Elevator. Norton P. Otis and Rudolph C. Smith, Yonkers.

This invention consists in providing a means whereby the controlling device of the motor, after being shifted to its full extent to permit the maximum power to be applied in starting, is automatically returned to a slight extent toward its mid-position and also in providing means whereby the improvement may be applied in connection with elevator engines.

467,199. Electric Arc Lamp. Josef Riedel, New York, N. Y.

467,212. Automatic Fire Alarm. George S. Tilton, Bristol, N. H.

467,215. Commutator. Henry P. White, Kalamazoo, Michigan

This invention consists of a commutator consisting of a revolvable circular head having on its surface alternating conducting and non-conducting paths on opposite halves and an unbroken conducting path, the alternating paths jogging by each other at their termini.

467,233. Process of Electric Metal Working. Hermann Lemp, Lynn, and Walter S. Moody, Chelsea, Mass.

This invention consists in a method of periodically reversing the direction of electric currents, flowing at an angle into or through the same conducting medium, with relation to one another.

467,230. Method of and Apparatus for Controlling Electric Motors and Generators. Cary T. Hutchinson, New York, N. Y.

467,239. Battery Zinc. Charles B. Schoenmehl, Waterbury, Conn.

467,240 Electric Battery. Charles B. Schoenmehl, Waterbury, Conn.

467,243. Electro Magnetic Brake. Henry E. Walter, London, Eng.

Claim five is:

"An electro magnet brake for railways composed of electro-magnets carried from the axles or axle boxes of the vehicle in such manner that both magnet poles are in a line with a fixed longitudinal conducting bar and in close contiguity to it."

467,250. Trolley for Electric Railways. Edwin R. Harding, Winthrop, Mass.

467,255. Liquid Rheostat. Hermann Lemp, Lynn, Mass.

467,259 Electric Railway Brake. Edmond Verstraete, St. Louis, Mo.

467,270. Incandescent Electric Lamp Charles H. Wilkins, Chicago, Ill.

Claim one reads:

"The combination with the bulb and filament of an incandescent lamp said bulb being provided with interior glass socket integral with the bulb and opening into the interior of the latter, of a reflecting body or core of lime or other refractory non-transparent white substance, said body or core being sustained in position within the bulb by having one of its ends inserted and secured in said socket."

467,276. Incandescent Electric Lamp. John L. Curtiss, Grand Rapids, Mich.

467,287. Automatic Cut-off for Gas Burners. James E. Hogan, Oakland, Cal.

467,297. Mechanism for Controlling the Application of Power. James F. McLaughlin, Philadelphia, Pa.

467,318. Commutator for Dynamo Electric Machines and Motors. Elihu Thomson, Swampscott, Mass.

Claim two reads:

"The combination of the disk commutator composed of sector shaped insulated sections fitted and secured together, with brushes bearing on opposite sides of the disk and oppositely acting springs connected directly or indirectly with both brushes and thereby equalizing the pressure of said brushes against the side of the disk."

467,338. Rheostat. Charles Wilms, Baltimore, Md.

Claim three reads:

"A rheostat having a body of resistance material forming a path for the current of gradually decreasing width and divided into sections by a series of collecting sectors, each extending the width of the resistance material at the plane of the sector."

467,350. Electrolytical Plant. Otto Stalmann, Anaconda, Mont.

467,358. Regulator for Electric Generators. Edwin W. Rice, Jr , Lynn, Mass.

467,372. Galvanic Battery. Fernand Gendron, Bordeaux, France.

467,448. Electric Railway. Charles J. Van Depoele, Chicago, Ill.

Claim thirteen reads:

"In an electric railway system the combination of the tracks of the railway, a line or lines of conductors above said tracks and following the line of all said tracks, and electric motors, each making an upward pressure contact with the overhead conductors, and a downward contact with the lower conductors."

467,449. Controlling Apparatus for Electric Motors. Charles J. Van Depoele, Lynn, Mass.

This invention relates to mechanism for controlling the action of apparatus at a point distant from the operator, the medium of communication being in a practically incompressible liquid which, being operated upon at one point, communicates movement to other points of the system by acting against movable parts contained within suitable chambers—as, for instance, fixed elastic diaphragms or movable pistons contained within suitable cylinders.

467,450. Electro Magnetic Reciprocating Pumping Engine. Charles J. Van Depoele, Lynn, Mass.

467 451. Reciprocating Electric Engine. Charles J. Van Depoele, Lynn, Mass.

467,465. Electric Lock. Frederick S Holmes, Boston, Mass., assignor to James W. Torrey.

Claim eight says:

"The herein described transmitting apparatus for electrically actuated combination locks consists of a circuit breaker, an electric motor, gearing connecting the said circuit breaker and motor, and a pole changer connected in circuit with the said motor and circuit breaker."

467,478. Electric Railway Signal. William F. Z. Desant, New York, N. Y.

This invention consists of a movable part geared to an electric motor located in a local circuit, in combination with a relay which controls said local circuit, and a track circuit closer which closes the relay circuit and thereby opens and closes the local circuit each time a car wheel passes it.

467,481. Electrolytical Process and Apparatus for Carrying Out Said Process. Otto Stalmann, Anaconda, Mont.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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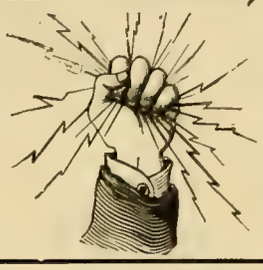

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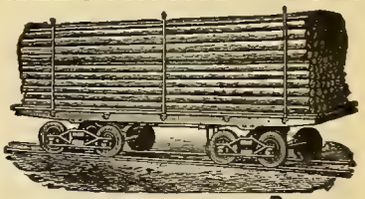

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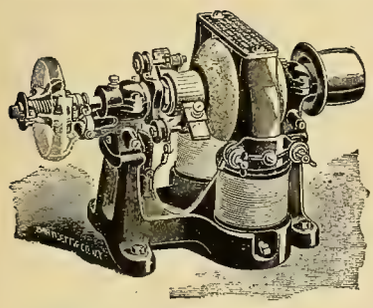

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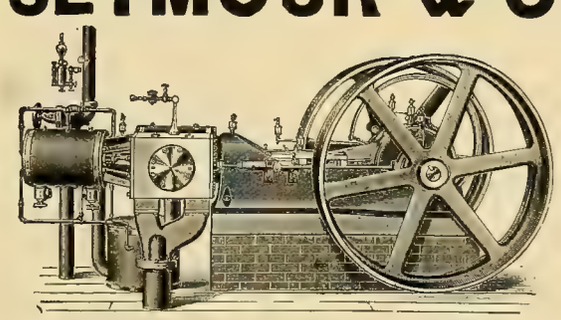

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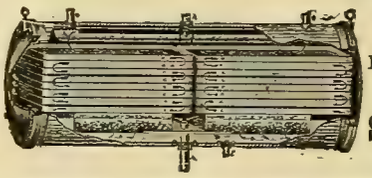

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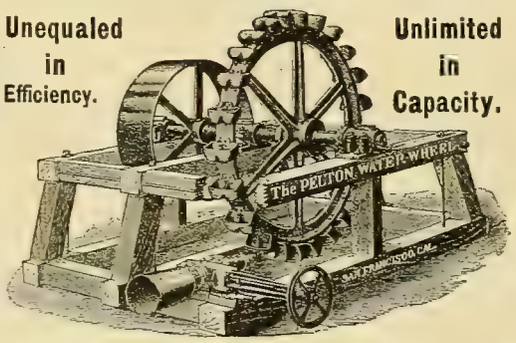

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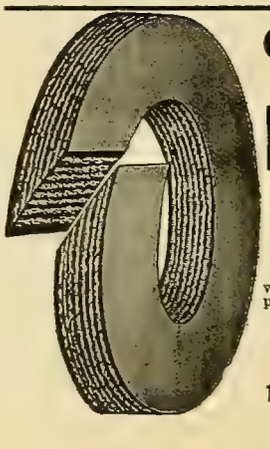

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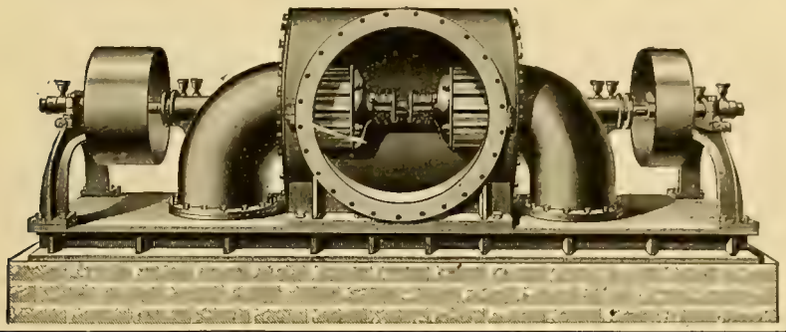

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12 inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

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MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

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FOR ELECTRICAL PURPOSES.

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Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

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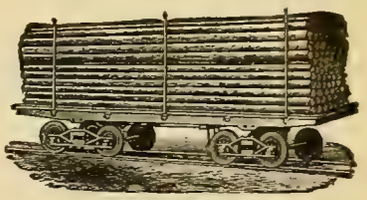

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FOR SWITCHES SWITCHBOARDS &C.
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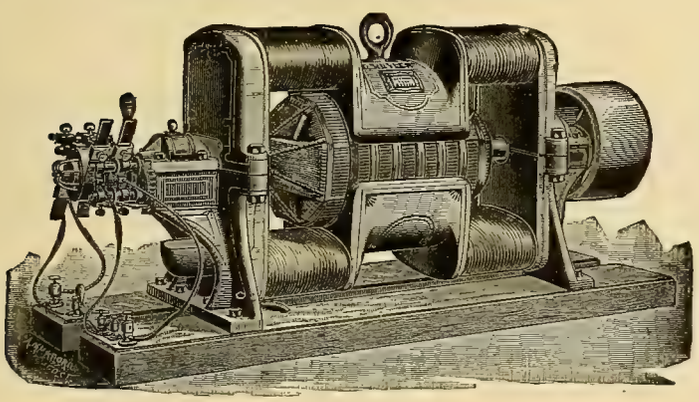
ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



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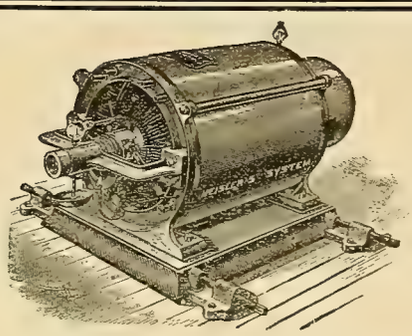

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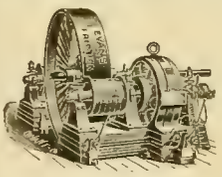

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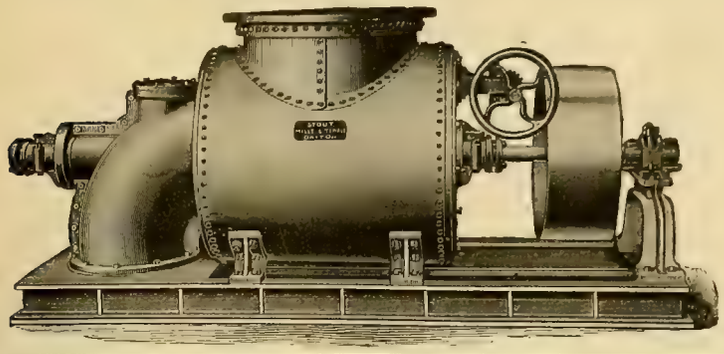

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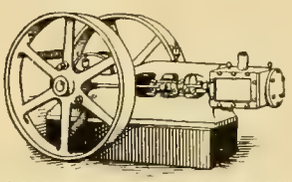

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For all purposes requiring steady power.
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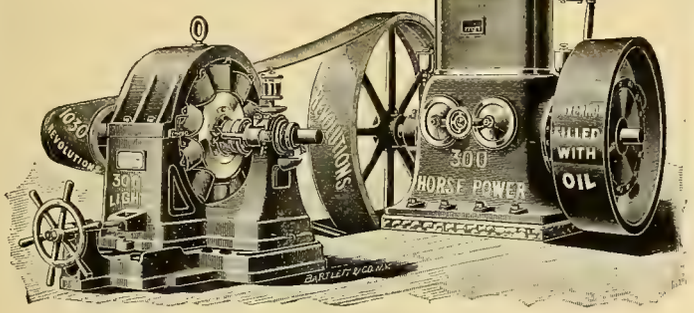

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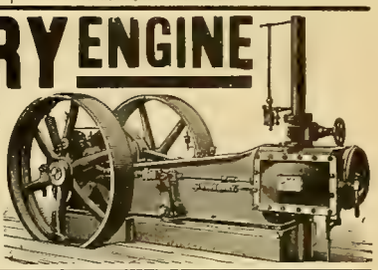

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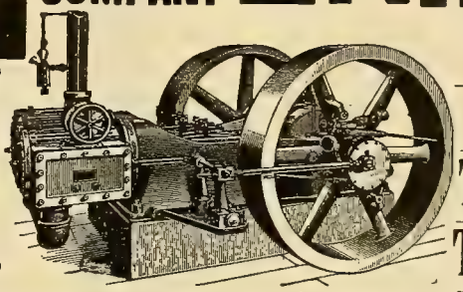

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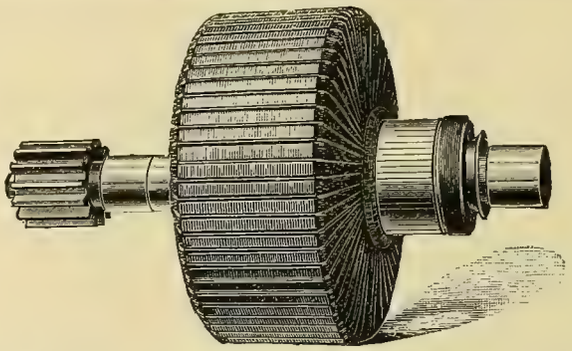

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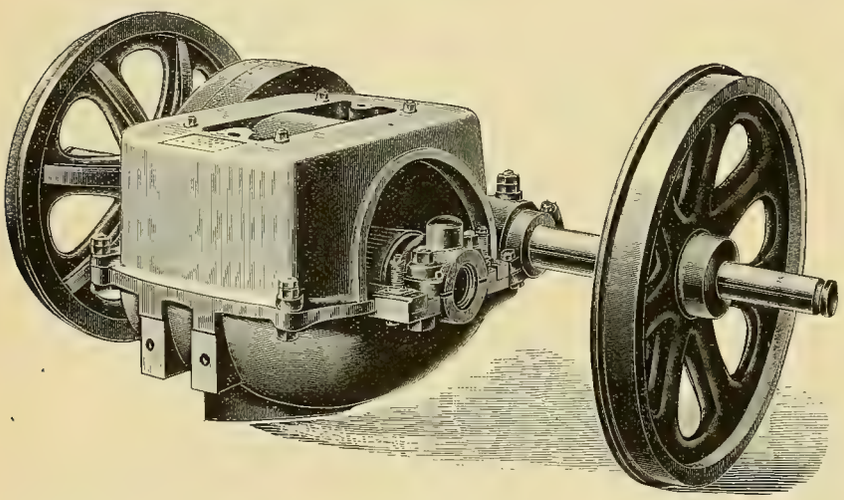

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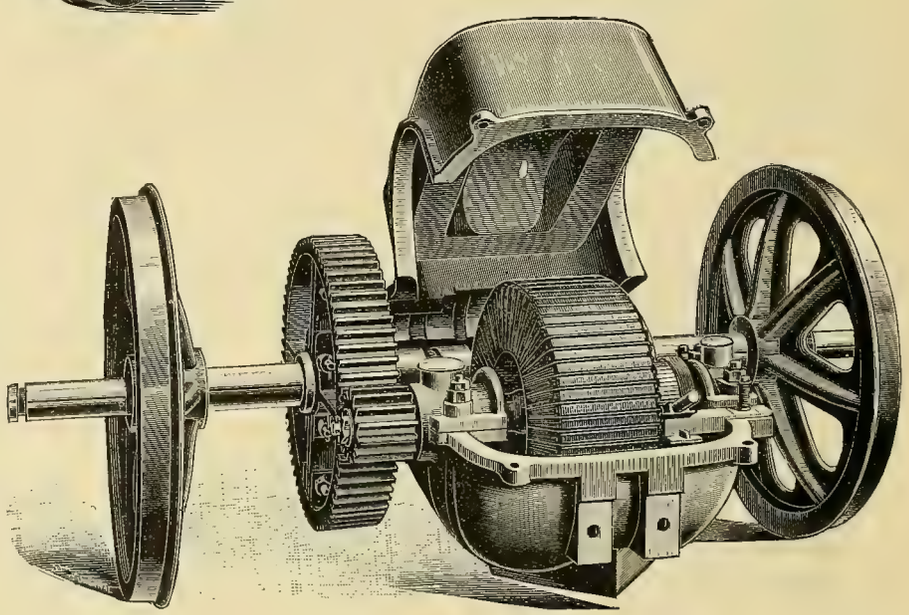

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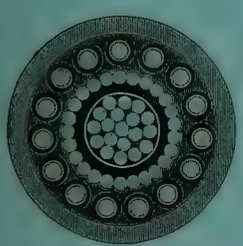
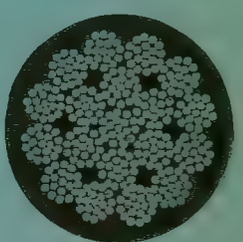
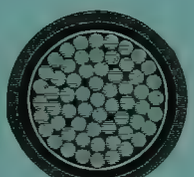
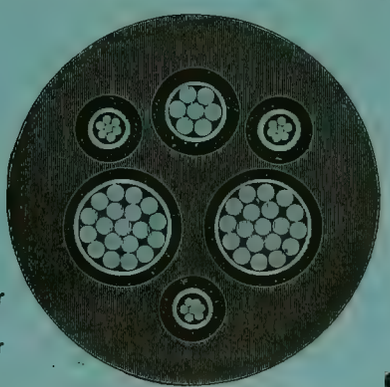
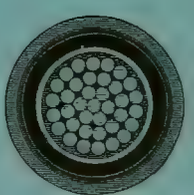

Underground Core.


Feeder Cable. Brooklyn Edison Electric Light Co.

Underground Core. N. J. Central R. R.


Feeder Core. Broadway Theater.


Submarine Work, Edison Electric Light Co., Easton, Pa.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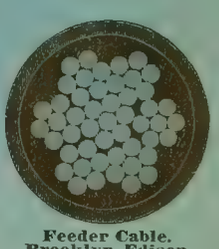
Feeder Cable. Brooklyn Edison Electric Light Co

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THE MOST PERFECT OF ANY.

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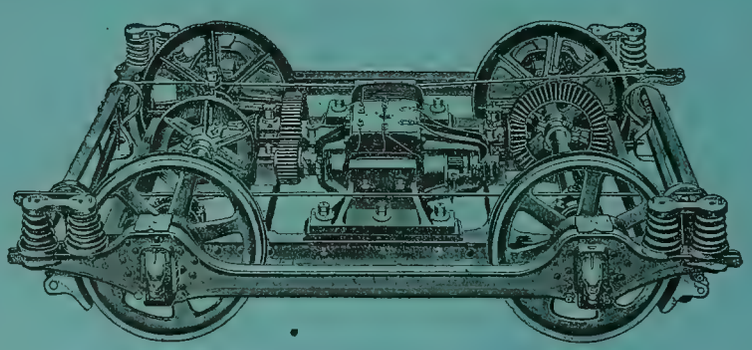

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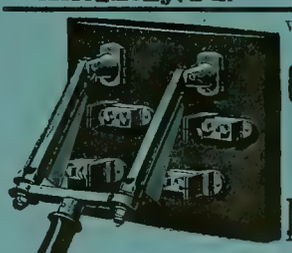

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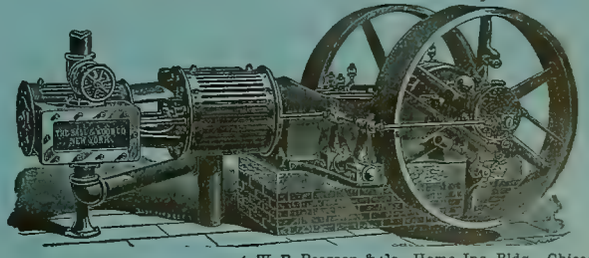

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Short Railway Generators

ARE NO LONGER A NEW TYPE. THEY ARE

STANDARD,

And the record they have made for themselves cannot be surpassed. Inquire in Rochester, Jamestown, Covington, East Liverpool, Muskegon.

The Jamestown Street Railway Company report as follows: JANUARY 6, 1892.

* * * * * * * * * * * * * * * * * * *

On Sunday morning last it commenced snowing very hard, and so continued all day Sunday, Sunday night and Monday. We were obliged to put forth every effort to prevent blockading of the road, which we succeeded in doing.

* * * * * * * * * * * * * * * * * * *

On Sunday morning we started your Generator No. 2 at 6:30 a. m, and continued to use the same until Tuesday morning at 3:30 a. m, when we shut it down. This Generator was in continuous service during the entire time, and was not even sanded, nor the brushes touched. It did not use to exceed one-half quart of oil. We consider this remarkable because of the hard work the Generator was doing. * * * * * * * *

Yours very respectfully, GEORGE E. MALLBY, Superintendent.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, OHIO.

Sometimes you forget to order

CARBONS

When you should; your supply gets low, and

YOU WANT SOME QUICK.

We are represented by the following concerns.
By ordering from the nearest one, you can

GET THEM QUICKLY.

They carry a large stock on hand.

THE WASHINGTON CARBON COMPANY,

WASHINGTON, PA.

EDISON GENERAL ELECTRIC COMPANY,

— AT —

Boston, Buffalo, Cleveland, Detroit, Cincinnati,
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FRANK S. MARR, 641 N. Broad St., Philadelphia, Pa.
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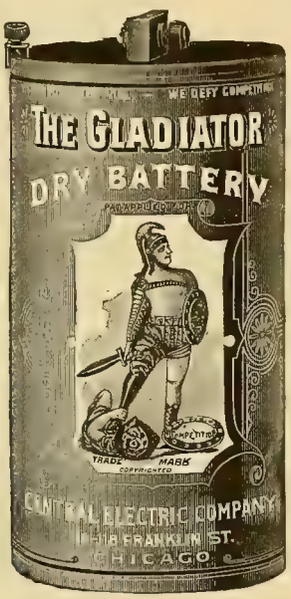
THE GLADIATOR DRY BATTERY.



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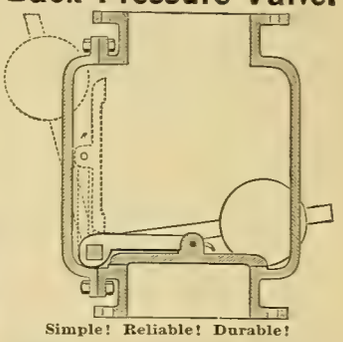

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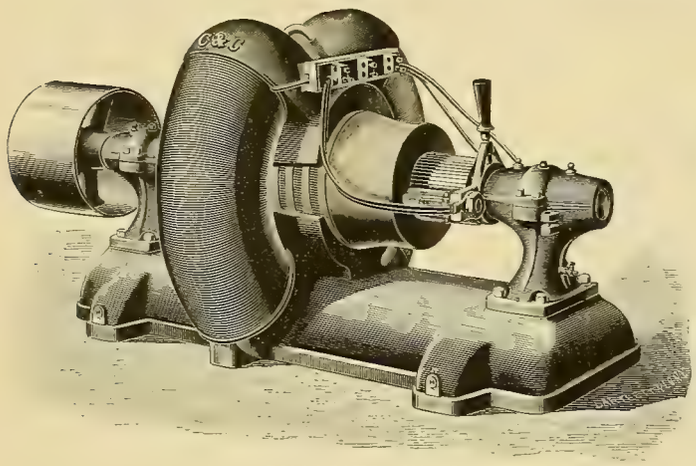

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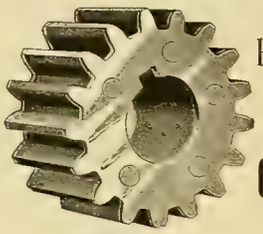

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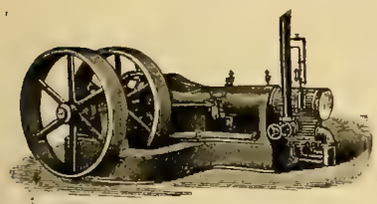

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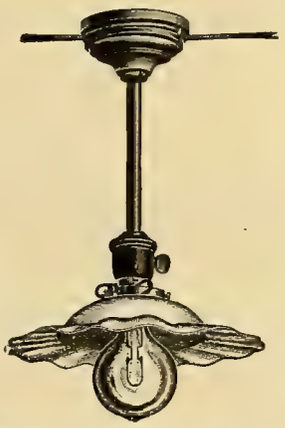

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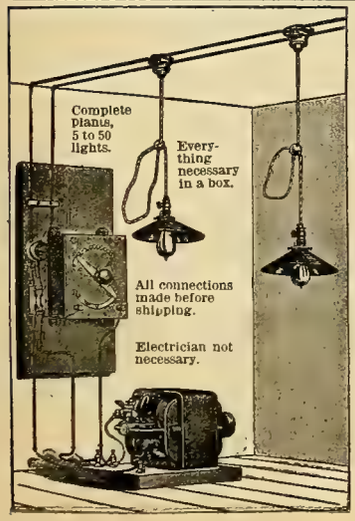

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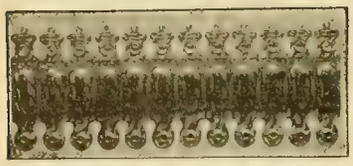

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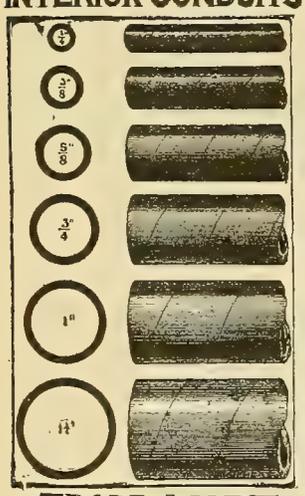

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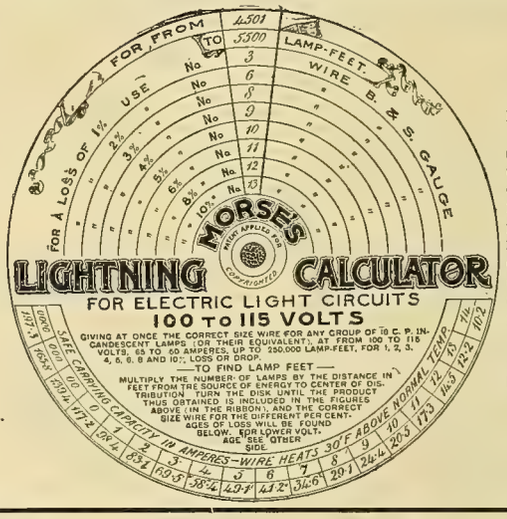

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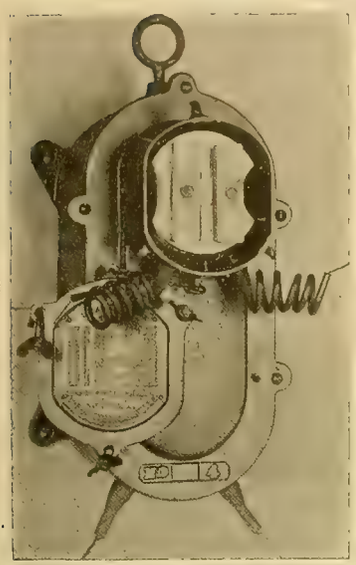

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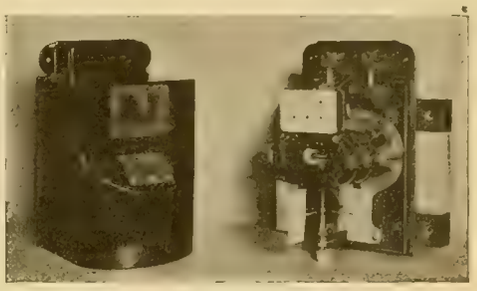

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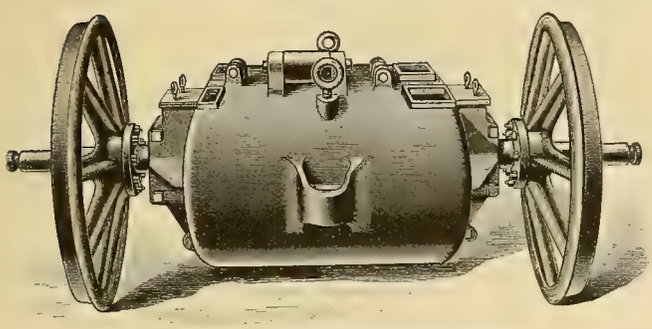

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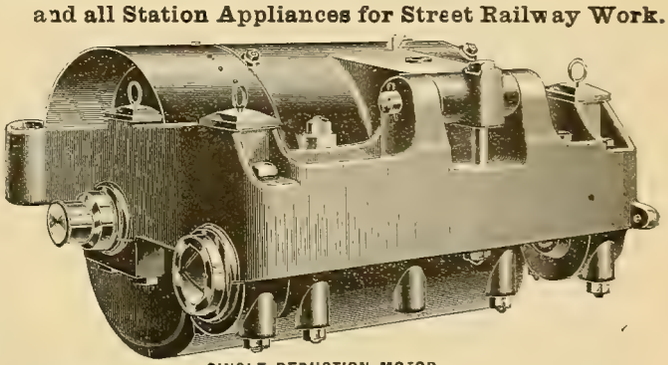

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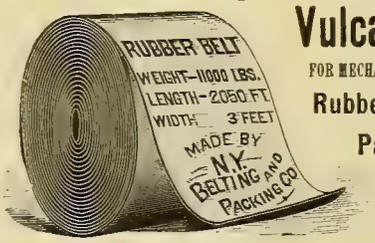

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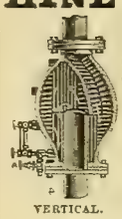
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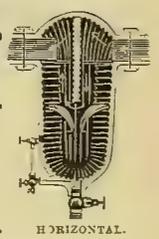
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Vol. X. CHICAGO, FEBRUARY 6, 1892. No. 6

Blowing an Organ by Electricity at St. James Church, Chicago.

Within the last few years many experiments have been made in applying cheap and efficient power for blowing organs. Steam and gas engines, though used to a limited extent, are costly to install, and, requiring skilled attendants, are expensive to maintain, and for these reasons have been applied only to a few large instruments. Beside this they are beyond the means of the church or individual owning an organ of average size. Water engines of various patterns, with power supplied from the street mains. have given the best results where the pressure was sufficient, and their use has become quite general in places where public water systems are in operation. In many of these places, though, and particularly in larger cities, the water supply is at times limited and the pressure reduced too low to make the use of the water motor for organ blowing practicable. On this acoount organ builders and users looked for some other power that would equal the water engine, and could be used with as good results. About this time the electric motor attracted the attention of organ builders and one of the leading conecrns, the Roosevelt Organ Works of New York, began experimenting with the view of adapting electric power to their instruments. The experiments were carried out under the supervision of Frank Roosevelt, and the first attempts were made with large organs having two or more bellows driven by a continuously rotating shaft connected with the motor, The regulation of the wind supply was accomplished by belt-shifting devices that stopped the action of the feeders of each bellows when the latter became filled, leaving the motor running at full speed. This last mentioned plan is now in satisfactory operation on several of the larger instruments built by this house; but it is not suitable for smaller organs on account of its expense as well as the noise attending the operation, which necessitates the location of the power plant in a separate room outside of the organ chamber.

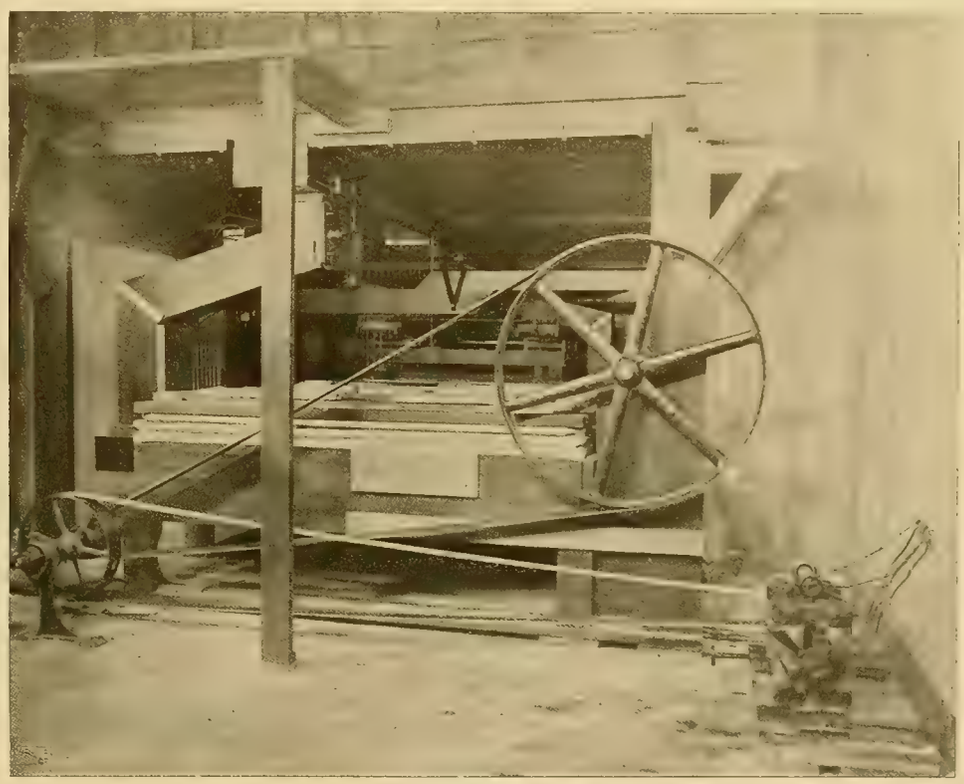


FIG. 1. BLOWING AN ORGAN BY ELECTRICITY AT ST. JAMES CHURCH, CHICAGO.

Continuing its experiments the Roosevelt Works perfected appliances by which the electric motor could be used for instruments of any size, with an operation as reliable, noiseless and efficient as the best type of water engine.

The illustrations show the improved electric power equipment as now installed by this company.

Two of the cuts are reproductions of photographs of an organ power plant just installed in St. James Roman Catholic church, Chicago.

This outfit is typical of a number in the West, and it was installed under the direction of General Agent W. J. Davis, in charge of the western business of the Roosevelt Works.

Fig. 1 shows the arrangement of the motor and regulating attachments at the rear of the organ. There is a shaft with three cranks set at equi distant angles, which lifts, in succession, each feeder of the bellows, and gives a continuous supply of wind, devoid of any unsteadiness. The starting switches are placed, as will be seen from Fig. 2, inside the case at the front of the organ, and may be easily reached by the organist.

Referring to the diagram, Fig. 3, which illustrates the wiring, the method of operation will be understood to be as follows: Wishing to start the motor, the organist closes the knife switch in the main circuit and moves the lever of the starting switch, thus closing the current through the field coils and armatures. The starting switch contains resistance which, by the described action, is put in series with the regulating switch and the armature. Further movement of the starting switch lever cuts out the resistance of the starting box, and the armature begins to revolve, moving the feeders of the bellows until the top rises and lifts the weight attached to the regulating switch lever, The regulating switch is connected with another rheostat, in series with the armature and of sufficient resistance to stop the motor when it is all in series. As the resistance of the starting switch is gradually cut out by the organist in moving the starting switch lever around the segments, the regulating switch resistance is added as the bellows top rises. The regulating lever now falls and the speed of the armature decreases, and it comes to a stop when the bellows is full. The action is less automatic, for the bellows top will fall, in a greater or less degree, as there is a demand for wind. The motor used is a one horse power 220 volt machine. It and the regulating equipment were built by the Detroit Motor company. Current is obtained from the Chicago Edison company's South Side station.

This arrangement, as perfected by the Roosevelt Organ Works, has been attached by them to organs of other builders as well as those of their own manufacture. With slight modifications the equipment is universal in its application.

National Electric Light Association.

C. O. Baker, who has charge of the transportation affairs in connection with the Buffalo convention of the National Electric Light Association, has issued the following announcement: "I have received official notification from the Trunk Line association, Central Traffic association and Southern Passenger association, stating that they have granted, from points in their territory, a fare and a third rate to Buffalo, on the certificate plan, to cover the time of our convention."

Electricity at the World's Fair.

Siemens & Halske of Berlin are evidently determined to leave no stone unturned in preparing to make a large and imposing display at the World's Fair. On Tuesday of last week A. von Siemens, a member of the firm, arrived in Chicago, and on the next day he paid a visit to Director-general Davis, to supplement the efforts of Herrn Vogel and von Babo, who have represented the house at the conferences that have heretofore been held. As has been before stated in this paper, the German firm is desirous of many concessions, some of which the directors do not see their way clear to grant, as by doing so they would create a precedent which they would be unable to follow in all cases. There is a cordial disposition, however, to encourage Siemens & Halske by accommodating them in all respects not conflicting with the general rules decided upon for the guidance of all exhibitors, and there is but little doubt that the representatives of the firm will leave Chicago with definite plans for a display that will worthily represent the importance of the house.

On Friday Herr von Siemens, accompanied by Herrn Henschell, Scharrin, Vogel and Von Babo and Dr. Berliner, visited Jackson Park under the guidance of E. E. Keller, of the department of electricity. Herr Scharrin is a Berlin architect of note who will design the artistic features of the exhibit. All the other gentlemen are connected with the firm of Siemens& Halske. The Germans were impressed with the size of the buildings and the magnitude of the preparations.

In conversation with a representative of the WESTERN ELECTRICIAN on Thursday of last week Mr. Siemens stated that the matter of a display by his firm was still in an unsettled state, and he begged to be excused from discussing the plans for an exhibit until some understanding with the authorities of the exposition had been reached. Mr. Siemens added that he expected to remain in Chicago about a week. It is understood that Siemens & Halske will pay much attention to a display of electric rail way apparatus, with an idea of securing a portion of the American trade.

Samuel Edison, the father of Thomas A. Edison, was recently interviewed in New Orleans. He is described as eighty-eight years old, tall and erect, and bearing a striking resemblance to Blaine. In response to a question relating to his distinguished son, Mr. Edison is reported to have said: "I was at Llewellyn Park less than three weeks since. Work has absorbed all the social features of life there, and in the family circle my son was but little seen during my stay. A vast space has been offered to my son in which to place his inventions for exhibition at the Chicago Fair, and preparations for the great exhibition absorb much of his time."

Twenty one roof trusses are in place on the electricity building, and the carpenter work is proceeding slowly.

It is gratifying to note the continued tendency on the part of the fair-minded men engaged in the gas industry to disown the browbeating circular of the Philadelphia Gas Alliance in relation to the World's Fair. A disposition to accord the electrical fraternity fair treatment in discussing

the question is noticeable. Thus, *Light, Heat and Power* of Philadelphia says:

We are not with the narrow minds who claim that unjust influence was used in behalf of electricity to the exclusion of gas. That an unjust discrimination was made, and according to the official records, still exists, is too plain to need discussion; but we cannot blame this upon the advocates of electrical force. They simply did all they could in behalf of the industries they represented. This was to be expected. It was their duty and they performed it without fault. It was not to be expected that they would turn aside from a single point that could be gained, and, last of all, to yield a point or press one in favor of industries that

FIG. 2. BLOWING AN ORGAN BY ELECTRICITY AT ST. JAMES CHURCH, CHICAGO.

they consider as rivaling theirs. It is true that their method of procedure was different from that adopted by the gas industries. The electrical representatives acted at once. They allowed no long waits for conventions and formal committee appointments, nor did they allow any putting aside of common good for personal notoriety's sake. And they struck even before the iron was hot. With their own methods they heated it and welded it. As a consequence, coming as a powerful auxiliary in the earlier days of uncertainty, when exhibitors were in strong demand, they won all they sought for and had granted all they could ask. We see no undue influence in all this. It was simply earnest and hard work, early and unremitting until the end was accomplished, and for all that they have won they deserve credit.

While this is not exactly an accurate statement of the facts in the case, it nevertheless evinces a spirit of justice that is commendable.

Electric Metal Working.

The subject of utilizing electricity in the working of metals has attracted more general attention than any other department of electrical development since the introduction of the telephone. It has advanced much more rapidly than was anticipated, and it may safely be assumed from the many industries in which it has acquired prominence that it will occupy a most important position. Metal workers generally will be interested in the subjoined description of the electric metal working machines, the principles governing their construction and operation, and the advancement made in the application, by S D V. Burr in *Iron Age*, from which the accompanying cuts are reproduced.

The art of electrically working metals was discovered several years ago by Professor Elihu Thomson, while lecturing before the Franklin Institute of Philadelphia, by the accidental melting together of the coarse wires of an induction coil. From this simple incident, and the train of experiments and research following quickly in its wake, has come the present development of the art.

The first machine placed in commercial operation was in July, 1888, at the wire works of John A. Roebling's Sons company, Trenton, N. J. This machine has since been in almost constant operation, much of the time night as well as day. Other machines have been added to the plant, which now consists of seven welders, adapted for various classes of wire and similar work.

Machines are in practical operation at the present time, turning out work in brass and copper, ranging from No. 16 wire gauge up to rods having a cross sectional area of 3 square inches. In steel and iron the section varies from No 16 wire gauge to a sectional area of 8¼ square inches. Experimentally, a wire $\frac{1}{100}$ inch in diameter has been welded, and, as far as the large areas are concerned, it depends more on the demand than on any limitation there may be to the process. The greatest trouble experienced in the welding of extremely fine wire is the difficulty of maintaining the abutting ends in contact. This, as it will be seen, is a job requiring extreme delicacy and one in which the wires are very apt to slip by one another. Dissimilar metals are easily united, such joints having been made between round bars of iron and brass of a diameter of two inches, and a vast variety of smaller work has been accomplished.

From the very first the navy department has taken the greatest interest in the electric welding process. In February, 1890, a board consisting of four naval officers convened at Boston under orders of the secretary of the navy to visit the works and investigate the process. A most favorable report was made recommending the general adoption of the machines both on board ships of war and in the navy yards. Welders of large capacity are now being installed at the Brooklyn and Norfolk navyyards, and other apparatus is being constructed for the navy department.

In the manufacture of carriages, wagons, etc., the process has proved of special advantage, and in some of the largest works of this character the old-time forge and hand work have been entirely superseded by electric welders. The construction of these machines and the demand they directly created in their own manufacture tended to solve some problems in engineering, reflecting the greatest credit upon those who had the work in hand. In the construction of large universal machines castings of copper

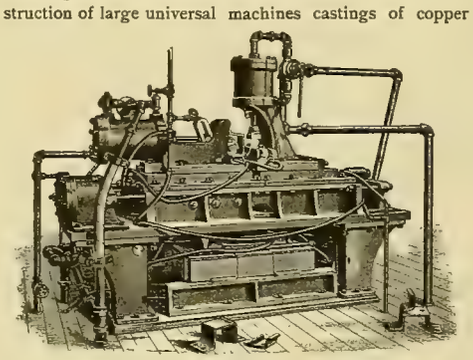


FIG. 1. ELECTRIC METAL WORKING.

have been required larger than ever before demanded for electrical purposes. Several such castings are now in the works, weighing from 1,200 pounds to 1,500 pounds each. The welding machines have been received with the greatest favor abroad, and are now doing commercial work in England and on the continent.

The following list comprises the metals, alloys and combinations which have been so far actually welded with success by the electric current:

METALS.

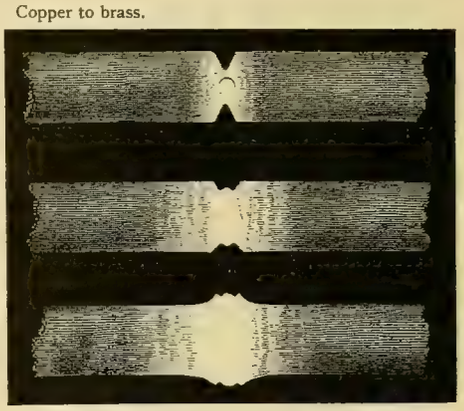
Wrought iron.	Cobalt.
Cast iron.	Nickel.
Malleable iron.	Bismuth.
Wrought copper.	Aluminum.
Cast copper.	Silver.
Lead.	Platinum.
Tin.	Gold (pure.)
Zinc.	Manganese.
Antimony.	Magnesium.

ALLOYS.

Various grades of tool steel.	Fuse metal.
Various grades of mild steel.	Type metal.
Steel castings.	Solder metal.
Chrome steel.	German silver.
Mushet steel.	Aluminum alloyed with iron.
Stubs steel.	Aluminum brass.
Crescent steel.	Aluminum bronze.
Bessemer steel.	Phosphor bronze.
Cast brass.	Silicon bronze.
Gun metal.	Coin silver.
Brass composition.	Various grades of gold.

COMBINATIONS.

Copper to brass.



FIGS. 11, 12 AND 13. ELECTRIC METAL WORKING.

Copper to wrought iron.
Copper to German silver.
Copper to gold.
Copper to silver.
Brass to wrought iron.
Brass to cast iron.
Tin to zinc.
Tin to brass.
Brass to German silver.
Brass to tin.
Brass to mild steel.
Wrought iron to cast iron.
Wrought iron to cast steel.
Wrought iron to mild steel.
Wrought iron to tool steel.
Gold to German silver.
Gold to silver.
Gold to platinum.
Silver to platinum.
Wrought iron to mushet steel.
Wrought iron to stubs steel.
Wrought iron to Crescent steel.
Wrought iron to cast brass.
Wrought iron to German silver.
Wrought iron to nickel.
Tin to lead.

Glancing through this list, it will be noticed that there are many metals, such as aluminum, lead, zinc, copper, etc., which have hitherto resisted all attempts to weld them, or when, welded, have proved to be exceeding difficult to handle.

A further application—not of the electric welding process, but a direct outcome of the work performed—is that of electric brazing and the bending and upsetting of metals. Experiments made toward perfecting the electric welding process early showed that metals could be locally heated, no matter what their shape, and could then be treated in precisely the same way as if they had been heated in the fire. This branch has been developed into an important industry, and we now find concerns utilizing the electric current for making difficult shapes, and for drawing and upsetting.

An electric welding machine requires a current of extremely low voltage and great quantity, this being what is known as the heating current. Its electromotive force being so in significant, in the largest machines being only about one volt, its power to overcome resistance is extremely

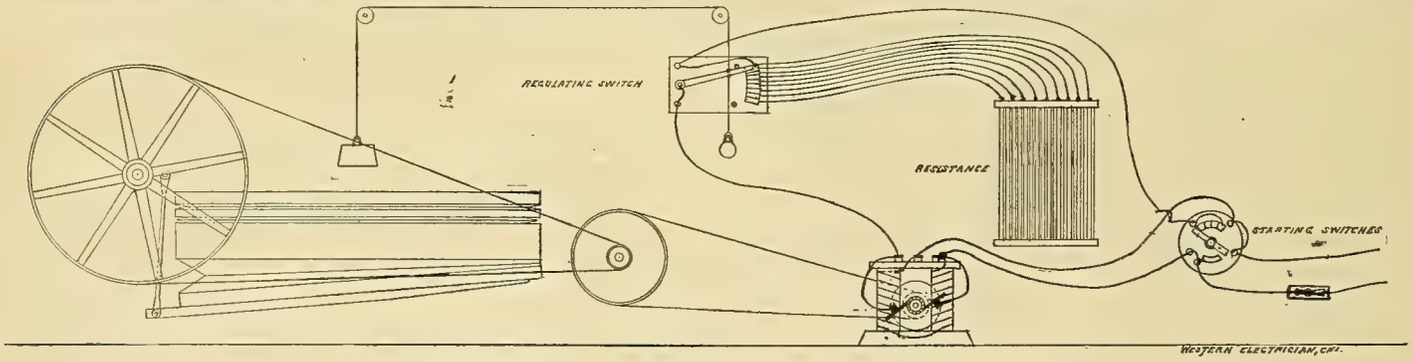


FIG. 3. BLOWING AN ORGAN BY ELECTRICITY AT ST. JAMES CHURCH, CHICAGO.

slight, while at the same time its power for generating heat in the material it is passing through is augmented.

It is evident that the slight resistance created at the point of contact of the two pieces to be welded generates heat. The phenomenon here is precisely similar to that taking place in the incandescent and arc lights, where in the former the resistance of the carbon filament causes the raising of the filament to incandescence, while in the latter case the distance between the carbon points produces the arc. It is further obvious that this resistance, supposing he pieces to be welded to be in metallic contact, varies

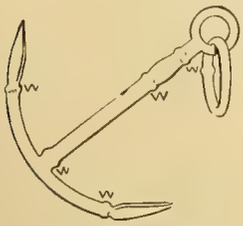


Fig. 35.—Anchor Made by Electric Welding.

Fig. 34.—Pick.

Fig. 41.—Point Welded On.

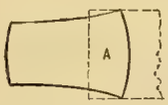


Fig. 38.—Blade Welded to Body.

Fig. 32.—U-Shape Welded to Bar.

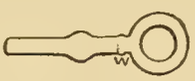


Fig. 33.—Welded and Upset

Fig. 36.—Heads Welded to Body.

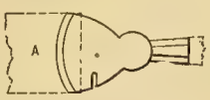


Fig. 39.—Blade and Head Welded to Body.

Fig. 40.—Point Welded On.

Fig. 42.—End of Screw Welded On.

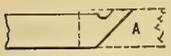


Fig. 37.—Cutting Point Welded to Bar.

ELECTRIC METAL WORKING.

directly as the conductivity of the material. It therefore becomes necessary, even in the welding of sections of wire of the same size but of different materials or composition, to vary the strength of the current.

The machine itself, by means of a transformer, changes the electric current to one of low voltage. Consequently it is essential to regulate the strength of the current by means independent of the machine. The rheostat was first employed, but as it introduced a resistance which merely served to reduce the current without any compensating work, it was wasteful. This is now formed by a reaction coil or "kicker," as it is familiarly called, the invention of H. Lemp. This consists of a ring of laminated iron, one portion of which, about one-sixth, is reduced in section to receive a coil of wire through which the current from the dynamo passes. Mounted upon a shaft placed in the center of the ring is a hood of thick copper covering the face and two sides of the ring for a distance about equal to that occupied by the coil. When this hood, which can be moved to any part of ring by a handle, is diametrically opposite the coil, the reaction in the coil is maximum and the current is reduced to the minimum. When the hood covers the coil the reverse takes place. By placing the hood at the proper intermediate point, the desired current is produced. Should a short circuit occur when the hood is near or over the coil, the increased current would throw it back, thereby bringing the coil into action, and preventing damage. Hence the name "kicker."

Electric welding has been performed by means of the continuous current, by secondary batteries, and also by unipolar machines, but the most favorable results have been obtained from the employment of the alternating current. This is due to the fact that this current can be economically produced in large volume, and easily transformed so as to have low electromotive force or voltage. The current, further than this, can be readily controlled and can be distributed at high pressure over conductors of small sections, thus permitting its transmission to a distance without much loss of energy. One of the principal obstacles arising with the use of the continuous current is that the heating will not take place with absolute uniformity in the two abutting ends. As has been observed in the case of the carbons in an arc light, the current in its passage conveys the small incandescent particles of carbon from one carbon to the other, and when the same current is applied to the heating of two pieces of metal the current acts in precisely the same way, and one is heated to a greater extent than the other.

The most convenient method of obtaining this low voltage current depends upon induction. The principle is the same as that found in the induction coil of an ordinary secondary battery, but the construction or arrangement of the two coils is reversed. An iron core is provided, and around this is a wire coil carrying the dynamo current. But the secondary coil, instead of being of very fine wire and correspondingly high resistance, as in the common induction coil, consists of a single casting of copper of the requisite shade, having a minimum resistance.

One of the first methods of transforming the alternating current into one of low voltage was that shown in Fig. 2. The current from the alternating generator passes through the coil *B*, wound around the iron ring *A*. The secondary coil *C* consists in this case of a few turns of very heavy copper wire. The large section of this wire itself of copper of very large section *C*. Later forms of transformers are shown in Figs. 4 to 10, inclusive. These give a good idea of the transformers as constructed and arranged at the present time. In each case the dynamo current is passed through the primary coil, about which is placed a solid piece of copper of large section and which serves as a secondary. It is this construction that made necessary the making of copper castings of unusual size, since it was necessary to make the secondary coil in one piece in order to obtain low resistance, which would not be possible if it were built up.

The type of transformer now used, and which has been found to give the best results, is that in which the primary and secondary coils are concentrically placed in an iron core, so as to oblige all lines of force generated by the former to cut through the latter. If the two windings are placed side by side in an iron core or upon opposite legs, as shown in Fig. 4, there is a tendency to form constant poles at the point where the two windings

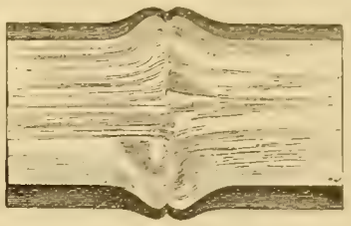


FIG. 14. ELECTRIC METAL WORKING.

meet, due to the leakage of lines of force. The leakage will depend upon the distance between the two legs and upon the length of the magnetic circuit. It has been increased and turned to advantage by Prof. Thomson for obtaining constant current in the secondary, while the primary is supplied with constant electromotive force, this construction being shown in Fig. 5. Various forms of secondary may be employed to work in accordance with this principle, some or these being shown in Figs. 6 to 10 inclusive. For mechanical reasons and convenience the forms shown in Figs. 6 and 7 are mostly used, experience having shown that there is practically no leakage. This and its short length produce an almost inappreciable electrical resistance, and this, therefore, governs the voltage of the induced current which is carried off by it. From this secondary coil *C* the current passes through the rods *E D*, the abutting ends of which are

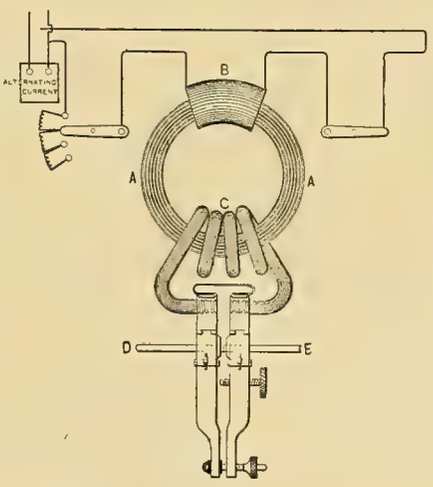


Fig. 2.—Early Type of Transformer.

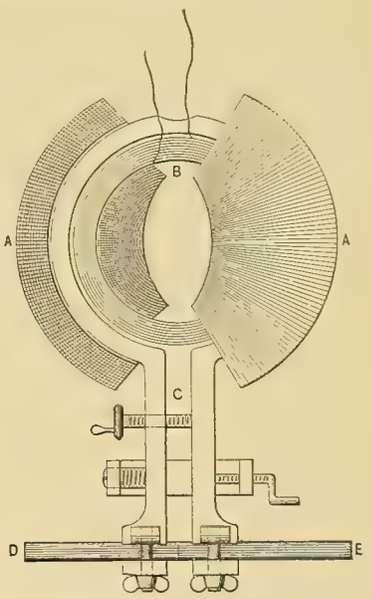


Fig. 3.—Later Type of Transformer.

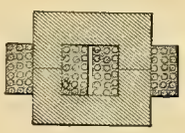


Fig. 4.

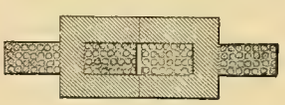


Fig 5.

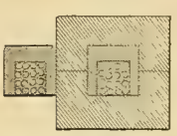


Fig. 6.

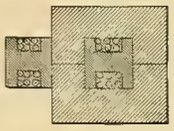


Fig. 7.

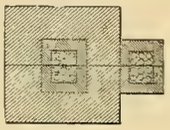


Fig. 8.

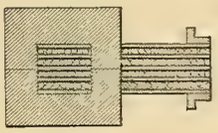


Fig. 9.

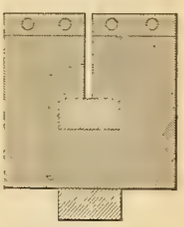


Fig. 10.

Present Types of Transformers.

ELECTRIC METAL WORKING.

welded. Another form, which came out in 1886, is shown in Fig. 3. Here the current first passes through the coil *B*, which in this case is a ring placed within the iron coil *A*, the induced current being carried off by the single loop construction also permits the removing the primary without disturbing the secondary in the least.

The transformer in the rail chair welding machine, a cut of which is presented, consists of a massive copper

casting of rectangular shape and formed with a central rectangular opening. In the opening is placed the iron core consisting of insulated sheets. In each side face of the copper casting is formed a square groove to receive the copper coils conveying the dynamo current—in this case the copper coils being formed of strips. It will be seen that the same principle is here present—an iron core surrounded by a primary coil of small strips and a secondary coil of one turn of large cross section.

In all small sections and in certain metals which fall down quickly when they approach the melting point, such as aluminum, lead, tin, etc., it is absolutely essential that the machine should be automatic. In general all electric welding consists first in bringing the two ends to be united in metallic contact, if possible, then to pass the current through them, and as the abutted ends become heated to the welding temperature, press the two parts forcibly together. In welding large sections this can be controlled by hand, since the heating is comparatively slow and the increase in temperature can be readily observed, but in small sections, and with certain metals, where there is no external evidence of heat being present, the machine is depended upon for doing the work. In welding aluminum, for instance, the two pieces are clamped between copper jaws, one of which is movable toward and from the other. The two ends being brought together, the current is turned on, and at the instant the points have been heated to a melting temperature, the movable clamp is pushed forward, the softened metal is thrown out on each side in the shape of an exaggerated burr, Fig. 43, and the electric current turned off at the same instant.

The uniformity of the result depends more closely upon the pressure applied to the movable clamp than upon any other condition. This pressure, which is governed by the size and material of the wire to be welded, should be in accordance with what we might term the plasticity of the metal when it has been brought to the proper temperature. If the current is too strong, the time necessary for welding alone would be affected, and in this case would be shortened. The pressure necessary is controlled directly by the metal itself, and therefore varies and it is only to be ascertained by actual experiment. The pressure required for steel is approximately 1,800 pounds to the square inch of section, and this, we may observe in parenthesis, explains why in the large welding machine shown in Fig. 1 hydraulic plungers are introduced in order to provide this pressure. In iron a pressure of some 1,200 pounds to the inch is required, while for copper only 600 pounds is necessary.

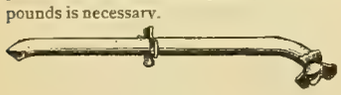


Fig. 43.—*Aluminum.*

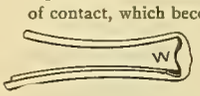


Fig. 44.—*Bicycle Tire Bent at Weld.*

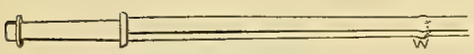


Fig. 47.—*Axl*

Fig. 45.—*Bicycle Tire.*

Fig. 46.—*Bicycle Saddle Post.*

Fig. 48.—*Dashboard Frame.*

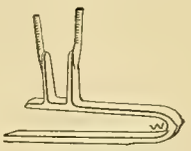


Fig. 52.—*Clip*

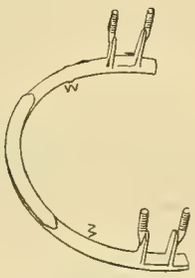


Fig. 50.—*Fifth Wheel.*

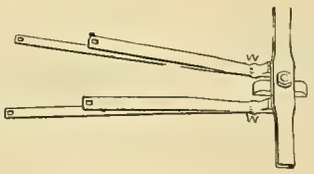


Fig. 53.—*Double Perch Frame.*

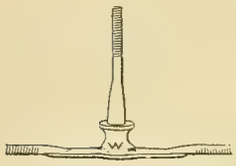


Fig. 49.—*Clip King Bolt.*

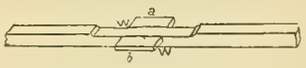


Fig. 51.—*Axle Spring Bea.*

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It is of the utmost importance to disconnect the current at the instant a weld is made. Its continuance would only result in further melting the metal and in destroying the work already done. The movement in the case of a ⅛ inch aluminum wire is about ¼ inch, the surplus matter being thrown out. Figs. 11 to 13, inclusively, show very clearly, first, the shape of the abutting ends of a steel rod of any section from ⅛ inch up to 2 inches in diameter, and also the effect produced at different stages of the process.

Fig. 15.—*Bar Welded to Disk*

Fig. 16.—*Weld in Steel Planed Down.*

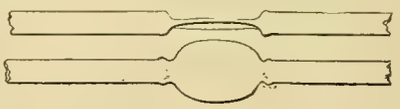

Fig 17.—*Weld Hammered Out.*

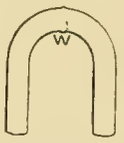

Fig. 18.—*Bar Welded and Bent at Weld.*

Fig. 19.—*Rock Drill.*

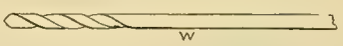

Fig. 20.—*Twist Drill, Shank Welded On.*

Fig. 21.—*Head Welded on Screw.*

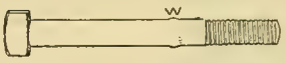

Fig. 22.—*Screw Bolt Made by Welding.*

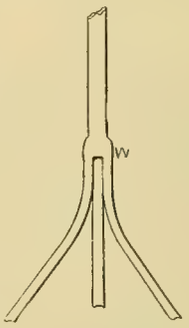

Fig. 24.—*Three Bars Welded to One.*

Fig. 23.—*Two Bars Welded to One.*

Fig. 26.—*Two Flat Bars Welded to One.*

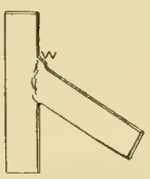

Fig. 29.—*Bar Welded at an Angle.*

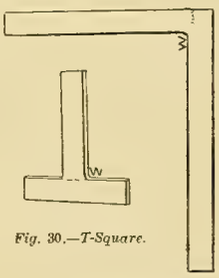

Fig. 30.—*T-Square.*

Fig. 31.—*Carpenter's Square.*

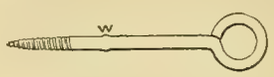

Fig. 27.—*Screw Eye Made by Welding.*

Fig. 28.—*Wrench.*

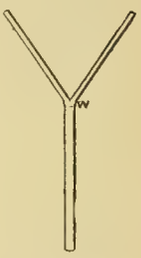

Fig. 25.—*Similar to Fig. 23.*

ELECTRIC METAL WORKING.

When the two ends have been brought forcibly in contact and the current turned on, the first indication of the passage of the current is in the change in color at the points of contact, which become a dull red and then brighter, and finally, white hot. As the conical points heat the metal is softened, so that with the pressure it gives way and the area in contact is thus gradually increased. Owing to the fact that the resistance at all points of the circular section is not the same the heating takes place unequally, and it is therefore advisable in large work, at intervals of a few seconds, to throw off the current in order that the heat already imparted to the metal may diffuse itself uniformly. When this has taken place, as can be perceived readily by the operator, the current is again turned on until an enlarged section has been heated. In this way the process continues until the entire section of the metal has been heated to a white heat, until the two parts have been forcibly pushed together, and then the operation having been completed, the current is turned off.

The appearance of the electric weld in a ½ inch steel bar after it has been planed down longitudinally is shown in Fig. 14.

The planed surface was first highly polished and then subjected to dilute acid, bringing out the grain, as shown in the drawing, which has been slightly enlarged to more clearly show the grain. It will be observed that at the point of contact the grain has been deflected radially toward the surface, but has in no case been broken up. Its integrity is very apparent, the only change being in the direction. In the case of two metals, the line of demarkation separating the two ends is very clearly defined, and has the appearance of two pieces of soft material which have been pressed together. Prof. A. E. Dolbear of Tufts College has made many hundred tests of the tensile strength of electrically welded bars of iron, steel and other metals. The results were of such a character that he stated that it was possible to weld both wrought iron and steel so that the weld is as strong as the same cross section in any other part of the bar. He had a number of bars welded by an expert blacksmith, the result being that the electrically welded bars were very much stronger than those welded by hand.

Fig. 93 represents a bar of brass and iron united by combined electric welding and a mechanical joint or dovetail, which is described further on. At and on each side of the weld, the metals were turned off slightly and then the bar was subjected to strain until ruptured, as shown in the drawing. The break was in that part of the bar which had not been reduced in diameter, proving that the joint was stronger than any other part.

Hard tool steel can be welded without destroying its good qualities. We have before stated that the heating takes place at the point of contact of the two bars and that heating can be effected locally or at any desired point in a continuous bar. This has one special advantage in that the expenditure of energy is confined directly to the point desired, and that there is no superfluous heating. In other words, a bar having been welded can be picked up within three or four inches of the weld, the temperature at that

point then being so low as to be hardly perceptible. That this is true is shown by the welding of insulated copper wires. The covering is removed, Fig. 73, for a distance just sufficient to admit the clamps. The remaining covering is not injured in the least. In welding wire cables, Figs. 71, 72 and 74, the wires are fused into a solid bar for about one inch and the hemp core charred for a like length.

The point has been frequently brought up by those not

Fig. 105.—Spiral from Machine, Fig. 101.

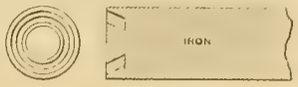

Fig. 102.—Ring Joint.

Fig. 103.—Another Form of Joint

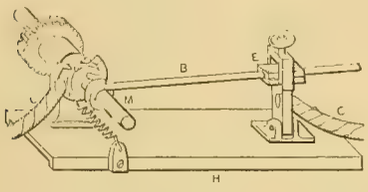

Fig. 104.—Electrically Heating and Coiling.

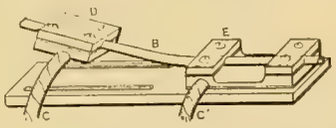

Fig. 108.—Electrically Heating and Bending.

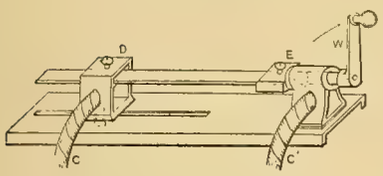

Fig. 106.—Electrically Heating and Twisting.

Fig. 110.—Shape made on Fig. 108.

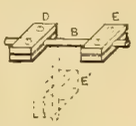

Fig. 109.—Second Step in Machine, Fig. 108.

Fig. 107.—Specimen of Twisted Metal.

Fig. 111.—Electrically Heated and Upset.

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conversant with the process that there is a certain amount of danger attending the handling of these machines. This is due mainly to the fact that it is supposed that a current of sufficient strength to bring a large section of steel to a white heat would naturally have sufficient power to create disagreeable results in the man who might be so placed as to permit any part of it to pass through him. The writer may state that he has placed his moistened fingers on the two copper clamps of an electric welding machine through which the current was passing in the act of welding two-inch steel bars. It was impossible to note any effect whatever, as there was absolutely no sensation.

One of the most recent successful applications of the electric welding process is carried on at the works of the Johnson company, Johnstown, Pa., in the making of rail chairs. A perspective view of this machine and also views of the two parts composing the chair, as well as the completed chair, are shown in Fig. 1. This machine is used in welding what may be termed the rail clamp to the top of the rail chair proper, the shapes of both of these being clearly outlined in the drawing. In the upper left-hand corner of the machine is a hydraulic cylinder, the piston rod of which is arranged so as to operate an elbow lever, the right hand arm of which, when the plunger moves forward, presses upon and firmly holds the body of the rail chair. The cylinder and the lever it operates are mounted upon a sliding base similar in many respects to the platen of a planer, which is arranged to be moved forward by means of the two hydraulic cylinders shown at the left. These cylinders are eight inches in diameter and have a stroke of about two inches, and are adapted to give a pressure of about an average of 1,800 pounds to the square inch of welding section, which in this case is about four square inches. The cylinder shown at the top and to the right is adapted to hold the rail clamp in position during the operation of welding, and also to resist the pressure brought to bear by the operating cylinders. It has been found that with the aid of this machine rail chairs can be economically produced, and that the integrity of the weld can be relied upon implicitly.

The arrangements of the small drawings representing what has been done in electric welding in a practical way up to date has been with a view of grouping them according to the shape and material operated upon, without any reference to the application of the process to any particular industry. Fig. 15 shows a bar or standard welded to the center of a disk. Fig. 16 is similar to Fig. 14, and is intended to show that the line of demarkation separating the two pieces welded is absolutely unperceivable unless, as stated before, the plain surface is first polished and then treated with acid. Fig. 17 shows an electric weld which has been hammered down, the edge and flat view of the welded portion being represented. This is intended to illustrate the perfect continuity at the point of welding. Fig. 18 represents a bar which has been welded straight and then curved at the weld. Figs. 19, 20, 21, 22, 27, 28, 33 and 34 represent various applications of electric welding in straight and bar work, and where, as in the case of the drill, Fig. 20, the rock drill, Fig. 19, and the pick, Fig. 34, it is essential to make the cutting point of tool steel and the shank of softer metal. Figs. 26, 29, 30, 31 and 32 show the welding of different shapes. Fig. 23 shows two bars which have been welded to the end of one bar, Fig. 25 representing the same shape, but with the legs spread. Fig. 24 is the same construction except that three bars have been welded to the end of one. Fig. 35 is an anchor made by the welding process, there being, as indicated by the letter *W*, five welds.

In the drawings Figs. 36 to 42, inclusive, another branch of electric welding is shown which consists in adding to a body of soft material a short length of hard steel, the additional portion being represented in each case by the letter *A*. In the case of the hammer, for instance, Fig. 36, the body is first formed and then material for the two heads is added from a bar of steel by an electric weld, the proper lengths being afterward cut off. In the same way the axe blade, Fig. 37, the trammel point, Fig. 40, the plum bob point, Fig. 41, the lathe tool, Fig. 37, the hatchet blade and head, Fig. 43, and the dog clamp, Fig. 42, being provided in a similiar fashion.

Figs. 44 to 46 represent where the electric welding process has come into the manufacture of bicycles. Fig. 45 is a drawing of the *U*-shaped bicycle tire, showing the weld. In this work it has been found that the operation of welding can be performed more expeditiously, more economically and with far greater success than with any other known method. In this it is particularly true that during the operation of welding, the operator not only knows whether he will make a successful joint or not, but he is also informed, as we might say, of the nature of the material during the work, and is therefore in a position to act in a certain sense as an inspector. Fig. 44 shows where the tire has been bent at the weld, and is intended merely as an illustration of the perfect condition of the pieces at the point. The standard carrying the seat in some bicycles consists of a tube in the upper part of which is held a spring frame carrying the seat. This is shown in Fig. 46, where the parts are ready for brazing.

We may here state that brazing operations are carried on by aid of the electric current in a far more advantageous way than with the ordinary furnace. The work being prepared, as shown in the drawing, a few turns of thin wire are wrapped around the entering bar, then the whole thing is placed in the welding machine, the result being that the wire melts, flows down and effectually seals the joint. In the ordinary way where a flux is used the work for a considerable distance each side of the joint is tarnished and more or less time is therefore necessary in order to clean it. With the electric process the joint is kept clean, and there is little work to be done after the brazing has been perfected.

Figs. 47 to 55 represent the position now occupied by electric welding in carriage work. It is in this industry that the method has been found to be peculiarly valuable, since the material, form and dimensions of the iron work entering a wagon lend themselves readily to the process. Beginning at Fig. 48, these drawings show the weld in first, the dash board frame, clip king bolt, fifth wheel, axle, spring bed, clip, double perch frame, carriage step and seat frame. In making the axle spring bed, Fig. 51, the two pieces *a b* are welded to the side of the axle.

The method of making a metal wheel by the welding process is shown in Figs. 56 and 57. The hub and the two rings *c c* are shaped as indicated in Fig. 57, the spokes being entered in the recesses provided for them, as indicated by dotted lines. The hub is then clamped in the welder, the resulting wheel being shown in Fig. 56. This method increases the strength and durability of the wheel, and at the same time makes possible the employment of lighter material.

Upsetting a collar on an axle or similar bar is shown in

Fig. 61.—Old and New Telegraph Wire Splice.

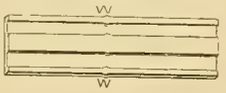

Fig. 62.—Welded Shape.

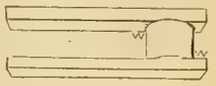

Fig. 63.—Two Bars Welded to Block

Fig. 64.—Thin Strip Welded.

Fig. 65.—Thin Strip Welded.

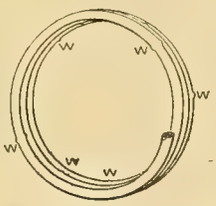

Fig. 66.—Coil of Pipe with Welded Joints.

Fig. 67.—Pipe Tested to Rupture.

Fig. 68.—Pipe.

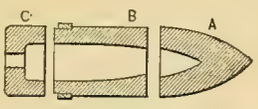

Fig. 76.—Projectile Ready for Welding.

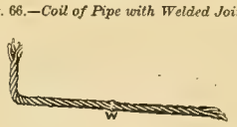

Fig. 71.—Wire Cable.

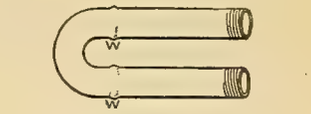

Fig. 69.—Cast-Iron Return Bend Welded to Wrought-Iron Pipe.

Fig. 77.—Projectile after Welding

Fig. 72.—Wire Cable.

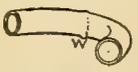

Fig. 70.

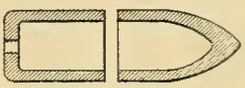

Fig. 78.—Projectile Formed of Two Parts.

Fig. 75.—Cable with End Welded to it.

Fig. 73.—Insulated Wire Welded.

ELECTRIC METAL WORKING.

Figs. 58 to 60. The separate parts are first arranged as shown in Fig. 60. The current is then passed through the bars, which are forced together, the result being as represented in the section Fig. 58, and the side view, Fig. 59. The old and new telegraph wire splice is represented in Fig. 61. The welding of a shape of peculiar section is represented in Fig. 62. The ends of two bars of rectangular section welded to the cylindrical piece is shown in Fig. 63. One of the most difficult operations to perform successfully by any method of welding is that of uniting wide flat strips of thin metal. This is shown in Fig. 64, the drawing of which was made from a piece 3-64 inch thick and 1½ inches wide.

Pipe welding is shown in Figs. 66 to 70, Fig. 67 representing a pipe which has been tested to rupture and shows that the break was stopped at the weld. Fig. 69 shows a return bend of cast iron, welded to lengths of wrought-iron pipe for refrigerator work. A peculiarity of the welding of pipes is the fact that the burr is only on the outside of the pipe, the tendency, when the metal has been heated and then pressed together, being to force the surplus metal outward. Provision has been made for removing the outside burr by means of a pneumatic hammer. A practical application of pipe welding by electricity has been made in the making of coils of very long lengths of pipe. In this method the welder is carried upon a car, during the movement of which forward a new length of pipe is welded to the preceding length. From the welder the pipe passes through a heating furnace and is heated to the proper temperature in order to be wound in a coil around the mandrel. Following the welder is a testing apparatus which tests the pipe after each joint has been made. In this way pipes of any length can be made and the joint readily bent. Figs. 76 to 78 show the electric welding process applied to the manufacture of projectiles. In the first view the point *A* and the base *C* are welded to the cylindrical body *B*, the perfected shell being shown in Fig. 77. Another method of making the shell is shown in Fig. 78, the shell here consisting of but two parts.

Figs. 71 to 74 show the welding of wire cables, Fig. 75, showing where a piece has been welded to the end of a cable in order to prevent fraying. As was stated previously, the welding process converts about 1 inch of the cable into solid metal, and if a hemp core be present, it chars it for a like distance. Figs. 79 to 82 represent chain and circular work, the points of welding being indicated. Fig. 83 shows one of the eyes of an eye bar. Fig. 88 represents a portion of a circular saw of

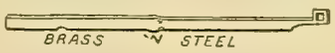

Fig. 90.—Typograph Lever.

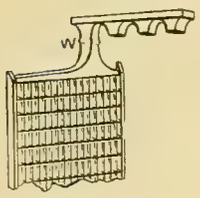

Fig. 95.—Lead Plate for Storage Battery.

Fig. 96.—Mechanical Joint and Electric Weld.

Fig. 99.—Another Form of Joint—Dovetail.

Figs. 90 to 94. A difficult task, and one not possible with any other process, is the welding of storage battery plates of lead, as shown in Fig. 95.

A combination weld and mechanical joint is shown in Figs. 96 to 103. It will be noticed that the end of the iron bar is so formed that the brass bar to which it is intended to unite it will constitute a mechanical joint or dovetail after the ends have been brought together, and subjected to the welding process. Several forms of making the dovetail are shown, Fig. 98 being a sectional view

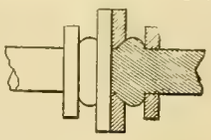

Fig. 58.—Section, Showing Upset Collar Finished.

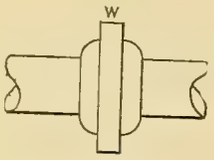

Fig. 59.—Upset Collar.

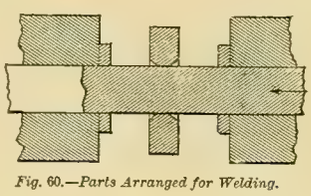

Fig. 60.—Parts Arranged for Welding.

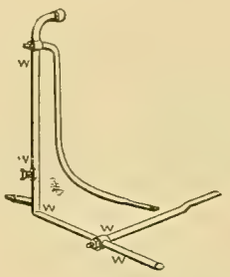

Fig. 55.—Seat Frame

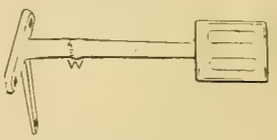

Fig. 54.—Carriage Step.

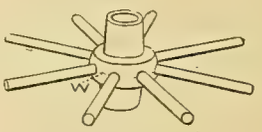

Fig. 56.—Wheel Formed by Electric Welding.

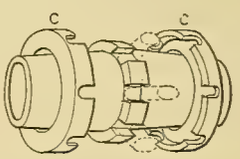

Fig. 57.—Parts of Wheels Assembled for Welding.

ELECTRIC METAL WORKING.

at the weld and being intended to show that the brass flows in so freely as to completely fill the grooves cut in the iron. In arranging these pieces for welding the clamps in the machine are so adjusted that the iron is first heated a short distance from its points of contact with the brass. The heat then follows by conduction along the iron and gradually increases the temperature of the abutting bar. After the brass bar has become heated thoroughly it begins to flow, and as the two parts are pressed together the metal

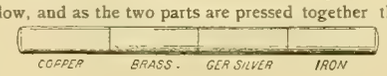

Fig. 91.—Welding Different Metals.

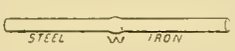

Fig. 92.

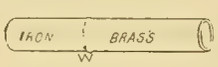

Fig. 94.

Fig. 93.—Bar Broken, but not at Weld

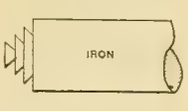

Fig. 97.—Form of Iron End.

Fig. 98.—Section Showing Weld and Joint.

Fig. 100.—Dovetail Joint.

Fig. 101.—Threaded Joint.

specified length, to each end of which is welded a brass extension, which serves as a guide.

The heating and bending of metals and their upsetting are represented in the remaining figures, Figs. 105 to 111. In the machine shown in Fig. 104 the metal to be coiled is placed in the clamp *E* and attached to the mandrel *M*, the current passing through the conductors *C C*. After having been heated to the proper degree, the mandrel is turned, the result being a coil, as shown in Fig. 105. Fig. 106 is practically the same arrangement, except that the clamp *E* is provided with a handle by which it may be turned in order, after the strip has been heated, to form the twisted shape shown in Fig. 107. Bending of the bar *B* after it has been heated is shown in Fig. 108, where the clamp *D* is movable, the second operation after the bar *B* has been bent to a right angle being shown in Fig. 109, the result being shown in Fig. 110. Fig. 111 represents a bar which has been heated and then upset.

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large size, in which a new tooth has been placed by the electric process. Fig. 89 shows the welding of a couple of band saws, large and small sizes. The fifth wheel shown in Figs. 84 to 87 is formed of three parts, shown in the first three figures. The shell consists of two channel sections, Figs. 84 and 86, in which are held rollers, the completed wheel being as presented in Fig. 87.

The welding of different materials together is shown in Figs. 90 to 94. A difficult task, and one not possible with any other process, is the welding of storage battery plates of lead, as shown in Fig. 95.

A combination weld and mechanical joint is shown in Figs. 96 to 103. It will be noticed that the end of the iron bar is so formed that the brass bar to which it is intended to unite it will constitute a mechanical joint or dovetail after the ends have been brought together, and subjected to the welding process. Several forms of making the dovetail are shown, Fig. 98 being a sectional view flows down, fills the grooves cut on the iron end completely and makes a perfect mechanical joint, which is independent of the uniting of the two ends together by fusion. This joint, as explained and as shown in Fig. 93, possesses greater strength than the weaker metal of which it is composed. This method has been found of great convenience in the manufacture especially of reciprocating electric engines, where it is desirable to have a soft iron core of a

The Law of Hysteresis.[1]

By Charles Proteus Steinmetz.

Part II.

As before said, the first sets of tests were made on the magnetic circuit of a small Westinghouse converter.

The constants of this converter, so far as they are of interest here, are:

Mean length of magnetic circuit, 21 cm.

Mean cross-section of magnetic circuit = 43 67 cm.[2]

Hence volume of iron = 917 cm[3].

Resistance of secondary coil = .2 ω.

Further sets of readings were taken on a magnetic circuit, built up of very thin sheets of iron, alternately 8 in. × 1 in. and 3 in. × 1, in rectangular shape, very carefully insulated against eddy currents, with layers of thin paper between the sheets. On the two long sides two coils of each 50 turns, very coarse wire (3 No. 10 in parallel), were wound and connected in series, thereby giving $n = 100$ turns of an internal resistance of .048 ω.

Here the mean length of the magnetic circuit was $l = 41$ cm.

The cross-section, $s = 3.784$ cm.[2]

The circuit consisted of 58 layers of sheet-iron of the thickness $s = .02577$ [2] and the width $w = 2.579$.

The whole volume of iron was = 155 cm.[3]

The sheet iron pieces were first freed from scales by dipping into dilute sulphuric acid.

In one set of tests an open magnetic circuit was used, by leaving the short end pieces (3 in. × 1 in.) off, and using two piles each of 66 pieces (8 in. × 1 in.) of the same iron, the same pieces as used in the former closed circuit tests.

In these readings, for the determination of the hysteretic loss, only voltmeter and wattmeter, but no ammeter, were used, and the susceptibility curve determined separately by voltmeter and ammeter.

The calculation of the readings was done in the following way:

After applying the corrections for self-induction of instruments, resistance and speed, the readings were reduced to lines of magnetic force per square centimeter B and consumption of energy by hysteresis per magnetic cycle H, in ergs.

Then the results were plotted on cross-section paper and if any value was found to be very much out of the curve connecting the other values, it was stricken out as evidently erroneous, not considering it worth while to determine whether it was a wrong reading of any one of the instruments or mistake in the calculation.

Then from the other values of B and H, under the sup-

1. Read before the American Institute of Electical Engineers, Jan. 19, 1892.

2. Calculated from the weight.

position that H were proportional to any power x of B:

$$H = \eta B^x$$

this exponent x was determined.

The value x will be seen always to be so near to 1.6 that 1.6 can be considered at least as first approximation to x.

Then, under the assumption

$$x = 1.6$$

hence

$$H = \nu B^{1.6}$$

the coefficient η was calculated, and now the equation

$$H = \eta B^{1.6}$$

plotted in a curve, as given in the figures, and the observed values of H drawn in and marked.

From the curve were taken the calculated values of H, corresponding to the observed values of B, the difference $H_{calc} - H_{obs}$ determined, and expressed in per cents. of H_{calc}.

These values are given in the tables, and shown in the curves.

I. Magnetic Circuit of the Westinghouse Converter.

Fig. 2—Table II.

MAGNETIC CHARACTERISTIC.

F = Magneto motive force in ampere turns per centimeter length of magnetic circuit.

Fig. 79.—Chain Link.

Fig. 80.—Star Welded at Each Bend.

Fig. 83.—Eye Bar.

Fig. 82.—Flat Link.

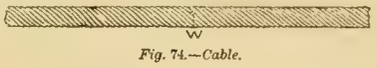

Fig. 74.—Cable.

Fig. 81.—Chain.

Fig. 88.—Tooth Welded in Circular Saw.

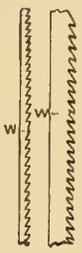

Fig. 89.—Band Saws Welded.

Fig. 84.

Fig. 85.

Fig. 86.

Parts of Fifth Wheel.

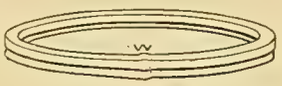

Fig. 87.—Fifth Wheel.

ELECTRIC METAL WORKING.

B = Magnetization, in lines of magnetic force per square centimeter.

Table II. (1)

F.	B.	F.	B	F	B.
2	1500	12	14,750	45	18,150
3	3400	14	15,080	50	18,500
4	6800	16	15,370	55	18,820
5	9000	18	15,630	60	19,140
6	11,750	20	15,880	65	19,440
7	12,850	25	16,450	70	19,740
8	13,600	30	16 9 0	75	20,020
9	14,100	35	17,370	80	20 300
10	14,350	40	17,780	85	20,560
				90	20,820

B = Magnetization in lines of magnetic force per square centimeter.

H = Loss of energy by hysteresis, in ergs per cycle, and cubic centimetre = 10^{-7} watt-second.

Table II. (2)

Frequency: $N = 28$ complete periods per second.

B.	H. obs	H. calc.	H. − H. = calc. obs.	%
3510	1178	1160	−18	−1.6
10,560	6286	6610	+324	+4.9
13,800	10,286	10,180	−106	−1.0
17,040	15,357	15,600	+243	+1.6
		av:	±173	±2.3

Exponent of power, derived from tests:

$$x = 1.6111 \sim 1.6$$

Coefficient of hysteresis:

$$\eta = .002410$$

hence, theoretical curve:

$$H = .00241\ B^{1.6}$$

Table II. (3)

Frequency: $N = 36$ complete periods per second.

B.	H obs	H. calc.	H.—H. = calc. obs	%
7090	3333	3500	+167	+4.8
10,250	5067	6310	+643	+10.2
13,410	9694	9700	+6	+.1
17,080	14,417	14,480	+67	+.1
19,340	16,111	17,600	+1489	+9.4
		av:	±464 =	±4.4

Exponent of power, derived from tests:

$$x = 1.6476 \sim 1.6$$

Coefficient of hysteresis:

$$\eta = .002315$$

hence, theoretical curve:

$$H = .002315\ B^{1.6}$$

Table II. (4)

Frequency: $N = 137$ complete periods per second.

B.	H obs.	H. calc	H. — H. = calc obs	%
4000	1499	1419	− 80	−5.7
4670	1818	1800	− 18	−1.0
5510	2358	2350	− 8	− .3
5760	2482	2581	+ 38	−1.5
5 40	2540	2583	+ 40	+1.6
6600	3285	3180	− 105	−3.3
6800	3338	3293	− 68	−2.1
6860	3374	3370	− 4	− .1
12,430	8336	8610	+ 274	+3.6
13,750	10, 000	10,100	+ 100	+1 0
		av:	±73 5 =	±2 0

Exponent of power, derived from tests:

$$x = 1.3887 \sim 1.6$$

Coefficient of hysteresis:

$$\eta = .002438$$

hence, theoretical curve.

$$H = .002438\ B^{1.6}$$

Table II. (5)

Frequency: $N = 205$ complete periods per second.

B.	H. obs.	H. calc	H—H. calc—obs.	%
1790	376.	400	+24	+6.0
1990	463	460	− 3	− .7
2380	585	620.	+35	+5.7
2620	735	720	−15	−2.1
3060	893	920	+27	+2.9
3390	1054	1100	+46	+4.2
3660	1297	1240	−57	−4.6
3710	1288	1250	−38	−3.0
4620	1822	1800	−22	−1.2
5070	2024	2070	+46	+2.2
4990	2034	2010	−24	−1.2
5910	2663	2620	−43	−2.8
6100	2844	2750	−96	−3.5
6550	3039	3080	+41	+1.3
7290	3673	3640	−33	− .9
8050	4341	4300	−41	−1.0
8320	4410	4530	+120	+2.7
8240	4561	4460	−101	−2.2
		av:	± 47	= ±2.7

Exponent of power, derived from tests:

$$x = 1.6012 \sim 1.6$$

Coefficient of hysteresis:

$$\eta = .002434$$

hence, theoretical curve:

$$H = .002434\ B^{1.6}$$

From these 4 sets of readings, we get the results:

1.	$N = 28$	4 readings:	$x = 1.6111$	$\eta = .002410$
2.	36	5	"	1.6476	.002315
3.	137	10	"	1.5887	.002438
4.	205	18	"	1.6012	.002434

Therefrom we derive the average, by giving to each value as weight the number of readings, where it is based upon:

$$x = 1.60513 \sim 1.6$$

$$\eta = .0024164$$

Hence:

$$H = .0024164\ B^{1.6}$$

This curve is used for calculating the values given as H_{calc}, and is plotted in Fig. 2 in drawn line.

The observed values of H are drawn in Fig. 2:

1. For N = 28 with the mark ×
2. " 36 " " ▲
3. " 137 " " ●
4. " 205 " " ■

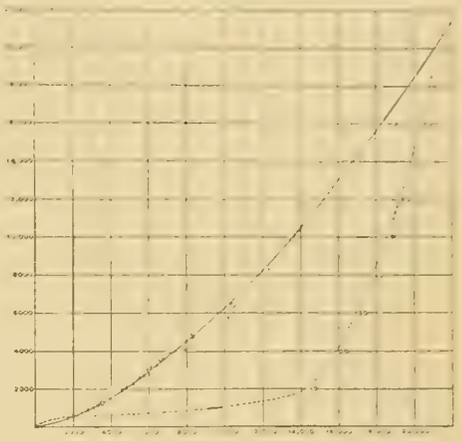

FIG. 2. LAW OF HYSTERESIS.

The magnetic characteristic is drawn in dotted lines.

From this curve the hysteretic loss

$$H = .0024164\ B^{1.6}$$

we derive the values:

Table II. (6)

B.	H.	B.	H.
1000	152	13,000	9230
2000	462	14,000	10,400
3000	884	15 000	11,610
4000	1400	16,000	12 860
5000	2000	17 000	14,180
6000	2680	18,000	15,550
7000	3430	19,000	16,970
8000	4240	20,000	18,400
9000	5130	25,000	26,200
10,000	6070	30,000	35,210
11 000	7 070	35 000	45,060
12 000	8130	40,000	55,800

II.—Magnetic Circuit Built up of Well Insulated Layers of Very Thin Sheet-Iron.

Fig. 3—Tables III.

MAGNETIC CHARACTERISTIC.

F = Magnito motive force in ampere turns per centimeter length of magnetic circuit,

B = Magnetization in lines of magnetic force per square centimeter.

Table III. (1)

F.	B.	F.	B.	F.	B.
2	4700	12	13,750	45	17,500
3	4800	14	14 260	50	17,900
4	7140	16	14,600	55	18,300
5	9250	18	14 900	60	18,650
6	10 400	20	15,200	65	19,030
7	11,160	25	15,700	70	19,380
8	11 820	30	16,200	75	19,730
9	12,470	35	16 620	80	20,080
10	13,050	40	17,050	85	2 ,400
				90	20,750

HYSTERESIS.

B = magnetization in lines of magnetic force per square centimeter.

H = loss of energy by hysteresis, in ergs per cycle and cubic centimeter, = 10^{-7} watt-seconds.

CLOSED MAGNETIC CIRCUIT.

Frequency: $N = 85$ complete periods per second.

Table III. (2)

B.	H. obs.	H calc.	H — H. = calc. obs.	%
5910	3320	3140	− 180	− 5.7
6700	3690	3420	− 270	− 7 9
7690	4220	4700	+ 480	+ 10.2
10,470	7160	7700	+ 540	+ 7.0
12,110	8370	8464	+ 96	+ 1.1
14,030	11,620	12,280	+ 320	+ 2.6
14,890	13,730	13,540	− 190	− 1.4
17,190	17,040	17,040		
17,940	17,570	18,240	+ 670	+ 3.7
		av:	± 315 =	± 4.4

Exponent of power derived from tests:

$$x = 1.6041 \sim 1.6$$

Coefficient of hysteresis:

$$\eta = .00285.$$

hence, theoretical curve:

$$H = .00285\ B^{1.6}$$

Table III. (3)

Frequency: $N = 138$ complete periods per second.

B.	H. obs.	H. calc.	H. = H. = calc. obs.	%
5220	3030	3015	− 15	− .5
5750	3620	3550	− 70	− 1.9
6540	4320	4355	+ 35	+ .8
7070	4830	4890	+ 60	+ 1.2
8210	5950	6160	+ 210	+ 3.4
8520	6090	6530	+ 440	+ 6.7
9570	7850	7840	− 10	− .1
10 450	8780	9040	+ 260	+ 2.9
11,090	11,060	11,230	+ 170	+ 1.5
14,570	15,840	15,340	− 500	− 3.3
14,660	10,160	15,580	− 580	− 3.7
16,770	20,350	19,200	−1,900	− 5.0
17,070	20,629	21,440	+ 820	+ 3 9
19,320	23,180	24,120	+ 940	+ 3.8
		av:	± 371 =	± 2.8

[*Continued on page* 79.]

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SEVERAL interesting articles on electric welding have appeared in the WESTERN ELECTRICAN and a number of special applications have been described and illustrated. The applications of this system have become so numerous and are of such universal interest that considerable space is devoted in this issue to an article on "Electric Metal Working." In addition to a description of several devices employed and the principles underlying the application of electricity to this work, there is a comprehensive description of many special applications and illustrations of the results obtained. The article will no doubt be read with interest by the electrical fraternity.

CHICAGO city officials and members of the South Park Board, which controls the boulevards leading to the World's Fair site, have been squabbling over the question of paying for electric lights on these thoroughfares. The South Park Board is willing to establish a plant in Washington Park, place electric lamps along the boulevards and make the connections, if the city agrees to operate the plant in the future. The city officials claim that the park commissioners should pay for lighting the boulevards, but the latter point to the fact that the city has paid the boulevard gas bills, and the park commissioners maintain that in doing so the city only preformed its duty, as the boulevards are public thoroughfares which must be lighted for the general convenience. It is to be regretted that such questions should be raised at this time when there should be no delay in securing improvements of this character for the boulevards. It is to be hoped that a compromise can be effected. It is suggested that the city maintain the electric lights for two years or until such time as the courts decide whether it is the duty of the park board to maintain them, and that the park board establish the electric plant in Washington Park.

THE interest manifested in electric traction by the managers of steam railroads is encouraging. A party of railroad officials recently visited the great electrical factories of the East and the gentlemen composing it appear to have been much impressed with what they saw and with the possibilities awaiting the electric railway. In speaking on the subject Chief Engineer McHenry, of the Northern Pacific company, is reported to have said that he did not see "why electricity should not displace locomotives, especially over steep grades." It is not probable that Mr. McHenry's expectation will be realized for many years to come, but experiments in the direction indicated can result only in good, and should be encouraged by all interested in the railway problem.

IN a recent issue of the WESTERN ELECTRICIAN a paper by George P. Low was presented in which attention was called to the improvements that have been made during the last few years in the construction of electric power plants In the early days of electric lighting any place was considered good enough for the generating plant, but experience soon showed that better accommodations and care would be required if the plant was to be relied upon. It is true that much improvement has been made, and it is largely due to this fact that the insurance men have begun to advocate the installation of electric plants. It should be remembered, however, that there is still considerable room for advancement, as is shown by frequent unfavorable reports from poorly constructed plants that still remain to remind parent companies of the days when they pursued the short-sighted policy of cheap construction.

THE announcement was made recently that the Chicago South Side Alley "L" road had placed an order for the rolling stock including steam locomotives. This seems rather strange in such a progresive city as Chicago in view of the fact that old steam roads are endeavoring to replace their present equipment with electrical apparatus. The "L" roads of Kansas City, for instance, are to be operated as electric lines as soon as the change can be made. Further evidence can be found in New York City, the stronghold of the "L" road, where it has been demonstrated that the present "L" system operated by steam locomotives, failed to provide adequate rapid transit for the metropolis.

No wonder, then, that the announcement of the Chicago "L" Road company should be received with amazement. Chicago prides itself upon its progressive spirit, yet it adopts the discarded system of Kansas City, while New York is preparing a most comprehensive system of underground electric railways that will give rapid transit and not merely pretend to.

The residents of that portion of Chicago through which the "L" road passes should enter an earnest protest against the adoption of steam locomotives on this line. There is no reason why they should be subjected to the annoyance of a dirty and noisy steam railroad. An electric system will not only remove these objections but it will also provide superior service.

ELECTRIC railway men who have been obliged to contend with opposition based upon the so-called "deadly" character of the current employed in operation will read with interest the attacks that are now being made upon the cable system wherever operated It should be borne in mind that much of the opposition to the trolley system and the unreasonable charges that the current employed was dangerous to life were raised by the advocates of the cable system whose only hope of success when they were brought into competition with electric systems was to alarm the people they had to deal with, who as a rule were unacquainted with the operation of electric roads. The cable men found it easy to raise a hue and cry in the daily newspapers about overhead wires, and when the people were thoroughly frightened the city officials would not dare to grant a franchise for an electric equipment. Now, however, the cable companies owing to numerous breakdowns and frequent accidents are finding it hard work to explain their failure. In Chicago for instance, according to the local papers, the people are becoming so thoroughly disgusted with the poor service that a proposition to revoke the franchises would be received wtth general approval. Accidents are occurring every day and sometimes they prove quite serious. The Chicago *Herald* in a recent editorial says: "The cable cars have maimed and killed so many people that it does not seem impossible to believe that they have become animated with a desire for blood, like the butcher in 'The Mysteries of Paris.'

AS indicated in a recent number of the WESTERN ELECTRICIAN, the National Electric Light Association will not hold an exhibition in connection with the convention at Buffalo this month. This change seems to meet the approval of the manufacturers and dealers in electric light apparatus as well as general electrical supplies. Heretofore, the exhibits have been made on a most elaborate scale and have proved very costly to the exhibitors. There seems to be no further inclination on the part of well-established concerns to make a big display. There is no reason why they should. It is not necessary to hold a side show in connection with the meetings to attract a large attendance. Practical papers on timely topics by experienced men will prove the best possible attraction for the men who support the organization. President Huntley is entitled to the thanks of the entire fraternity for inaugurating this reform.

Another suggestion that has been favorably received, is the holding of one meeting each year and abolishing the summer gathering. This, too, is a good idea, and should receive attention at the Buffalo meeting. It has been suggested that the next meeting be held in Chicago in 1893, when there will be an electrical display that will astonish the world.

ST. LOUIS has something of a reputation as a city from which oddities, both of men and things, may be expected. But it has one citizen whose ideas are attuned to such a pitch of impracticability that they must be regarded as humorous even in the big town on the Mississippi. This gentleman has discovered a cause for alarm, and he sounds the tocsin by writing to the *Globe-Democrat*. As one who surveys the horizon from the watch-tower of public safety, this vigilant sentry appropriately signs himself "The City's Welfare." Nor has his untiring zeal been exercised in vain, for he has discovered the omission of an important safeguard in the electric lighting system of the city. "A careful perusal of all the contracts, ordinances and franchises now in force between the city and the Municipal Electric Light & Power company," he complains, "fails to disclose any provision for the erection by the company of a duplicate plant in case of the destruction of the one now operated by them. It is not my intention to unnecessarily alarm any one, but let the careful reader think for one moment of the terrible danger, as well as serious inconvenience that would result to a city the size of St. Louis in case it were left without artificial light for any length of time." The writer then draws a grewsome picture of the dangers of the failure of street lighting, "if but for a single night," and then attempts to show that such a contingency is not an impossibility. He concludes with this suggestion: "Now, is it not a matter of necessity that a plant so liable to accidents and to get out of order as one used for electric lighting purposes should be duplicated, in order that all the possible dangers arising from a failure to light the city may be avoided?"

Here is culpability of the gravest kind, and the only shred of consola ion for the offending company is the dismal reflection that its iniquity is shared by about every manufacturing or commercial concern in the country. But it seems to us that the *Globe-Democrat's* correspondent does not carry his reasoning out to its broad and legitimate conclusions. For instance, the railroads of the country are liable to have their service entirely interrupted for considerable periods by fire or flood. This causes great injury and annoyance to the public. Why not make it a condition to the granting of a charter to any railway company that the applicant shall bind itself to construct two duplicate lines, so that if traffic by one is interrupted the other may be immediately resorted to? The preservation of documents showing the transfers of real estate is of the highest importance. Why not have two repositories and file two duplicate copies of deeds? The breaking down of all the pumps in the city waterworks would cause widespread distress. Such an accident is as liable to happen as that feared by "The City's Welfare." Why not erect duplicate pumping stations? The idea is capable of indefinite expansion, and it is surprising that the St. Louis alarmist stopped short with one instance. He might, too, have regaled his readers with some figures of the initial cost and interest charges of the "duplicate plant" and then calculated what his scheme would cost the people of St. Louis in the shape of increased cost for light. Perhaps this would have some effect in impelling them to the conclusion that the correspondent's plan is not a "matter of necessity."

[*Continued from page 77.*]

Exponent of power derived from tests:

$$x = 1.6044 = 1.6$$

Coefficient of hysteresis:

$$\eta = .00335$$

hence, theoretical curve:

$$H = 00335\ B^{1.6}$$

TABLE III. (4)

Frequency: $N = 205$ complete periods per second:

B	$H.$ obs	$H.$ calc	$H.-H.=$ calc − obs	%
6360	4440	4660	+220	+4.8
7340	5380	5780	+100	+6.9
10,010	9510	9510	—	—
10,860	9980	10,670	+690	+6.5
12,230	13,700	12,940	—700	—5.9
14,000	17,390	17,160	—230	—1.3
14,700	17,830	17,340	—490	—2.8
15,750	19,700	19,360	—340	—1.7
16,700	21,990	21,300	—690	—3.2
		av:	±425	±3.7

Exponent of power, derived from tests:

$$x = 1.697 = 1\ ($$

Coefficient of hysteresis:

$$\eta = .00373$$

hence, theoretical curve:

$$H = .00373\ B^{1.6}$$

OPEN MAGNETIC CIRCUIT.

Two gaps of ~ 4 cm. length.

TABLE III. (5)

Frequency: $N = 138$ complete periods per second.

B	$H.$ obs.	$H.$ calc.	$H.-H.=$ calc. obs	%
3150	1570	1560	— 10	— .6
3940	2110	2020	— 90	—4.4
4690	2930	2950	+ 20	+ .7
5490	3510	3780	+ 270	+7.2
6270	4380	4690	+ 310	+6.6
10,250	10,450	10,290	— 160	—1.6
11,000	11,810	11,520	— 290	—2.5
12,980	14,250	13,740	— 510	—3.7
		av:	± 208	±3.4

Exponent of power derived from tests:

$$x = 1.6040 \sim 1.6$$

Coefficient of hysteresis:

$$\eta = .00394$$

hence, theoretical curve:

$$H = .00394\ B^{1.6}$$

FIG. 3. LAW OF HYSTERESIS.

From these four sets of readings we get the results:

CLOSED MAGNETIC CIRCUIT.

$N = 85$ 9 readings: $x = 1.6041$ $\eta = .00285$
138 14 " 1.6044 .00335
205 9 " 1.6970 .00373

OPEN MAGNETIC CIRCUIT.

$N = 138$ 8 readings: $x = 1.6040$ $\eta = .00393$

Herefrom it seems that the consumption of energy by hysteresis per magnetic cycle increases with increasing frequency—that is, with increasing velocity of the magnetic change.

The three values of three coefficients of hysteresis for closed circuit in their dependence upon the frequency N, can be expressed by the empirical formula:

$$\eta = (.0017 + .000016\ N - .00000003\ N^2)$$

To compare the values of hysteretic loss for different frequencies, in Fig. 3 the curve of hysteretic loss for $N = 100$ complete periods per second is plotted, giving:

$$\eta_{100} = .003$$

hence

$$H = .003\ B^{1.6}$$

and the observed values of H are not directly drawn in, but the observed values of H multiplied with the factor:

$$\frac{\eta_{100}}{\eta_{obs}}$$

to compare the different frequencies with each other.

These values are plotted for:

$N = 85$ with the mark Y
138 " " + Closed magnetic circuit.
205 " " *

$N = 138$ with the mark °; Open magnetic circuit.

From this curve of hysteretic loss,

$$H = 003\ B^{1.6}$$

we derive the values, for the frequency of $N = 100$ complete periods per second.

TABLE III. (6)

$B.$	$H.$	$B.$	$H.$
1000	[illegible]	13,000	11,460
2000	570	14,000	12,900
3000	1100	15,000	14,430
4000	1740	16,000	15,900
5000	2490	17,000	17,610
6000	3330	18,000	19,290
7000	4260	19,000	21,060
8000	5280	20,000	22,830
9000	6360	25,000	32,640
10,000	7530	30,000	43,680
11,000	8790	35,000	55,950
12,000	10,080	40,000	69,270

Especially noteworthy is the last set of readings, on open magnetic circuit, in so far as it proves the fallacy of the general opinion that the hysteretic loss of energy in the iron is smaller in the open magnetic circuit than in the closed circuit.

For the coefficient of hysteresis observed on open magnetic circuit,

$$\eta = .00393$$

is even greater than that for closed magnetic circuit,

$$\eta = .00335$$

But this discrepancy is easily explained by the fact that in the closed magnetic circuit the magnetization is nearly uniform throughout the whole iron. But in the open magnetic circuit the magnetic field intensity differs considerably from point to point, being a maximum in the middle of the magnetizing coils, a minimum at the ends of the iron sheets. Now, the values of B given in the table are the average values of the magnetization, and the values H the average values of hysteretic loss. But the average value of the 1.6th powers of different quantities B is larger than the 1.6th power of the average value of B.

For instance, in a cubic cm. of iron magnetized to $B = 12{,}000$ is $H = 10{,}080$; in a cubic cm. of iron magnetized to $B = 6{,}000$ is $H = 3{,}330$; hence of these 2 cubic centimeters the average magnetization is

$B = 9{,}000$, and the average $H = 6{,}705$ ergs

but to $B = 9{,}000$ corresponds $H = 6360$ ergs; that is, about 5 per cent. less, and the difference becomes still greater, if the values B differ still more.

III.—FIG. 4. TABLE IV.

A third set of determinations of the hysteretic loss of energy is given in the following:

Again a magnetic circuit was built up of seventeen lay-

FIG. 4. LAW OF HYSTERESIS.

ers of a soft kind of sheet iron, each layer consisting of two pieces of 20 cm. length, 2.54 cm. width, and two pieces of 7.6 cm. length and 2.54 cm. width, of the thickness $\delta = .0686$ cm.

Here evident proof of the induction of eddy currents in the iron was found. Especially perceptible was a decrease in the watts consumed by the iron, when a larger magneto motive force of high frequency was left acting upon the iron. This decrease must be attributed to the increase of the electric resistance of the iron, caused by its increasing temperature.

To eliminate this source of error as far as possible, before each set of tests an alternating current of high frequency ($N = 200$) and considerable strength was sent through the magnetizing coils and left on for ten or fifteen minutes, and then first readings with low magnetization, then with high, and then again with low magnetization were taken. But, nevertheless, as was to be expected, in these tests the observed values agreed less with each other than in the former readings.

The method of determination, the apparatus, etc., were the same as in the second set of tests, only that ammeter, voltmeter and wattmeter were used at the same time. In calculating these tests, the law of the 1.6th power was assumed as true, and the loss of energy in the iron expressed by the equation,

$$H = \eta\ B^{1.6} + \varepsilon\ N\ B^2$$

where

$$H_1 = \eta\ B^{1.6}$$

is the true hysteretic loss per cycle and cm.^{3}, which is independent of the frequency, and

$$H_2 = \varepsilon\ N\ B^2$$

is the loss of energy by eddy current, per cycle which is proportional to the frequency N.

From this expression

$$H = H_1 + H_2$$

the coefficients η and ε were calculated, and the agreement or disagreement of these coefficients η and ε allow now to check the correctness or incorrectness of the law of the 1.6th power.

These tests gave the following results:

MAGNETIC CHARACTERISTICS.

F = magneto motive force in ampere turns per centimeter length of magnetic circuit.

B = magnetization in lines of magnetic force per square centimeter.

TABLE IV. (1)

$F.$	$B.$	$F.$	$B.$	$F.$	$B.$
1.5	2,700	7	11,700	18	15.450
2	4.350	8	12,200	20	15,800
3	7,100	9	12 700	25	10,400
4	8,856	10	13,100	30	16,800
5	10,000	12	13.900	35	17,200
6	10,800	14	14,500	40	17,500
		16	15 600		

HYSTERESIS.

B = magnetization in lines of magnetic force per square centimeter.

H = loss of energy by hysteresis, in ergs per cycle η ch cm. (= 10-^{7} joules) = $H_1 + H_2$.

$H_1 = \eta\ B^{1.6}$ = loss of energy by hysteresis proper, in ergs per cycle and cm^3. (= 10–^{7} joules).

$H_2\ \varepsilon\ N\ B^2$ = loss of energy by eddy currents, in ergs per cycle and cm.^{3} (= 10–^{7} joules).

TABLE IV. (2)

Frequency: $N = 78$.

$\eta = .00331$ $\varepsilon = .751 \times 10^{-6}$

$B.$	H_1	H_2	$H.$(1) calc.	$H.$ obs.	△	= %
4171	2,060	1,080	3,140	3,060	+ 80	+ 2.6
5850	3,540	2,120	5.660	5,640	+ 20	+ .3
9520	7 740	5,600	13,340	13,440	— 100	— .8
13,160	12,960	10,710	23,670	24,540	— 870	— 3.7
14,320	14,880	12,720	27,600	26,460	+1140	+ 4.0
16,050	17,280	15,900	33.180	33,180	——	0
				av:	{+ 6.9 / — 4 5}	± 1.9 (+ .4)

TABLE IV. (3)

Frequency: $N = 140$.

$\eta = .00331$ $\varepsilon = .730 \times 10^{-6}$

$B.$	H_1	H_2	$H.$(1) calc:	$H.$ obs.	△	= %
4880	2,630	2,720	5,360	5,280	+ 80	+ 1.5
6780	4,490	5,270	9.760	9,420	+ 340	+ 3.4
7720	5,530	6,830	12,360	12,000	— 240	— 1.9
10,200	8.640	11,940	20,580	20,400	+ 180	+ .9
12,080	11,300	16 700	28,000	29,100	—1100	— 4.0
17,200	19,860	33 840	53.700	53,000	+ 700	+ 1 3.
				av:	{+ 7 1 / — 5.9}	± 2 2 (+.2)

TABLE IV. (4)

Frequency $N = 207$.

$\eta = .00ꞏ36$ $\varepsilon = .757 \times 10^{-6}$

$B.$	H_1	H_2	$H.$(1) calc.	$H.$ obs.	△	= %
2710	1,030	1,290	2320	2,340	— 20	— .8
4720	2,510	3.910	6,430	6,480	— 50	— .8
7540	5,320	9,070	15,290	15.960	— 670	— 4.4
12,380	11,700	26,800	38,500	38,500	——	0
13,200	13,000	30.400	43,400	42,600	+ 800	+ 1.8
				av:	{+ 1 8 / — 6 0}	± 1.6 (— .8)

Therefrom we get the results:

N = 78,	6 readings,	η = .00331	ε = .751 × 10^{-6}
140,	6 "	.00331	.730 × 10^{-6}
207,	5 "	.00336	.757 × 10^{-6}

The values found for η are so nearly alike that we can consider them as constant, and take their mean value

$$\eta = .00333$$

as the coefficient of hysteresis.

Even the values found for ε are not much different from each other, not more than was to be expected from the unavoidable differences in the temperature of the iron, which because of the high electric temperature coefficient of iron makes ε rather variable.

Taking the average of ε, we derive

$$\varepsilon = .746 \times 10^{-6}$$

and as formula of iron loss

$$H = .00333\ B^{1.6} + .746 \times 10^{-6}\ N\ B^2$$

In Fig. 4 are drawn the four curves,

1. True hysteretic loss, $H = .00333\ B^{1.6}$
2. Iron loss for N = 78 $.00334\ B^{1.6} + .00005856\ B^2$
3. " " 140 $.0001022\ B^2$
4. " " 209 $.0001567\ B^2$

The observed values are plotted by crosses, +

IV.—Figs. 5 and 6. Tables V and VI.

Two other sets of determinations of the hysteretic loss of energy, for the frequency 170 complete periods per second, were made on two laminated horse shoe magnets, with laminated keeper or armature.

The method of observation and of calculation was the same as in III, and the same precautions were taken.

The dimensions of the horse shoe magnets were:

Mean length of magnetic circuit: 38 cm.
" cross-section: 70 cm.^{2}
" volume of iron: 2660 cm.^{3}
" distance of keeper from magnet, in the first case: .15cm.
" distance of keeper from magnet, in the second case: .08 cm.

each magnet consisting of 300 sheets well-insulated iron, of the thickness .0405 cm.

In the first set of readings, considerable eddy-currents were found; in the second set, only a small amount of eddies.

The magnetic susceptibility of the iron was not determined, because the reluctance of the magnetic circuit mainly consisted of that of the air gap between magnet and keeper.

The results were,

$\mathcal{B}$ = magnetization in lines per cm.^{2}
H_{obs} = observed loss of energy in the iron, in ergs per cycle and cm.^{3}, for N = 170.
H_1 = true hysteretic loss of energy.
H_2 = loss of energy by eddy currents.
H_{calc} = whole calculated loss of energy, = $H_1 + H_2$

Table V.

Frequency: N = 170.

η = .0045 ε = 1.16 × 10^{-6}

B	H_1	H_2	H calc.	H obs.	H — H calc. obs	= %
340	51	23	74	70	+ 4	+ 5.3
410	68	34	102	102	± 0	± .0
546	108	59	166	166	± 1	+ .0
620	132	78	210	219	— 9	— 4.3
670	150	90	240	234	± 6	+ 2.5
746	178	111	289	300	— 11	— 3.7
850	210	138	348	333	± 15	+ 4.3
1020	293	208	501	524	— 23	— 4.5
1100	345	234	579	549	+ 30	+ 5.3
1200	392	290	682	695	— 13	— 2.0
1310	436	343	779	795	— 16	— 2.1
1490	539	445	984	985	— 1	— .1
1930	820	742	1562	1547	± 15	± 1.0
2600	1310	1280	2590	2670	— 80	— 3.1
				av:	± 71 / — 153	+19.0 / —19.8
					± 16	± 2.8

Therefrom we get the formula for the loss in the iron,

$$H = .0045\ B^{1.6} + 1.16\ N \times 10^{-6}\ B^2$$

In Fig. 5 are shown

1. The curve of true hysteretic loss, $H_1 = .0045\ B^{1.6}$
2. The curve of the whole loss in the iron, $H = H_1 + H_2$

with the observed values marked by crosses +

Table VI.

Frequency: N = 170.

η = .00421 ε = .2083 × 10^{-6}

B	H_1	H_2	H calc	H obs	H — H calc obs	= %
85	5.2	1	5.5	5.6	— .1	— 1.8
182	17.3	1.3	18.6	16.9	+ 1.7	+10.0
211	22.0	1.7	23.7	23.5	+ .2	+ .9
560	105	11	116	122	— 6	— 5.0
675	140	15	155	146	+ 9	+ 6.1
685	145	16	161	157	+ 4	+ 2.6
775	176	21	197	202	— 5	— 2.4
800	186	22	208	200	+ 8	+ 4.0
1000	265	35	300	300	. .	. .
1070	296	41	337	353	— 16	— 4.6
1130	322	47	369	386	— 17	— 4.3
1260	379	56	435	430	+ 5	+ 1.2
1380	445	69	514	514	— 26	— 4.7
2200	940	179	1110	1130	— 20	— 1.8
2420	1090	208	1298	1268	+ 30	+ 2.4
					+ 38 / — 90	+27.2 / —24.6
					± 10	± 3.4

1. H_{calc} is calculated by using for η the mean value η = .00333, but for ε the individual values, corresponding to the particular set of observations.

Therefore we get the formula for the loss in in the iron,

$$H = .00421\ B^{1.6} + .2083 \times 10^{-6}\ N\ B^2$$

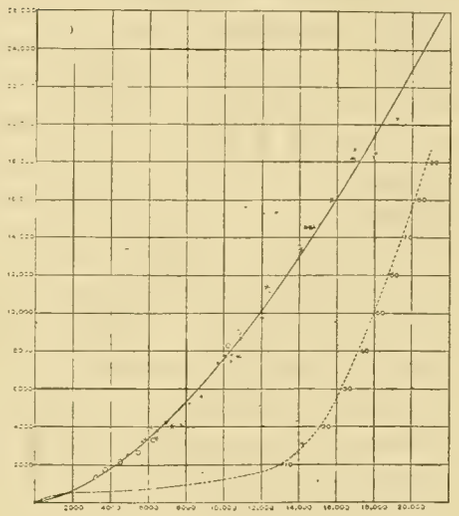


FIG. 5. LAW OF HYSTERESIS.

In Fig. 6 are shown,

1. The curve of true hysteretic loss, $H_1 = .00421\ B^{1.6}$
2. The curve of the whole loss in the iron, $H = H_1 + H_2$

with the observed values marked by crosses +

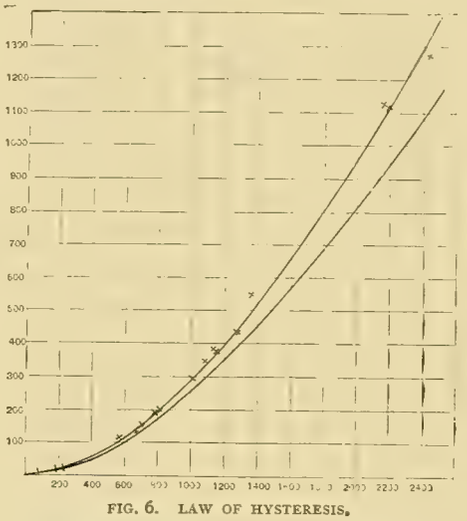


FIG. 6. LAW OF HYSTERESIS.

Especially interesting are these two sets of readings in so far as they cover quite a different range of magnetization as the tests in I. to III.

In I. to III. the tests cover the range from 1,790 to 19,340 lines of magnetic force per cm.^{2}, that is, for medium magnetization up to high saturation, while the tests in IV. cover the range from 85 to 2,600 lines per cm.^{2}, that is, from medium down to very low magnetization.

The law is found exactly the same,

$$H = \eta\ B^{1.6} + \varepsilon\ N\ B^2$$

and herewith proved for the full range from 85 lines per cm.^{2} up to 19,340 lines, a ratio from 1 ÷ 230.

This seems not to agree with Ewing's theory of the molecular magnets. According to this theory, for very small magnetization the hysteresis should be expected to disappear, or almost disappear, and the cycle be reversible. Then for medium magnetization, where the chains of molecular magnets break up and rearrange, hysteresis should increase very rapidly, and slowly again for saturation. Nothing of this is the case, but hysteresis seems to follow the same law over the whole range of magnetization, and is certainly not zero for even such a low magnetization as 85 lines per cm.^{2}

Magnetometer tests.

The method used in the foregoing has the great advantage that

1. It allows the taking of a greater number of readings, over a wide range of magnetization, in a short time, by mere simultaneous instrument readings, and thereby reduces the probable error by increasing the number of observations.
2. It allows the use of electro-dynamometers, as the most reliable electric measuring instruments.
3. It deals with larger amounts of energy, counting by watts or even hundreds of watts, whereby a much greater accuracy can be reached than by the ballistic galvanometer.
4. It measures the hysteresis under the influence of an harmonically, and not suddenly varying magneto motive force that is under the same conditions, where it becomes of importance for practical engineering.

But it has the great disadvantage that it can be used only for testing sheet-iron or other thoroughly laminated iron, where eddies are either inappreciable or can be calculated also. For testing solid iron and steel pieces, this method cannot be used, because of the tremendous amount of eddies which would flow in a solid piece of iron. To determine the hysteretic loss of energy in steel and cast-iron the Eickemeyer differential magnetometer was used.

With this instrument a number of magnetic cycles of different samples of steel and cast-iron were determined.

First, a powerful alternating current was sent through the magnetometer and around all the iron pieces used, to destroy any trace of permanent or remanent magnetism.

Then the examined sample was laid against the front, the standard against the back of the magnetometer, balanced, and a larger number of magnetic cycles completed between given limits, for instance, + 95 and — 95 ampere turns magneto motive force per centimeter length. Then readings were taken from maximum magneto motive force + 95 down to zero, and again up to the maximum — 95, down over zero and up to + 95, thereby completing a whole magnetic cycle, and then of a second magnetic cycle, a few readings were taken as check for the first one.

In this way for different magneto motive forces the curve of hysteresis was found, and by measuring its area the loss by hysteresis determined.

The further calculation was done in a somewhat different way. Generally the number of cycles was not large enough to determine conveniently the exponent by analytical methods.

Therefore the law of the 1.6 power:

$$H = \eta\ B^{1.6}$$

was assumed as true, and for each cycle from the known values of H and B determined the coefficient η.

If for different cycles the values of η agreed, this would prove the assumption, the correctness of the law of the 1.6th power, while a disagreement would disprove it.

In the following for a number of samples the magnetic cycles are given:

F = magneto motive force in ampere turns per cm. length.

B_r and B_d = the intensity of the magnetization, in kilolines, corresponding to magneto motive force F, for the rising and the decreasing branch of the magnetic curve.

The area of the looped curve, representing the loss of energy by hysteresis is derived by adding the values of B_d, and subtracting therefrom the sum of the values B_r, B_d and B_r, being given from 5 to 5 ampere turns, or .5 absolute units, the difference of the sums B_d—B_r just gives the loss by hysteresis, in ergs per cycle.

Cast-steel, annealed and hardened. Fig. 10. Table VII.

Of one kind of steel, two test pieces were cast, at the same casting, turned off to standard size, and, by comparing them in the magnetometer, found to be exactly alike.

Then the one piece was hardened, the other left annealed.

Magnetometer tests gave the following magnetic cycles:

Table VII.

	Hardened.			Annealed.	
F	B_r B_d	B_r B_d	B_r B_d	B_r B_d	B_r B_d
0	± 5.0	± 7.0	± 7.8	± 6.6	± 8.6
5	—4.4 +5.6	— 6.4 + 7.5	— 7.3 + 8.2	— 1.4 +10.7	— 2.6 +11.3
10	—3.7 6.1	— 5.6 7.9	— 6.8 8.6	+ 3.4 11.9	+ 3.7 12.3
15	—2.7 6.5	— 4.4 8.2	— 5.6 8.9	8.4 12.5	8.4 12.7
20	0 6.9	— 1.9 8.6	— 2.3 9.2	10.9 12.8	10.8 13.0
25	+3.9 7.3	+ 1.9 9.0	+ 4 9.5	12.2 13.1	12.0 13.3
30	5.5 7.6	4.2 9.3	9.5 9.8	13.0 13.4	12.7 13.6
35	6.7 8.0	6.2 9.6	4.2 10.1	13.5 13.7	13.2 13.9
40	7.7 8.3	7.6 9.9	5.8 10.4	13.9 14.0	13.5 14.2
45	8.5	8.7 10.2	7.2 10.7	14.1	13.8 14.5
50	(44.5)	9.6 10.5	8.4 11.0	(44.5)	14.1 14.7
55		10.4 10.8	9.6 11.2		14.4 15.0
60		10.9 11.1	10.4 11.5		14.7 15.2
65		11.4	10.9 11.8		15.0 15.4
70		(64.5)	11.4 12.0		15.3 15.6
75			11.9 12.3		15.6 15.8
80			12.2 12.5		15.8 16.0
85			12.5 12.7		16.0 16.1
90			12.8 12.9		16.2 16.3
95			13.0 13.1		16.4 16.5
100			13.2 13.3		16.6
105			13.4 13.4		(101.0)
110			13.5		
			(108.0.)		
H = obs.	48,300	77,800	101,100	34,800	45,000

Herefrom as coefficient of hysteresis, was found

$$\eta = .02494 \mid .02512 \mid .02490 \mid .007997 \mid .007962$$

Average. η = .024987 ~ .025 η = .007980 ~ .0080

Hence, when annealed, the hysteretic loss is

$$H = .008\ B^{1.6}$$

when hardened

$$H = .025\ B^{1.6}$$

and calculated by means of these formulas, we derive

H_{calc} =	48,400	77,500	101,500	34,730	45,100

and

H_{calc} — H_{obs} =	+100	—300	+400	—70	+100
= per cent. of H_{calc}	+.2	—.4	+.4	—.2	+.2

In Fig. 10 are drawn some of the magnetic curves for both samples.

It is especially interesting to note that though the chemical constitution of both samples is exactly the same, their

magnetic behavior is entirely different, so that the magnetic properties of iron seem to be determined much more by its physical than its chemical constitution

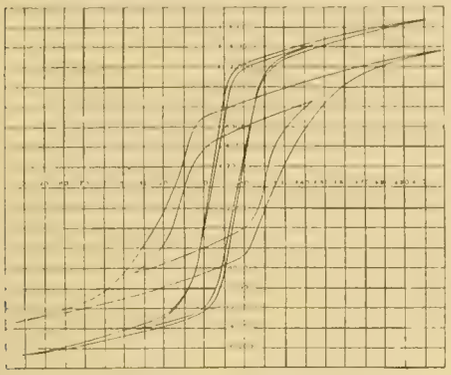


FIG. 10. LAW OF HYSTERESIS.

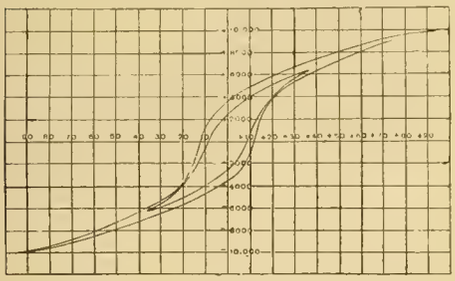


FIG. 11. LAW OF HYSTERESIS.

SAMPLE OF CAST STEEL OF LOW SUSCEPTIBILITY.

TABLE VIII.

F.	B_r B_d	B_r B_d	B_r B_d	B_r B_d
0	± 2.5	± 2.8	± 3.1	± 3.4
5	−1.5 +3.4	−1.9 +3.6	−2.1 +3.9	−2.7 +4.2
10	+ .6 4.1	− .4 4.3	− .6 4.6	− 1.3 4.8
15	2.7 4.6	+2.7 4.9	+2.2 5.2	+2.3 5.4
20	3.9 5.1	4.0 5.5	4.7 5.8	3.8 5.9
25	4.7 5.6	4.9 6.0	5.1 6.2	4.8 6.4
30	5.5 6.0	5.6 6.4	5.9 6.6	5.5 6.7
35	6.2 6.3	6.2 6.7	6.1 6.9	6.0 7.1
40	6.38	6.6 7.0	6.6 7.2	6.5 7.4
45	(37.0.)	7.0 7.3	7.0 7.5	7.0 7.7
50		7.4 7.5	7.4 7.8	7.4 7.9
55		7.64	7.8 8.1	7.8 8.2
60		(52.0)	8.1 8.4	8.1 8.5
65			8.4 8.6	8.4 8.8
70			8.7 8.8	8.7 9.0
75			8.95	9.0 9.2
80			(75.0.)	9.3 9.5
85				9.5 9.6
90				9.8 9.8
95				10.0
				(95.0.)
H = obs.	14,600	19,900	25 000	29,600
η =	.0119	0122	.0119	.0118

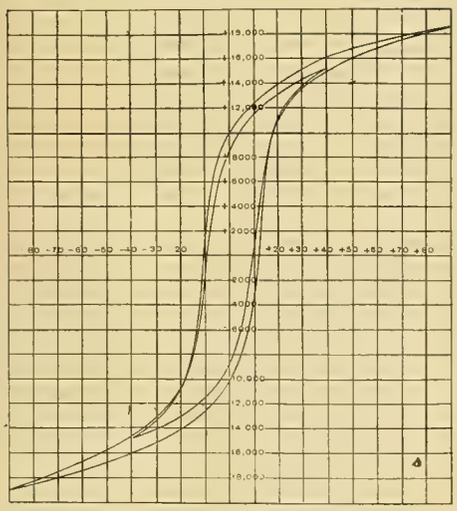


FIG. 12. LAW OF HYSTERESIS.

Average, η = .001195
∼ .012

Herefrom,

$$H = .012\ B^{1.6}$$

H = calc	14,620	19,520	25,140	30,020
$H-H$ calc obs	+20	−380	+140	+420
= per cent. of H calc	+.1	−1.9	+.6	+1.4

With regard to hysteresis, this kind of cast steel is 50 per cent. worse than the annealed cast steel No. 1, but still twice as good as the hardened sample. But, magnetically, it is poor—that is, of low susceptibility, giving for 40 ampere turns magneto motive force per centimeter length only ∼6600 lines of magnetic force per square centimeter, while the annealed steel gives ∼14,000—that is, more than twice as many, and even the hardened steel gives more, ∼8000.

TOOL STEEL. FIG. 12.

TABLE IX.

	I		II		III		
F	B_r	B_d	B_r	B_d	F	B_r	B_d
0	± 8.3		± 9.6		50	15.9	16.8
5	− 5.7	+ 10.2	− 7.5	+ 11.2	55	16.4	17.0
10	+ 1.2	12.6	− 2.0	12.4	60	16.9	17.4
15	7.4	13.6	+ 7.2	13.5	65	17.3	17.7
20	11.0	13.4	10.9	14.2	70	17.7	18.0
25	12.6	13.8	13.4	14.8	75	18.0	18.2
30	13.5	14.2	13.3	15.3	80	18.3	18.4
35	14.2	14.5	14.0	15.7	85	18.6	18.7
40	14.8		14.7	16.0	90	18.8	
45	(39.0)		15.3	16.4		(99.0)	
H = obs.	64,400					64,600	
η =	.0944					.0928	

Average, η = .00936

hence

H = calc	44,000	64,600
η =	−400	+600
	= ± 1 per cent.	

CAST IRON. FIG. 13.

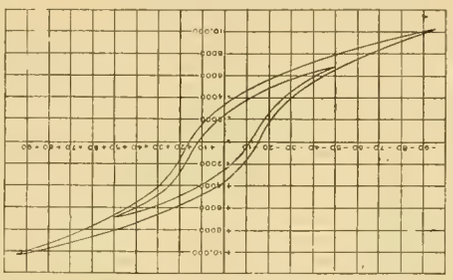


FIG. 13. LAW OF HYSTERESIS.

TABLE X.

	I.		II.			II.	
F	B_r	B_d	B_r	B_d	F	B_r	B_d
0	± 2.5		± 3.5		50	6.8	7.9
5	−1.7	+3.2	−2.7	+4.1	55	7.3	8.2
10	− .6	3.9	−1.7	4.7	60	7.8	8.6
15	+ .9	4.4	− .2	5.2	65	8.2	8.9
20	2.6	4.9	+1.6	5.7	70	8.6	9.2
25	3.8	5.4	3.0	6.1	75	9.0	9.4
30	4.6	5.8	4.0	6.5	80	9.4	9.7
35	5.2	6.1	4.9	6.8	85	9.7	9.9
40	5.8	6.4	5.5	7.2	90	10.0	10.1
45	6.3	6.6	6.1	7.6	95		10.3
50	6.8						(95.0.)
	(50.0.)						
H = obs.	22,300 ergs		42,000 ergs				
η =	.01047		.01589				

Average, η = .01616

H = calc	22,000	42,800
$H-H$ calc obs	−300	+800
= per cent.,	−1.5	+1.9

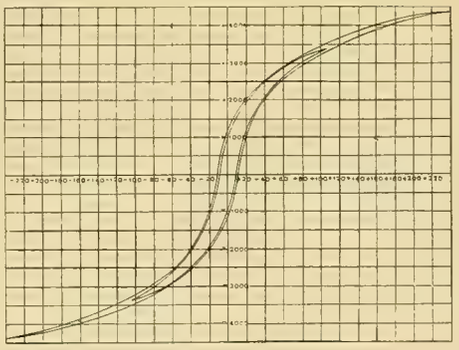


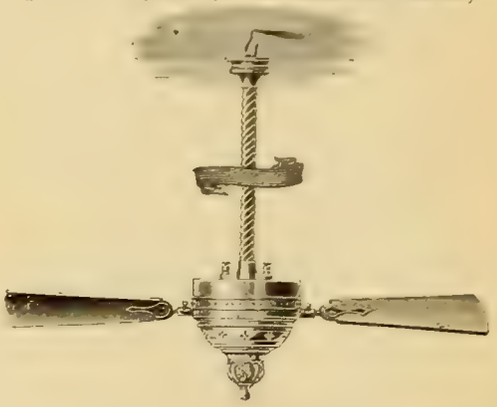
FIG. 14. LAW OF HYSTERESIS.

Chicago Central Station Burned.

The Hyde Park Electric Light & Power company's plant, at Forty-first street, near Cottage Grove avenue, Chicago, was burned to the ground on January 27th, entailing a loss of $3,000. The building was a one-story brick structure fifty feet square. It was badly damaged by fire only a few weeks ago, and on the day of the fire the laborers were finishing tarring the roof and erecting the large chimney. The fire was caused by the explosion of a gasoline lamp in the waste room. Hoyt Burnett, a fireman, in his efforts to extinguish the blaze, was badly burned about the hands. The loss was principally on three Sperry arc dynamos.

Diehl Electric Motor Fans.

Where the Diehl electric fan is employed shafting and belting are entirely dispensed with, the device taking the shape of a handsome chandelier. The fan is suspended upon a hook securely screwed into the ceiling, the wires from the motor passing up through the tubing and connecting at the top with the service wires. The fans are handsomely finished in nickel or fine polished brass, the ornamented baskets concealing the motor. The blades are attached to the wheel inclosing the revolving armature, thereby receiving the full benefit of the power without the interposition of a drop shaft. The roller bearing below is encased in a perfectly air-tight oil cup, making the leakage of oil an impossibility. The motors are absolutely



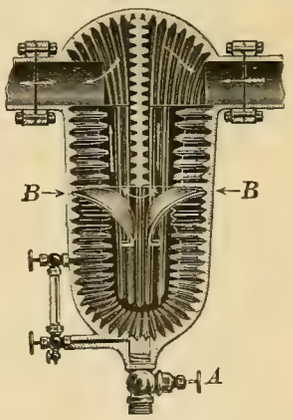
DIEHL ELECTRIC FAN MOTOR.

free from liability to heating and are specially constructed for the work required of them. They are successfully operated on 110 volt incandescent circuits, or when specially wound on any voltage under 110, or they may be run in series under 220 volt or 500 volt circuits. They are equaly successful, too, on a direct arc current.

Diehl & Co., New York, the manufacturers, having enlarged their factory equipment, are prepared to turn out large quantities of not only this style but other designs in the shape of handsome column fans for floor and counter use, highly ornamented bracket fans as well as the unique and attractive propeller or "buzzer" fans.

Hine's Eliminator.

In these days of high speed engines with small clearances and the necessity of forcing steam boilers to their utmost capacity, as often occurs in electric lighting stations, the importance of a reliable steam separator must certainly be felt. Many an engine has been wrecked by water being lifted over from forced boilers or from condensation incidental to long lines of steam pipes. For these reasons, if for no others, the sectional view of an improvement recently made by the Hine Eliminator company of New York will be of interest. In the horizontal style of this eliminator there is given every essential requisite in a steam separator. The construction is such as to thoroughly break up the steam, so to



HINE'S ELIMINATOR.

speak, and at the same time provide a means for carrying the particles of foreign matter out of and away from the action of the steam current before they can be again taken up and carried forward. By reference to the illustration it will be seen that the steam upon entering the eliminator is driven against a sharply corrugated diaphragm which extends vertically to half the length of the body, dividing the inlet from the outlet side. By the force of the inflowing current and its impingement against the corrugated surfaces, the steam is broken up and the separation accomplished before the turn is made

into the outlet side. At a proper distance below the diaphragm are two converging plates, *B B*, between which the water, oil or other eliminated particles readily flow out of the way into the chamber below and out at valve *A*. As steam will readily accommodate itself in the changes of direction of flow and as more solid particles continue in a direct course, it will be seen that the solids at once flow into the sub-chamber while the clean dry steam passes under the diaphragm and ascends to the outlet side, being deflected by an inwardly extending pipe at the immediate point of outlet.

The vertical style of eliminator made by this company is the one which, in competition in the list of steam separators made at Sibley College, Cornell University, last year was demonstrated to have in twelve distinct trials, with steam under varying conditions, an average of 98 7-10 dry steam. From tests made with the newly constructed horizontal style the manufacturers are satisfied that its efficiency fully equals that of the vertical type.

Somoff's Incandescent Lamps.

The decorators who have been resorting to the incandescent lamp to heighten illuminating effects are no longer satisfied with the combinations which can be worked out with the ordinary style of lamps. The call is now for novelties, and it was this demand that led J. L. Somoff of New York to introduce a number of styles of fancy incandescent lamps of low voltage. The sales of such lamps have been steadily growing and, the new year's trade is said to be as brisk as it was at Christmas. There are many wealthy residents in New York and other cities who, not satisfied with the ordinary pear lamps of 16 candle power, have been importing fancy lamps from Germany and France. But from the accompanying cuts it will be seen that all that could be wanted in this line of lamps can

FIG. 1. SOMOFF'S INCANDESCENT LAMPS.

now be obtained on this side of the water. The illustrations show some of the novel lamps.

Fig. 1 is the "Prism" lamp, which produces a most beautiful display of rainbow colors. The effect is superior to that of the prisms suspended from a gas chandelier. The "Torch" lamp, Fig. 2, is another one designed by Mr. Somoff for theatrical purposes, etc. In has four lenses fused to it and all the surface around them is frosted. The effect of this combination is to project the light in the form of four condensed beams. Last December 450 of these lamps were shipped to a European theatrical company to be used in the production of the opera "Robert le Diable." The lamps were mounted on torches which contained small storage batteries. Little vanes at the bases of the lamps revolved with the least motion of the air and turned the lamps, the beams of light striking in every direction. Fig. 3 is the "Lantern" lamp, English pattern. The storage battery lanterns, as made in England and imported into the United States, have a very shallow reflector and the bull's eye quite close to it.

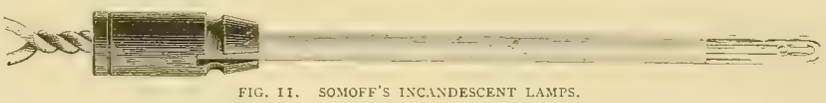


FIG. 11. SOMOFF'S INCANDESCENT LAMPS.

There is no room for any other but a flat lamp. The lamp is suspended from three springs, two of which constitute the terminals. Fig. 4 is a cut of the "Candle" lamp after the design of A. de Khotinsky, manufacturer in Berlin. A large number of these lamps are yearly imported into the United States on orders from wealthy New Yorkers. Mr. Somoff made this style of lamps as the new protective tariff makes their importation expensive. Fig. 5 is the "Miniature Candle" lamp, whose globe is of corrugated and twisted glass. Fig. 6 represents the "Corrugated Sphere" lamp. In this the corrugations on the globe produce the pleasing effect of distorting the rays of light. This lamp is also made with the channels of the globe plated with silver, so that it presents a large number of alternate strips of crystal glass and mirrors, and looks as if a great many filaments were inclosed within the globe. Fig. 7 is a miniature wall bracket. Figs. 8 and 9 are "Striped" lamps, the strips being alternately red, blue, milk white and crystal. These lamps are especially suitable for flower baskets. Placed in the center of a flower the lamps assume the color of the flower. Fig. 10 is a surgical lamp of English design. Fig. 11 is an antiseptic surgical lamp for use by physicians. The part surrounding the filament is of clear

FIGS 5, 8, 9 AND 10. SOMOFF'S INCANDESCENT LAMPS.

glass, and the rest, serving as the handle, is of opaque milk-white glass. Any dirt that might prove infectious can thus easily be seen and washed off.

Electric Lighting in Detroit.

Mayor Pingree of Detroit devotes considerable attention in his annual message to the common council to the question of public lighting and shows a partiality for municipal plants. The figures which the mayor presents will no doubt be of interest to the people of Detroit and they may influence them in the way of securing a city plant, but a little further investigation will no doubt prove that there are several other conditions to be considered than those presented in Mayor Pingree's message. It appears that the mayor has been gathering statistics on the subject of street lighting and its cost, for he says:

Reports from eighty-eight cities of the United States which are lighted in whole or in part with arc lights of

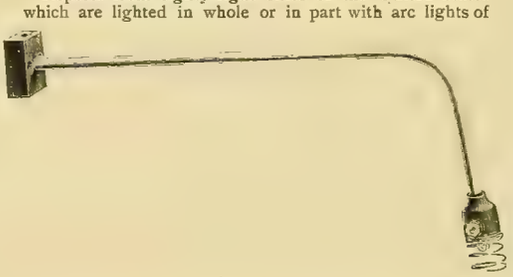


FIG. 7. SOMOFF'S INCANDESCENT LAMPS.

2,000 (nominal) candle power show that the maximum cost per light per year is $200.75; minimum cost $44, and the average cost $103.20. The highest price is paid in San Francisco, and the lowest price in Ottumwa, Ia. The price in Detroit, under the contract system, is about $136 per year, or $33 more than the average price. The cost per light in Chicago, where the lighting plant is owned and operated by the city, is only $50 per year, or $53 less than the average price, and $86 less than the price paid in this city. The service of the Detroit Electric Light & Power company, the present contractor for furnishing the city with light, has been notoriously and shamefully poor during the past year and a half. Latterly so many of the lights have been going out or burning dimly that the press of the city has severely criticized the company for its failure to carry out its contract in properly lighting the city. I notice that the company, through its manager, acknowledges that it has not properly lighted the city, but gives as an excuse the fact that it had been using poor coal, and that its boilers had not been properly cleaned, as a reason why it had not lived up to its contract. The contract with the Detroit Electric Light & Power company does not expire until July 1, 1893, but now is the time for the city to prepare to do its own lighting at the expiration of that period. It may require legislation to enable the city to build or purchase and operate its own electric lighting plant, but I believe that the legislature, at the request of the city of Detroit, will cheerfully grant the necessary authority to do so.

The mayor also takes up the subject of overhead wires and makes several interesting observations. He calls attention to the fact that the telephone company is extending its lines and suggests that they be placed underground.

The numerous overhead wires throughout the city, and especially in the central portions thereof, are not only an eye-sore and a considerable detriment to the efficient work of the fire department, but a serious danger to life. There are several ordinances passed by former common councils, which provide for the placing underground of all telephone, telegraph and electric light and other wires. But the trouble with these ordinances, as I understand it, is that they have never been enforced; perhaps because of a lack of provision for their enforcement. No hardship is imposed upon the companies operating these wires in the requirement that they be placed underground, beyond the expense of so placing them. But very naturally the companies desire to avoid this expense as long as the citizens are willing to put up with the nuisance of the overhead wires. These ordinances can only be enforced by officials

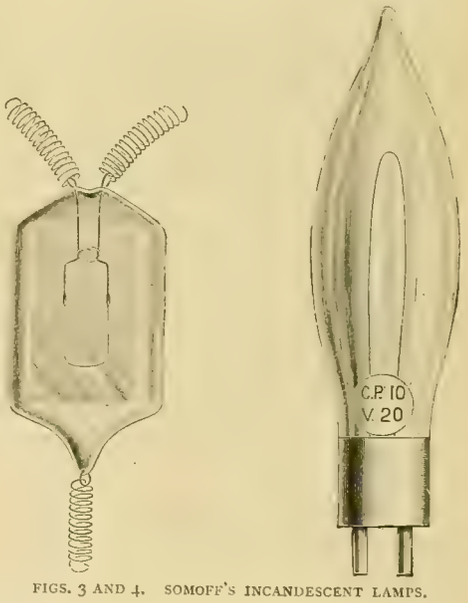
FIGS. 2 AND 6. SOMOFF'S INCANDESCENT LAMPS.

who show a determination not to permit corporate interests to over-ride public rights. I therefore request that your honorable body pass such supplementary ordinances as will give the mayor authority to clear the streets of these obnoxious wires, and I pledge myself now that if you do so I will see that the streets are cleared. In Washington the city is building proper underground conduits, in which all electric wires are being placed; those belonging to private parties pay rental for the use of the conduits. The city could do the same here, so that there would not be half a dozen companies tearing up the streets and a handsome return would be made on the cost of the conduits.

Attention is called to the fact that the Telephone & Telegraph Construction company is at the present time erecting poles in the city on which it is stringing wires under a resolution of the common council adopted April 1, 1881, granting the right to erect poles in any street in the city it deems necessary. The common council has, by its deliberate action in the passage of the ordinance above alluded to, taken the position that the overhead wires on poles should be removed from the streets, and in consonance with this position I would recommend that the resolution above alluded to granting this permission to the Telephone & Telegraph Construction company be rescinded and its poles ordered from the streets the same as those of any other corporation.

New Western Agency for Day's Kerite.

Doubtless it will be news to many to learn that the western agency for Day's Kerite insulation has been turned over to F. W. Cushing, so well known in Chicago and New York electrical circles. For some time General Agent W. H. Eckert has been making plans for an aggressive campaign, through which it is proposed to still further develop the western business. With this object in view, it was necessary to procure as manager a man of experience in both business and technical matters, and arrangements to this end were finally consummated in securing Mr. Cushing as western manager. In undertaking this branch of the management of the Day insulation products, Mr. Cushing enters the field equipped with qualifications that in themselves may be taken as a guaranty of his fitness for such work. Like Mr. Eckert, Mr. Cushing has a practical knowledge of construction work; in fact, he was one of the pioneers in the establishment of the present system of underground electric conduits in Chicago, personally superintending the laying of a great deal of the conduit now employed for high tension service. Mr. Cushing was



FIGS. 3 AND 4. SOMOFF'S INCANDESCENT LAMPS.

also instrumental in organizing the Chicago Arc Light & Power company, and was for some time superintendent of that company. Later on he was associated with Prof. Elisha Gray of Highland Park and the Western Electric company of Chicago. Previous to his acceptance of the Kerite agency, he held the responsible position of secretary of the Central Electric company, Chicago. Mr. Cushing has opened offices and warerooms in Temple Court building, 225 Dearborn street, Chicago, where he will keep a large stock of Kerite wires and cables.

Burnley Cartridge Battery.

Various materials have been tried as substitutes for the heavy and fragile porous cup used with most Leclanche cells. The latest effort in this direction is shown in the cut and consists of a "cartridge" of chemically treated pasteboard, containing the usual depolarizer and carbon slab. This form seems to possess several commendable features. It is not liable to breakage in handling or transportation; weighs nearly two pounds less than the old form, and, owing to the manner of construction, can be made considerably cheaper. It is claimed that while the pasteboard permits a free circulation of the solution, it will not become clogged up with a crystalization of sal-ammoniac or creeping salts. This battery is made for the Electrical Supply company of Chicago.

Mount Morris Electric Light Company's Plant.

The accompanying illustration of the interior of the engine-room of the Mount Morris Electric Light company's station plant, shows the disposition of the engine and the method of transmitting the power. As originally intended the plant was to consist of three Green improved Corliss engines alone, side by side, belted to the dynamos on the second floor through a countershafting. Since then, three high speed engines have been added, and the cut serves incidentally to compare the two systems of subdivided and centralized power. At present the power consists of two Green improved engines, 26 x 48, two Ball high speed engines, 12x13, a Westinghouse compound 18 and 30x16.

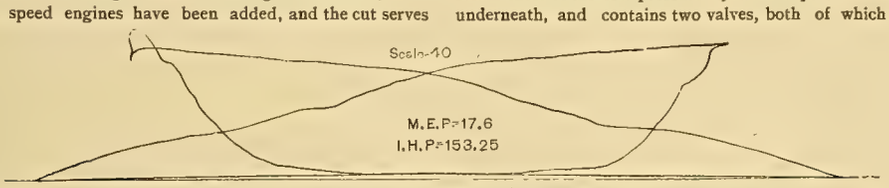


FIG. 2. BALL & WOOD CO.'S ENGINES.

The dynamos which are driven by these engines are of the Westinghouse alternating current, Schuyler arc, Wood and Excelsior types. Current is furnished for 11,000 incandescent lamps, 600 Schuyler arcs, 100 Wood and 150 Excelsior lamps. The company also furnish current for 45 horse power in motors on the same circuit with 52 arc lamps an Excelsior generator furnishing current. Extensive additions to this plant will soon be made and it is believed the company will introduce several new Westinghouse engines, each belted to a single dynamo.

Ball & Wood Company's Compound Engines.

The accompanying diagrams were taken from a 250 horse power cross compound engine just installed in the station of the Edison Electric Illuminating company of Paterson, N. J. The engine was designed and built by the Ball & Wood company, and embodies some new features in the arrangement of low pressure valves. The steam chest of the low pressure cylinder is placed directly underneath, and contains two valves, both of which are double ported, giving large and direct ports with very small clearance. The dimension of the cylinders are as follows: High pressure, 16 inch diameter by 16 inch stroke; low pressure, 25 inch diameter by 16 inch stroke. Speed, 220 revolutions.

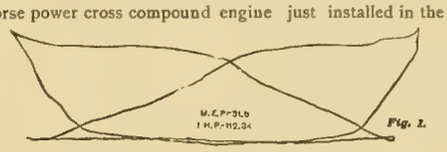


FIG. 1. BALL & WOOD CO.'S ENGINES.

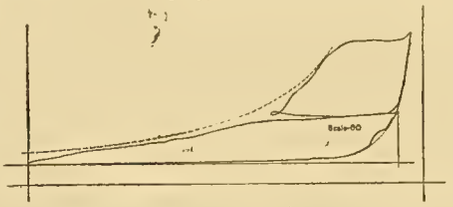


FIG. 4. BALL & WOOD CO.'S ENGINES.

Fig. 1 is a reproduction of cards from the high pressure cylinder, and Fig. 2 simultaneous cards from the low pressure cylinder. Fig. 3 represents a combination of the cards, showing their relation to each other and the measure of loss between the cylinders up to point of cut-off. In Fig. 4 the cards from both cylinders are referred to the low pressure cylinder in the usual manner, and show the efficiency of the system. The theoretic expansion and compression curves are shown in dotted lines.

Hotel Fire Alarm System.

In the accompanying cut is shown a fire alarm gong placed on the market by the Partrick & Carter company, Philadelphia. This device is used in connection with this company's new fire alarm system for hotels. In this system the apparatus consists of electric bells having gongs of from 6 to 10 inches mounted on a polished base and having a box attached for holding two cells of dry battery and an automatic drop. These drops are connected in series to their respective boxes in the halls and pushes in the office. In each hall or designated place is placed a small alarm

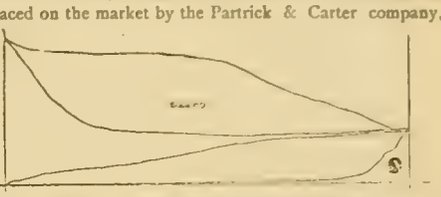
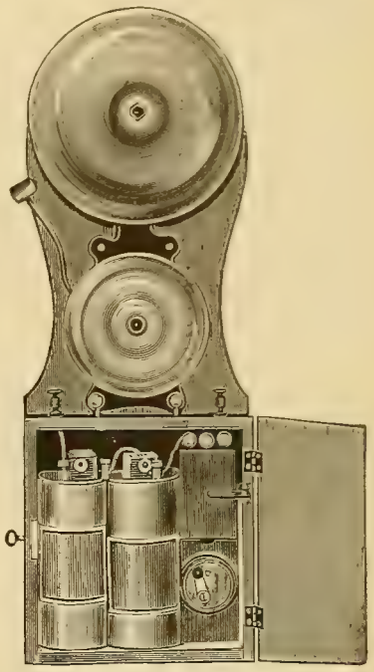
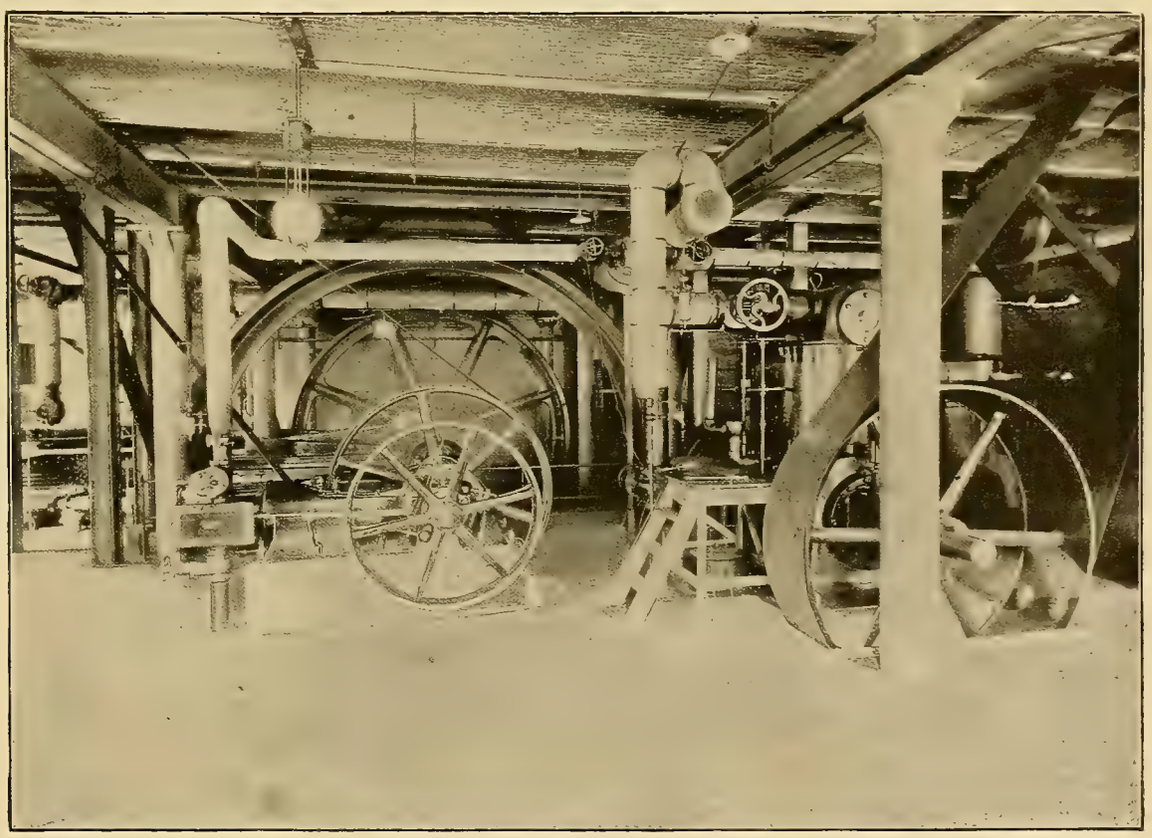


FIG. 3. BALL & WOOD CO.'S ENGINES.



HOTEL FIRE ALARM SYSTEM.



MOUNT MORRIS ELECTRIC LIGHT CO.'S PLANT.

box containing a push button, and provided with a very thin glass front. The pushing of any one button on any floor will cause all the bells on that floor to ring continuously until stopped by resetting the automatic drop in the bell box, and without the intervention of the office battery.

CORRESPONDENCE.

New York Notes.

NEW YORK, January 30.—The most important news of the week relates to the triumph of the trolley system in Brooklyn. As Mayor Boody failed to veto the trolley resolutions passed by the Brooklyn Board of Aldermen on January 11th, they became operative at noon, January 23d. In addition to this word comes from Albany to the effect that the State Railroad commission has granted the application of the Brooklyn City Railroad company for permission to change its motor power on its entire line from horses to the single trolley electric system. From this it would seem that Brooklyn will have the modern system after all.

It will be remembered that the resolutions above referred to are identical with those passed by the aldermen on December 21st, and which Mayor Boody vetoed on January 2d. Instead of adopting them over his veto then, the aldermen passed them anew and this time the mayor decided not to veto the resolutions. In explaining the apparent inconsistency between his present action and his previous veto he said: "I do not consider it my duty to take any further action in the matter. I have once vetoed the resolutions, and they have been passed over my veto with only two dissenting votes. I have, since it came before me the second time, done all that was possible to ascertain the working of the system in other cities, and to learn the wishes of our own citizens. Such information as I have gained has thrown new light of importance upon the subject, and no new reason for action appears, so far as I am able to see, and the fact that the question rests with the State Railroad commissioners is an important factor in the consideration of the subject. Another veto of the resolutions might easily be regarded as simply a useless obstruction to the inevitable. Therefore I have come to the conclusion that there is nothing for me to do beyond what I have already done in the premises."

In its decision the State Railroad commission says it would not feel justified in withholding its approval in consequence of the protests or dissents of property holders upon certain streets, in view of the fact that the company has complied with the requirements of law as to obtaining a majority of the consents of the property owners along the line of its road. Although on a few streets the road could not acquire a majority of consents, the excess of consents over a majority, however, for the system as a whole, and, indeed, upon each route, the road being divided into routes, confers upon the company the right to change its motor power so far as the consents of the abutting property holders are concerned.

The number of miles of road on which the change will be made is 83¾ miles of first track, 76 miles of second track, and 16¼ miles of sidings, etc., or 176 miles in all. The total assessed value of the property along the line is $143,379,115, and the company secured more than half in value of the consents of the property owners to the proposed change, having secured $78,346,800.

The Brooklyn City Railroad company filed its bond today with the Brooklyn city clerk for $150,000 to indemnify the city against any damages that may occur through the use of the overhead trolley system on its lines.

Word comes from Albany to the effect that the assembly has passed the bill allowing newspaper representatives to witness electrical executions.

The Gas commission has awarded some of the electric light contracts. The United States Illuminating company will light sixty-six lamps, the Brush company forty-five lamps, and the Harlem Lighting company twenty-four lamps at 40 cents per lamp per night.

The new trolley system on the street railroad between Newark and West Orange has been tested, and everything worked satisfactorily. The line will be operated regularly on Monday.

Efforts are being made to organize an electric railroad company to operate a line between Newark and Passaic, to follow the east bank of the river, passing through Harrison, Kearney, Arlington, Kingsland, South Rutherford and Passaic, and connecting at the latter point with the Passaic & Paterson electric railroad. The section between Harrison and Kearney is already under construction.

The Newark Passenger Railroad company has accepted a franchise from the West Orange township committee to operate a street railroad by the overhead system from the Orange line to Tory Corners, at Washington street. The road is to be in operation by February 1st. By that date it is expected that the electric railroad will be in operation from Newark to Tory Corners. W. F. O.

Milwaukee, Wis.

MILWAUKEE, January 30.—In the Superior Court a few days ago Judge Austin rendered a decision that possesses considerable interest for Milwaukee and Chicago people. It was in the case of Travers E. Hinckley of Chicago against John A. Hinsey of Chicago and Charles F. Pfister and others of Milwaukee. The property involved was the Milwaukee Electric railway, which has not yet been formally turned over to the Villard syndicate, but will be as soon as the title is clear. Hinckley caused the company itself to bring a suit similar to his own against Hinsey, Pfister and the other Milwaukee parties. The court, however, ordered the consolidation of the two cases.

The decision was an overwhelming defeat for Hinckley. When the company was organized, it appears, Hinckley took two-thirds of the capital stock, which was $500,000, and Hinsey took the remaining $200,000. It was decided to issue bonds for $500,000, to raise money for building and equipping the road. Bonds to the amount of $250,000 were actually issued, and together with half of the capital stock which Hinsey and Hinckley contributed proportionately in order to put up the collateral, were pledged to Pfister to secure a loan of $125,000. The company's note for that sum was signed by Hinckley, as president, and by the secretary. The note contained a power of sale. When the loan became due and was not paid, Mr. Pfister took the bonds and stock and sold a part of them to August H. Vogel, retaining the remainder as his own property.

Hinckley claimed that Pfister had violated the contract, and that the defendants had colluded to defraud him. He asked for the appointment of a receiver; that he be considered a creditor of the road to the amount of $70,000, which he said he had advanced in order to build the system; that the rightful ownership of the stock be determined; the sale of stock and bonds by Pfister be set aside, and that the property be sold and the proceeds divided equitably.

When the case came up for trial the defense demurred to the complaint on the ground that it did not state facts sufficient to constitute a cause of action. The demurrer, after a long argument, was sustained by Judge Austin. The court held that Hinckley was a participant in the issue of the stock, and although the money he had advanced and the services he had rendered, might have been in payment of part of the stock which he held, he had not averred so, but had left the inference that the considerations named had been for the whole of his stock, and hence he was not qualified to maintain an action as a stockholder. Hinckley having claimed that he was to be considered a creditor of the company until he was paid in money, or bonds had been issued to him, the court said that if such was the case he had paid nothing for his stock, and hence was not in a position to question the legality of the issue of the company's stock. "I am in favor," said the judge, "of sticking to the old doctrine that a man who comes into a court of equity must come in clean handed."

The claim had been made that Hinckley had a cause of action as a surety on the Pfister note, but the court held to the contrary, declaring that he could not sue to set aside the very securities that he had pledged for his debt. Hinckley, the court continued, might have had a cause of action against Pfister if he had alleged fraud on the part of the latter, and the pledged stock had been sold without his knowledge, but he had made no such allegations. Hinckley, the court further held, had not even stated a cause of action as a creditor. Moreover, he had placed a barrier against himself for maintaining an action as a creditor by alleging that he was to receive bonds in payment of his loan, and admitting that he had never asked for the bonds. The decision on these points applied equally to the company's complaint. The company, the court held further, could not maintain an action to set aside the stock which it had issued. As to the claim that the company could maintain an action to determine the actual ownership of the stock, the court said that having already decided that the stock and bonds were good as against the company, it was no concern of the company who the rightful owners of the stock were until it came to be voted at an annual meeting.

The cases were, therefore, thrown out of court. Hinckley, however, was granted a stay of proceedings to enable him to take an appeal to the supreme court, and the injunction restraining the defendants from disposing of their stock will remain in force until the case is decided by the supreme court. The defendants confidently expect another victory in the higher tribunal, in which case the system will be formally transferred to the Villard syndicate.

In the university extension course, Prof. H. B. Loomis of Madison lectured at the high school last evening on "Electromagnets." The subject of the previous lecture was "Magnetism." The course, which was arranged by the Wisconsin Electric Club, is being attended by between 150 and 200 people. The lectures are given in the high school laboratory, which is supplied with all the necsssary appliances for illustrating experiments.

The Villard syndicate has secured a lease of the Milwaukee and Wauwatosa Rapid Transit line for a term of one year. The Rapid Transit people are to complete the equipment of the line, except to furnish it with cars, and then turn it over to the Villard people. The power house at Wauwatosa will be used for running the road. It is expected that every third or fourth car on the Walnut street line will make the through run to Wauwatosa. There will be no change of cars, and one fare only will probably be charged for the long trip. The arrangement will undoubtedly result in the Villard company purchasing or permanently leasing the Wauwatosa line. Rapid Transit stockholders say that the Villard people would like to buy this property at once, but some of the stockholders, notably Capt. Pabst, don't want to sell. It is stated that steam power will be used on the other suburban line between Milwaukee and Wauwatosa. Work on that road has been in progress for several years, and it is not known now when it will be completed. The task of erecting the immense viaduct across the Menominee valley has just been commenced.

About twenty-five sample cars have been ordered for the Villard lines. They include open and box cars. The makers of the car that gives the greatest satisfaction will receive an order for 150 of them, and hence there will be much rivalry and some "bang-up" samples. C.

Toledo, O.

TOLEDO, O., January 30.—A recent disastrous fire destroyed the street car barns of the Toledo Electric Street Railway company, situated on Canton avenue. The fire occurred about 2 o'clock in the morning, when most all the cars had been put up for the night, and consequently the company loses twenty-six of its best cars, all of which were motor cars; six of them were new and had just been placed in service. The loss is estimated at $125,000; insurance on cars, $54,000; on building, $5,400. The company has now only nine cars to operate its lines.

It has succeeded in securing 14 cars to be delivered inside of a month, and is making all possible haste in putting the line in its former good condition.

It is reported that peaceful negotiations have been made by the Consolidated Street Railway company and the Toledo Electric Street Railway company, for which the people have waited so long. In the Circuit Court the Robisons (Toledo company) voluntarily dismissed two of the suits against the Consolidated. These were the general wire suit and the Nebraska avenue wire suit. They proposed keeping the Consolidated from using wires on its own tracks, when the Robisons also used them. Last week the Toledo Electric Street Railway company's lawyers were told by the Circuit Court judges that the court had under advisement the question of which company should be permitted to use wires over the tracks of the Consolidated, if but one set could be used. The Consolidated company declares that the use of a double set of wires is a success. A contract agreement has been adopted by the companies regulating their relations. It is specifically stipulated that it shall in no way affect the litigation pending. One thing is the division of the intersections between the companies and the use of one set of wires by both. Another part regulates the use of a double set of wires, and another provides for double tracks on Washington street. Each company will use the other's tracks on this street, and also on Cherry street and Nebraska avenue. This settlement only affects minor questions. The tracks may cause more litigation, but the agreement in the present case may break the ice for something further.

This settlement of the difficulties opens the way for the use of electricity on all the Consolidated lines. The company's attorney is authority for the statement that this will be done, and that before May 1st ninety electric cars will be in operation on the old horse car road.

Twenty new electric cars have already been ordered for the Consolidated's new belt line, to be formed by connecting the Adams and Monroe street lines with the new Central avenue line mentioned some time ago. The intention is to have it connected by May 1st. Thirty new electric cars have been ordered for the Consolidated system and the indications are that this is but a beginning. The company operates a large and most complete system, of horse cars

and if converted into an electric road exclusively Toledo will have the best of rapid transit facilities. F. C. H.

NEW INCORPORATIONS.

Hancock Light & Power company, Findlay, O.; capital stock, $25,000; generating electricity and furnishing same for light, heat and power, etc ; Chas. Smith, Findlay, O.

Connellsville Electric Railway company, Connellsville, Pa.; capital stock, $100,000; operating a street railway in Connellsville, Fayette county, Pa.; John L. Gans, Connellsville, Pa.

Somerset Electric Light, Heat & Power company, Somerset, Pa.; capital stock, $12,000; supplying electricity in the borough of Somerset, Pa., etc.; Valentine Hay, Somerset, Pa.

Meyrowitz Manufacturing company, Ridgefield, N. J.; capital stock, $100,000; to manufacture optical goods, surgical and electrical instruments, etc.; E. B. Meyrowitz, Ridgefield, N. J.

American Electrical company, Chicago, Ill.; capital stock, $500,000; to manufacture, buy and sell all kinds of electrical devices; James E. Purnell, 715 Chamber Commerce building, Chicago, Ill.

Ephrata Light company, Ephrata, Pa.; capital stock, $10,000; supplying light, heat, and power by means of electricity to the public in the borough of Ephrata, etc.; W. U. Hensel, Lancaster, Pa.

Apollo Electric Light, Heat & Power company, Apollo, Pa.; capital stock, $20,000; supplying light, heat and power by means of electricity, etc.; Jas. S. Whitworth, 115 Warren avenue, Apollo, Pa.

Doylestown Electric company, Doylestown, Pa.; capital stock, $16,000; supplying light. heat and power by means of electricity in the borough of Doylestown, Bucks county, Pa.; Henry Lear, Doylestown, Pa.

Electric Reciprocating company, Denver, Colo.; capital stock, $250,000; to manufacture, buy and sell all classes and kinds of electrical appliances as well as to acquire and dispose of patent rights for the same.

Washington Brick, Lime & Manufacturing company, Spokane, Wash.; capital stock, $50,000; to operate gas and electric light and waterworks, railroads and steamboat lines; Jos. H. Spear, Spokane, Wash.

Massillon Light, Heat & Power company, Massillon, O.; capital stock, $150,000; manufacturing and furnishing light, heat and power by means of electricity, gas. steam or compressed air, etc.; C. M. Russell, Massillon, O.

Pen Argyl Electric Light & Power company, Pen Argyl, Pa.; capital stock, $10,000; supplying light, heat and power by means of electricity to the public in the borough of Pen Argyl, Northampton county, Pa.; N. D. Chase, Pen Argyl, Pa.

Mosher Arc Lamp & Manufacturing company, Chicago, Ill.; capital stock $25,000; to manufacture electric arc lamps, switches, cut-outs and other electric appliances pertaining to electric lighting; J. M. Fisher, 125 Ontario street, Chicago, Ill.

Millville Electric Light company, Millville, N. J.; capital stock $50,000; manufacturing, supplying, and transmitting light, heat, power and sound, by any materials, and electricity, or other motive power or force; Walter Wood, 400 Chestnut street, Philadelphia, Pa.

Clinton County Electric Light, Heat & Power company, Lock Haven, Pa.; capital stock, $25,000; supplying light, heat, and power or any of them by means of electricity to the public in the city of Lock Haven and to persons, partnerships and corporations, etc.; Henry C. Terry, Bullitt building, Philadelphia, Pa.

ELECTRIC LIGHTING.

An electric light plant is to be established at Alexandria, La.

There is talk of the establishment of an electric light plant at Elizabeth City, N. C.

Last year the Municipal Electric Light & Power company of St. Louis placed in position 153 new street lights.

The Bridgeport, Tenn., Lumber company is reported as about to establish an electric light plant to supply its mills and the city.

At an election held by the citizens of the borough of Quakertown, Pa., for or against the securing of an electric light system, it was decided in favor by a vote of 295 for and 112 against.

Within a few months the two chief cities of Australia, Melbourne and Sydney, will be lighted by electricity. This will undoubtedly, give a great impetus to electric lighting in the island continent.

The Northern Electric Light company of Philadelphia is having trouble with merchants on Columbia avenue in regard to the price paid for electric light service, some merchants claiming that they pay 60 cents for service furnished others for 40 cents.

The city council of Lafayette, Ind., has entered into contract with the Brush Electric Light company for lighting the streets. The contract is for five years, from May 1, 1892, at a rate of $75 per annum for each lamp—an increase of $24.40 over the existing contract, which expires on April 30th. It is reported that the Brush company will abandon its present site and erect larger works in some part of the city more remote and better adapted for such an enterprise.

United States Consul George E. Hollis, at Cape Town, informs the state department that electric lighting will probably soon be inaugurated in that portion of Africa, and it is possible that water from the mountains will be utilized to produce the power needed.

Baron Oscar Dickson of Gothenburg, who has done so much to promote the scientific study of the Arctic regions, has promised Dr. Nansen a valuable addition to the outfit of his North Pole expedition in the shape of a large dynamo. It is thought it will be the first time that an Arctic expedition has had electric light at its disposal.

A letter to the *New York Herald* from Barbados, West Indies, indicates that the departure of the U. S. S. Philadelphia from that port, owing to the Chilean difficulty, was delayed on account of the electrical machinery. It was necessary to put in a new field coil in one of the three dynamos, and the cruiser waited until this piece of machinery was shipped from New York.

A local company has recently been organized at Elmhurst, a Chicago suburb, to build and operate a lighting plant for the village. A contract has been made with the Brush company for a 600-light generator which is now being installed. The streets will be illuminated by 50 candle power incandescent lamps. Contracts have already been made for nearly the full capacity of the plant. The power is furnished by a New York Safety engine.

The Walla Walla, Wash., Electric Light & Gas company has decided to make a number of improvements. It will increase its power from 83 to 280 horse power, using water from Mill creek. The water will be taken in 40 inch pipes from above Yellow Hawk, to the amount of 5,000 miners' inches, and brought down to a point that will provide seventy-five feet fall, where the generating machinery will be erected and from which the power will be brought to the city by wire. To perfect these improvements will cost the company $60,000.

At the annual meeting of stockholders of the Waverly Electric Light & Power company, Waverly, N. Y., the following named directors were elected for the ensuing year; Percy L. Lang, F. E. Lyford, Geo. Koch, C. P. Henn, H. J. Baldwin, C. A. Brown, J. Geo. Kaelber. These officers were elected: President, Percy L Lang; vice-president, Geo. Koch; secretary and superintendent, J. M. Lyford; treasurer, F. E. Lyford; executive committee, J. Geo. Kaelber, H. J. Baldwin and Percy L. Lang. The company's stock is $37,500, all paid in, and there are no liabilities. The company now operates some 70 arc lamps, Western Electric system, and 750 incandescent lamps, National Alternating system.

The new Groveland apartment building at the corner of Thirty-first street and Groveland avenue, Chicago, will be equipped with an incandescent lighting plant by the Thomson-Houston company. The building is being wired for 1 000 lamps, and two dynamos, respectively of 30 and 16 kilowatts capacity, will be installed. This company is also putting in an isolated plant of like capacity in the Illinois State Reformatory at Pontiac and is engaged in installing a plant for 3,000 lamps in the Wainwright building in St. Louis. Work on the big installation in the Masonic Temple, Chicago, is proceeding satisfactorily. Between 7,000 and 8,000 lamps will be needed for this building, which is nineteen stories high.

ELECTRIC RAILWAYS.

The East Lake Land company, of Atlanta, Ga., will lay from three to five miles of track for an electric road.

The electors of Peterboro, Ont., have voted the electric street railway franchise to the Edison General Electric company.

Efforts are being made to induce the Atlanta & Chattahoochee River Railroad company to extend its line to Marietta, Ga.

The Consolidated Street Railway company of Columbus, O., is to have its lines entirely equipped with the trolley system by April 1st.

At Portsmouth, Va , the city council committee on streets has recommended that the Portsmouth Electric Railway company be granted the necessary rights of way. The company propose to build a belt line.

The refusal of the Boston city government to co-operate with the West End Street Railway company in the matter of appointing a commission to determine upon the best fenders for electric cars has led the company to appoint its own commission, which is expected to report about February 1st.

The power house of the Uniontown, Pa., Electric Street Railway company was completely destroyed by fire recently, The entire loss on building and contents is estimated at $30,000, on which there is no insurance. It is estimated that it will take four months to rebuild the plant and get the road in running order again.

The Overland railway, of Nashville, Tenn., will be sold under foreclosure proceedings, and after the sale new capital will be invested in rebuilding the road and the equipment of the entire line, from the public square in Nashville to Glendale Park, with electricity. Application has been made to the city council for the right to use electricity.

The Chicago City Railway company is contemplating the use of electricity on several of its cross town lines. One of the most important lines is that on Sixty-first street, by which Englewood is reached. A system of overhead wires will be used if permission can be obtained from the city council. In case the attempt is successful electric motors will be used on the Thirty-ninth street line and also on one or two other lines that have not so far been decided upon.

William C. Clarke of Wakefield, R. I., and associates, who have obtained the franchise to build an electric railroad at Newbern, N. C., have given bonds to commence the construction of the line within six months and have the road in operation within six months thereafter.

The Utica & Mohawk Railway company of Utica, N. Y., has made its annual report in which it says that the change from horses to electrical equipment has been attended with satisfactory results. The traffic of the road in summer increased so rapidly that it became necessary to purchase two additional electric equipments and two additional trail cars, and now the road is operating seven motor cars and seven trail cars. The report continues: "One of the greatest enemies of electric motors is rough and uneven tracks. When electric railway companies realize this fact and construct road beds suitable for electric traction, we will hear less of the heavy expense of keeping electric cars in repair; and smooth and easy riding tracks are an important factor in increasing traffic."

The Chicago tax-payers' committee on intermural transportation will urge the building of overhead electric systems. About three hundred letters have been received by the committee from the mayors of various cities in which such lines are in operation, and they will, it is likely, be incorporated in the report of the committee. The committee is convinced that there is no other way by which a better service could be obtained in time for the World's Fair. Franchises will be recommended containing the provision that as soon as a practicable underground electric conduit system is invented the companies shall be compelled to make the change. The Chicago City Railway company is said to favor an overhead system for all its cross-town lines if the consent of the city council can be obtained.

In relation to the Green electric railway patents the *Lynn Press* says: "Some time in the fifties a man invented a railway covering many of these principles. Prof. Thomson says that when he was a boy in Philadelphia he well remembers looking into the toy shop windows and seeing a miniature car supplied with a small motor run around a circular track, the movement being imparted through the rails by means of an electric battery. All that was needed to make that a working electric railway was to increase its size and add a dynamo. Mr. Green's patent is considered interesting as forming a connecting link between the old and the new in the application of the motor to railway service, for he sought to supply the current through the rails from storage batteries instead of using a dynamo. Had he been possessed of more money he might have made a name for himself as a pioneer in the industry. It is to his credit that he kept at his efforts to secure a patent until the Circuit Court of the District of Columbia passed favorably upon his application and it was granted, but it is difficult to see how his invention can affect the industry which has been developed in the last dozen years."

ELECTRIC MINING.

The electric hoist now building at the Thomson-Houston factory for the Queen of the Hills mine in Montana will operate a rope 1,600 feet long.

An electric drill has been put in the Candice mine at Ouray, Colo. The company will at once proceed to sink shaft to strike the ore body.

The electric plant at the Virginius mine is a fair illustration of the great benefits to western mining interests which have been brought about by the application of electricity as a motive power for mining machinery. The Virginius is situated on Mount Sneffles, near Ouray, Colo., at an altitude of some 12,500 feet. It formerly cost $15 per ton for coal with which to operate this mine, as all fuel had to be transported up the mountains on burros. The cost of coal reached $100 per day, or an aggregate annual expense of $36,000 for fuel alone. Every cent of this heavy running expense is now saved to the mine owners. The new operating force of the Virginius is water power transmitted by dynamos located at Red Canyon Creek, four miles from the mine.

TELEGRAPH.

An effort is being made by the city of Baltimore to secure the necessary legislation to have its telegraph wires placed underground.

According to a Washington dispatch it is authoritatively announced that in a very short time the new telegraph line will be completed between Valparaiso and Buenos Ayres. This line will connect at Buenos Ayres with the coast line from Buenos Ayres to Europe by way of Montevideo and the Brazilian ports. It will be operated from Valparaiso in connection with the West Coast Cable Line.

In an interview Grand Chief Ramsey, of the Order of Railway Telegraphers, who was recently in Knoxville, Tenn., to investigate the dismissal of several men from the East Tennessee, Virginia and Georgia company's service, states that if the road does not stop its warfare against the men he will block everything. "The engineers and other railroad men," he says, "are only too anxious to quit."

Among the questions considered at the recent meeting of the National Board of Trade in Washington was that of cheaper telegraph rates. It was held that the prices now paid by the people for telegraphy are too high, no abatement of consequence having been made in a score of years. A rate should be established not exceeding one cent per word in a radius of 1,000 miles. If private corporations decline to grant this much needed relief to the people of the United States, it is the opinion of the National Board

that it would favor the postal telegraph system advocated by Postmaster-general Wanamaker.

Mr. Quarry, the electrician of the Post and Telegraph department at Melbourne, has devised an electrically operated carrier to convey telegrams from the receiving office in Elizabeth street to the telegraph operating room in the upper-story of the postoffice. Preparations are now being made for the introduction of pneumatic tubes, but many months are likely to elapse before the scheme is matured, and Mr. Quarry was requested to find a substitute. The contrivance consists of an electric motor which works a steel wire, about 240 feet in length, on pulleys. Hooks are fixed on the wires for the attachment of neatly-made brass carriers, into which the telegrams are placed for conveyance to the operating-room.

Referring to the proposed cable from the Pacific coast of the United States to the Hawaiian Islands, a Washington dispatch of January 29th says: The senate resolution calling on the secretary of the navy for information as to what steps have been taken to make the survey for a submarine cable between San Francisco and Honolulu will be answered next week by the transmission of the report of the commanding officer of the Albatross, the vessel detailed to make the survey. In a telegram received at the department to-day Capt. Tanner, its commanding officer, states that the survey has been satisfactorily completed and that a full report showing the route selected is now on its way East. The department will urgently recommend that the construction of this cable be commenced at once.

MISCELLANEOUS.

The Chicago Battery & Traction company has made an assignment to George E. Farley. The assets are placed at $2,000, with liabilities of $1,630.46.

Preparations for the St. Petersburg exhibition are progressing satisfactorily. A portable telegraph will be exhibited by Prince Lvoff; metal working by electricity will be shown by M. Slovinoff; and the Thomson-Houston company is installing a number of motors for drilling and sawing purposes.

A fire in the laboratory of the Rose Polytechnic Institute at Terre Haute on January 14th did considerable damage to the electrical equipment.. A Westinghouse alternator and a Perret direct current machine were injured. The total loss is estimated at $10,000, of which $1,500 is on electrical machinery.

A Boston dispatch of January 25th relates that two young men with drawn revolvers attempted to rob the safe of the Sawyer Man Electric company on the afternoon of that day, and were finally beaten off by a plucky young woman who holds the responsible position of cashier of the concern. The thieves only secured about $50, but they had much more in their possession when the cashier showed fight.

TRADE NEWS.

The Automatic Switch company, Baltimore, Md., is perfecting a number of new electrical devices, among which is a new switch that has a number of improvements.

The Williams Engine company, Baltimore, is about to occupy its new factory, which, it is said, will have the most complete equipment of tools for the manufacture of engines of any factory south of Philadelphia.

With the Chesapeake Belting company of Baltimore the past year has been the most prosperous one since organization, and as soon as the weather permits the company will begin work on a large addition to its factory.

The Warfield Manufacturing company of Baltimore has recently increased its capital stock, and will at once begin the enlargement of the present plant, with the view of starting in to manufacture a general line of electrical goods.

The Pelton Water Wheel company of San Francisco and New York reports many large shipments during the last month. This company is giving special attention to the problem of utilizing water power for electric lighting and long distance transmission of power.

At first sight one would think it was a copy of a New York daily paper that had come by mail, but a second glance at the other side of the package reveals the fact that "the sales of the Law battery in 1891, its eleventh year, far exceed those of any other open circuit battery in America."

President A. G. Davis of the Viaduct Manufacturing company of Baltimore has been confined to his house during the last six weeks by a severe attack of the grippe. At present, though, he is improving rapidly, and in all probability will soon be able to attend to business. The Viaduct company expects to make a large exhibit at the World's Fair.

The Roundhoay Electric Tramway company of Leeds, Eng., has been using two belts furnished by Chas. A. Schieren & Co. of New York and is so well pleased that a second order has been placed with the same firm. The company has also ordered a supply of electric belt stuffing and belt cement from Schieren & Co. and seems to be thoroughly satisfied with American products.

The Ball Engine company of Erie, Pa., has shipped several engines during the last few weeks to electric lighting companies. The following shipments are reported: Edison Light & Power Company, Minneapolis, Minn., 300 horse power cross compound; Industrial Improvement company, Boston, Mass., 300 horse power cross compound engine; New England Conservatory of Music, Boston, Mass., 35 horse power engine; Philadelphia Columbia Electric Light company, 200 horse power engine; S. J. Lefevre, Gibson City, Idaho, 100 horse power engine; Palace Hotel, San Francisco, Cal., one 100 horse power tandem compound engine, two 100 horse power cross compound engines, two 200 horse power cross compound engine.

The new board of directors of the Standard Underground Cable company met on January 28th for the purpose of organizing. Joseph W. Marsh was re-elected vice-president and general manager; Frank A. Rinehart, secretary and treasurer; O. R. Ebel, auditor, and John H. Dalzell, Mark W. Watson and James H. Willock were chosen as the executive committee for the ensuing year.

The Electrical Supply company of Chicago has a constantly changing effect in its large show window, corner of Michigan avenue and Randolph street. The display is a kaleidoscope of things electrical—one week a railway exhibit and the next a central station plant. This week an exposition of electric motors was given, and at all times a display that attracts the attention of hundreds of people daily is shown.

BUSINESS.

That the Ries Electric Specialty company of Baltimore should have had application for 193 agents for its regulating sockets during the last three months indicates how rapid has been the growth of its business.

W. A. Foote, general manager of the Battle Creek, Mich., Electric company, in a recent letter to the Hine Eliminator company, New York, remarks that he "would not again set up an engine without an eliminator."

The directors of the Great Western Electric Supply company at the December meeting declared a dividend of 2 per cent., amounting to $7,000 on the $350,000 preferred stock of the company. This was paid January 10th.

Jas. Schawel & Co., 29 John street, New York, are receiving a large number of orders for the fine lamp wire which they have on hand at all times, and can deliver at short notice. It is worthy of note that more orders were received from concerns in the West than in the East.

The E. S. Greeley & Co., New York, announces the death of Edwin S. Riggs, director and assistant treasurer of this corporation. Mr. Riggs had been associated with the E. S. Greeley & Co. for the past twelve years in the capacity of city manager and purchasing agent of the railroad department. He died at his residence in Brooklyn, No. 309 La Fayette avenue. The interment was at New Haven, Conn., his former home.

The Banner weatherproof wires handled by the Central Electric company, Chicago, are noted for the firmness and waterproof qualties of the insulation. The manner in which the braid is woven on the copper gives it particularly firm and lasting qualities. Nothing but the best grades of cotton and compound are used in the process of insulating, and these wires are particularly adapted for use among trees, where the circuits are subjected to severe abrasions. This company also reports having on hand a large stock of the supplies manufactured by the Interior Conduit & Insulation company of New York.

ELECTRICAL PATENTS.

Issued January 26, 1892.

467,504. Electric Switch. Henry J. Haight, New York, N. Y.

467,505. Electric Indicating Instrument. Henry J. Haight, New York, N. Y.

467,509. Electric Drill System. Harry N. Marvin, Syracuse, N. Y.

467,510. Electric Drill System. Harry N. Marvin, Syracuse, N. Y.

467,511. Hanger for Electric Lamps. David B. Matson, Buffalo, N. Y.

467,520. Composition of Matter for Insulation Purposes. David H. Piffard, Piffard, N. Y.

The claim reads as follows:

"A composition of matter for insulating purposes, consisting of rubber, rosin, and plaster of Paris or its equivalent in the proportion, by weight, of five rubber, twenty-four rosin and twenty-sixplaster of Paris, more or less."

467,523. Incandescent Electric Lamp. Edward P. Roberts, Cleveland, Ohio.

467,537. Alternating Current Motor. Ludwig Gutmann, Pittsburg, Pa.

Claim one is:

"An electric motor consisting of the combination of field-magnets in circuit with one alternating current generator and an armature coil divided in two or more unequal circuits in series with a secondary electric generator. This invention consists in producing relative motion of the armature and field mganets of an electric motor by giving multiple poles to the armature, by permanently forming local closed circuits in the armature by induction, and increasing the induced currents in the closed circuits by an independent and additional current."

467,538. Electric Heater. Ludwig Gutmann, Pittsburg, Pa.

The object of this invention is to provide an apparatus to be operated by the direct application of continuous, pulsating alternating, or intermittent electric currents to an electric or magnet conductor, which in turn by direct radiation or by the magnetic field established is used for practical purposes.

467,540. Electric Switch. Charles J. Klein, New York, N. Y.

467 542. Carbon Brush Holder. Cyprien O. Mailloux, New York, N. Y.

476,543. Apparatus for Charging Secondary Batteries, Cyprien O. Mailloux, New York, N. Y.

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467,545. Charging Secondary Batteries. Cyprien O. Mailloux, New York, N. Y.

The claim reads:

"The herein-described improvements in automatically maintaining the strength of the charging current or rate of charge in a storage battery by running an electric motor with a constant torque by the charging-current and allowing the automatic variation of counter electromotive force of said motor to compensate for the variations of electromotive force of the battery as the charge progresses."

467,546. Apparatus for Charging Secondary Batteries. Cyprien O. Mailloux, New York, N. Y.

467,547. Apparatus for Charging Secondary Batteries. Cyprien O. Mailloux, New York, N. Y.

467,551. Automatic Electric Controller for Air-Pumps. Adolph Bergmann, New York, N. Y.

467,573. Secondary Battery. Justus B. Entz, New York.

This invention consists in the method of applying heat to the lower end or bottom of a cell o cells while the same are being charged or discharged.

467,576. Incandescent Electric Lamp. Harry J. Gutman, Des Moines, Iowa.

467,581. Electric Railway Signaling Apparatus. Frank I. Myers, New York, N. Y.

467,583. Trolley Wheel for Electric Cars. Levi A. Simons and George R. Roof, Omaha, Neb.

This invention consists in constructing a trolley wheel with cutting edged corrugations on the outer surface of the wheel.

467,610. Electric Arc Lamp. John A. Mosher, Abilene, Kan.

467,611. Rheostat. John A. Mosher, Abilene, Kan.

This rheostat is composed of heads, a cylinder held thereon and strips surrounded by asbestos held to said heads, and wrapped with braided wire.

467,613. Contact Board for Rheostats. Sidney H. Short, Cleveland, Ohio.

467,645. Magnetic Separator. Francis H. Richards, Hartford, Conn.

467,650. Apparatus for Laying Underground Conduits for Electric Wires. Horace B. Camp, Cuyahoga Falls, Ohio.

467,651. Electric Signaling Apparatus. Patrick B. Delany, South Orange, N. J.

467,656. Electric Arc Lamp. Charles E. Scribner, Chicago.

The first claim reads:

"In an electric arc lamp containing two sets of carbons, the clutch levers supported a short distance above the lifting lever and a cut-out carried by the said lifting lever, whereby the lifting lever may be raised a short distance without being obstructed by the weight of the clutch levers."

467,669. Meter for Electric Translating Devices. Henry H. Cutler, Newton, Mass.

467,678. Station Indicator. Reuben B. Ayres, New York, N. Y.

467,679. Electric Conductor Support. Eben M. Boynton, West Newbury, Mass.

467,684. Door Opener. Charles H. Grebenstein, New York, N. Y.

467,693, Motor Mechanism for Street Cars. Richard W. Thickins, Minneapolis, Minn.

467,699. Electric Railway. Warren B. Hutchinson, Passaic, N. J.

467 716. Incandescent Lamp Socket. Patrick Dunn, Cleveland, Ohio.

467,738. Adjustable Electrode for Dental Purposes. William P. Horton, Jr., Cleveland, Ohio.

467,748. Electric Clock. Frank A. Ellis, Toronto, Canada.

467,752. Arc Metal Working Apparatus. Henry Howard, Halesowen, England.

467,773 Regulation of Electric Circuits. Frank B. Rae, Detroit, Mich,

467,774. Electric Telltale for Tanks. Charles Reuter and George Bollman, Brooklyn, N. Y.

467,815. Lineman's Wire Grip. Charles A. Kent, Beverly, Mass.

467,833. Magnetic Separator. Francis H. Richards, Hartford, Conn.

467,875. Push Button. Adam Lungen, New York, N. Y.

467,884. Station Indicator. Reuben B. Ayres, New York, N. Y.

467,891. Electric Wire Tapper. Gustave S. Neu, New York, N. Y.

46,7897. System of Electric Distribution. Nelson W. Perry, Cincinnati, Ohio.

467 901. Test Circuit for Multiple Switch-Board. Charles E. Scribner, Chicago.

The first claim is:

"The combination in a circuit open at two points, of contacts whereby the circuit may be closed at either point or at both of two sources of intermittent currents, one source giving currents of opposite direction to and complementary to those from the other source, and a polarized device adapted to respond to composite currents from the two sources."

467,902. Test Circuit for Multiple Switch-Boards. Charles E. Scribner, Chicago, Ill.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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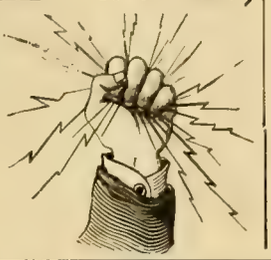

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WANTED.

Information regarding place of death of John Eicher who probably died in 1881 or thereabouts. He is known to have been interested in an electric light company, to which he bequeathed $50,000, probably in stock of the company. Remainder of his effects were bequeathed to his natural heirs. Any information as to place of death or as to identity of the electric light company to which he was interested, will be suitably rewarded if sent to William Eberhart, 803 State St., La Porte, Ind.

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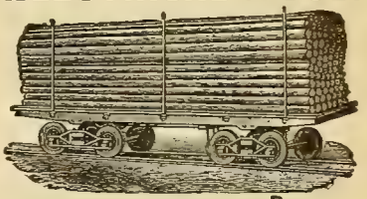

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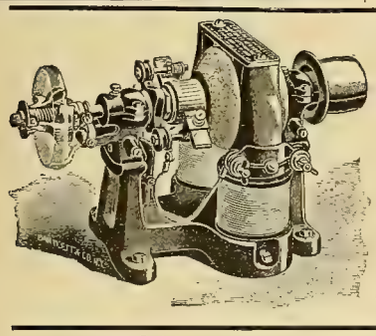

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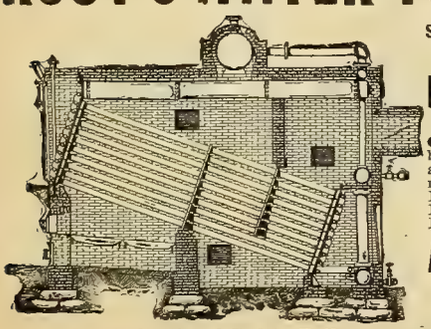

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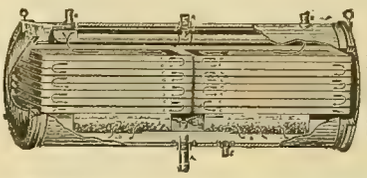

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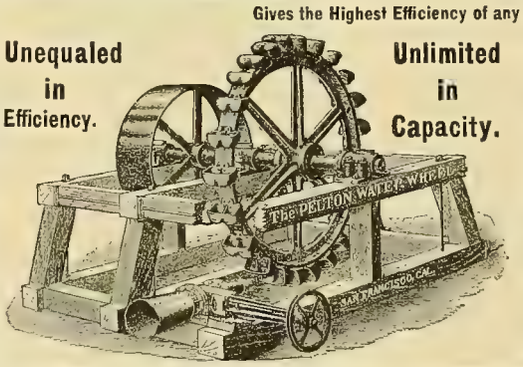

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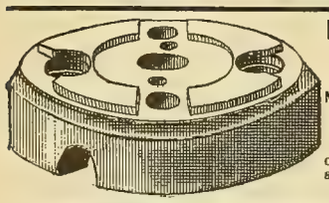

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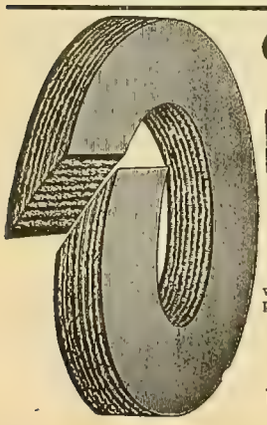

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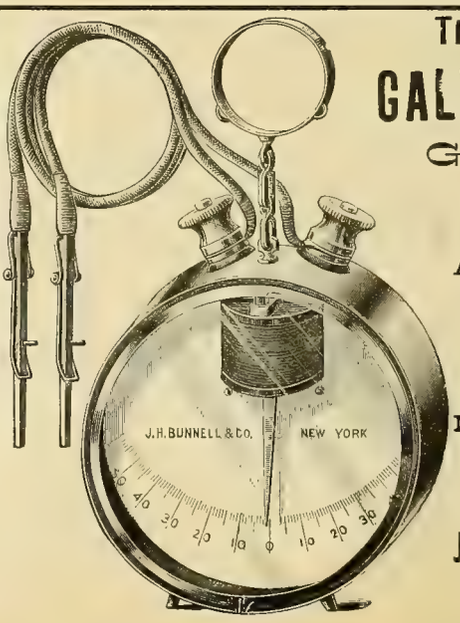

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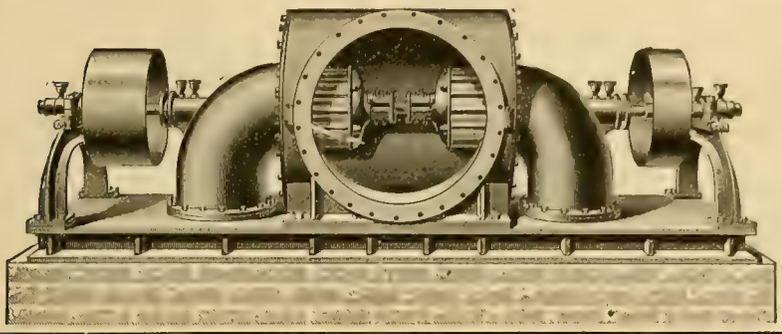

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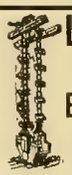

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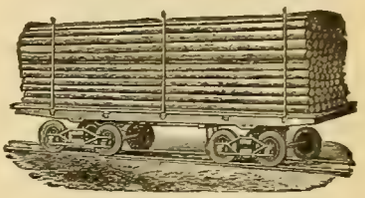

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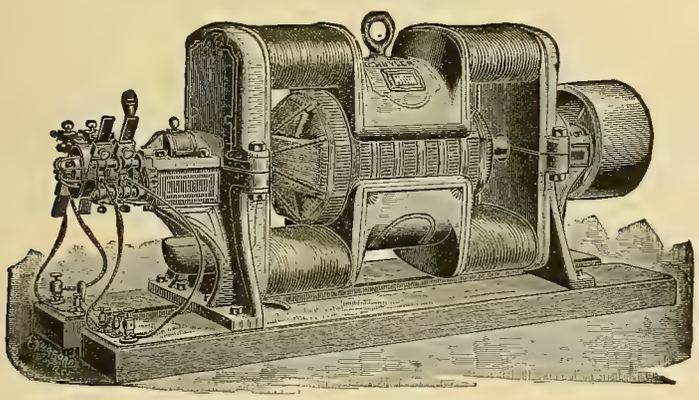

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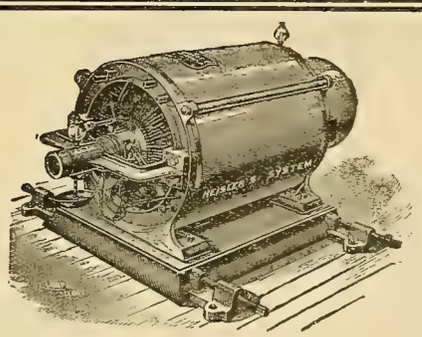

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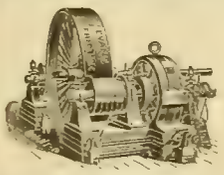

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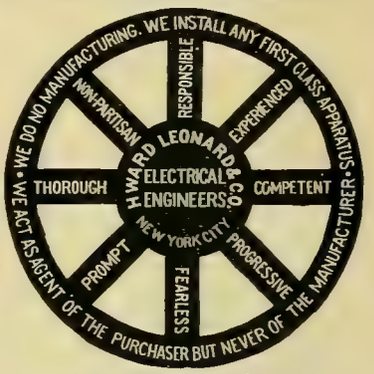

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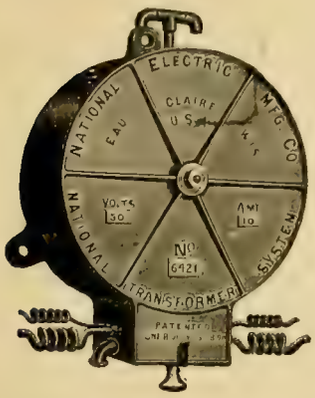

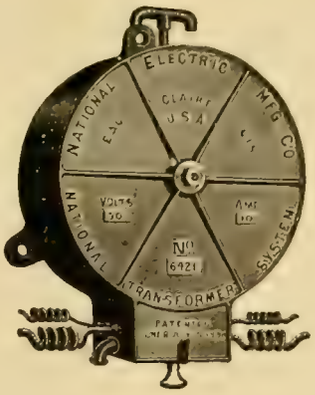

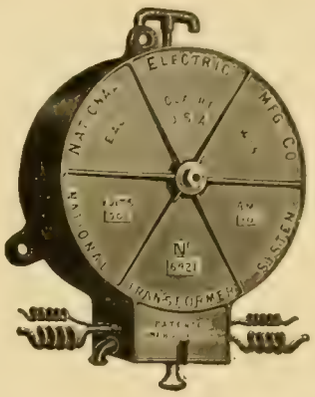

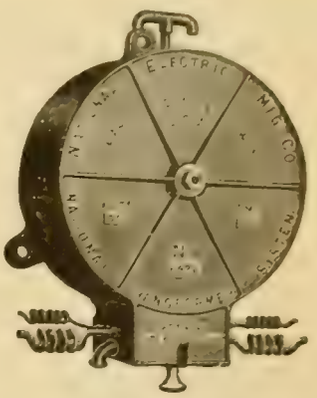

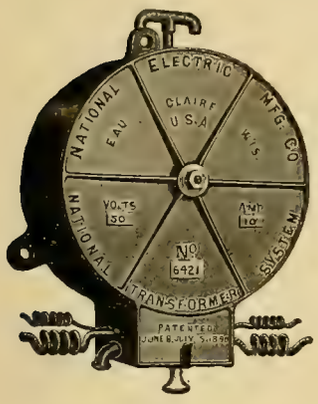

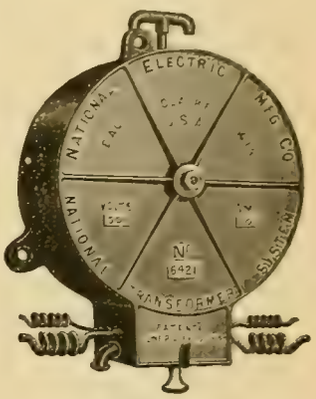

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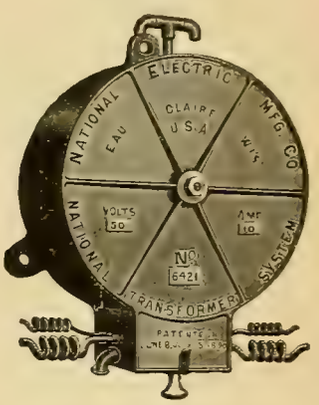

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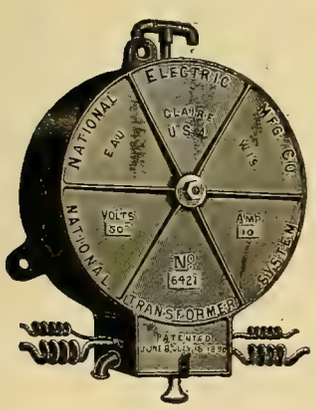

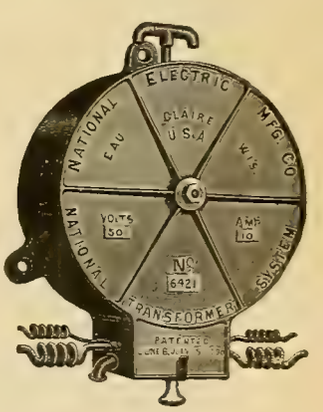

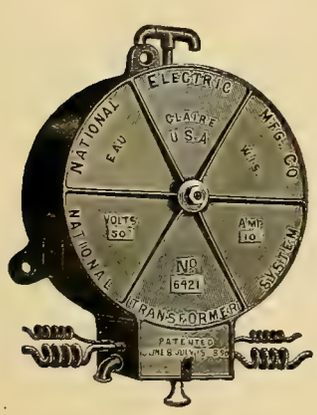

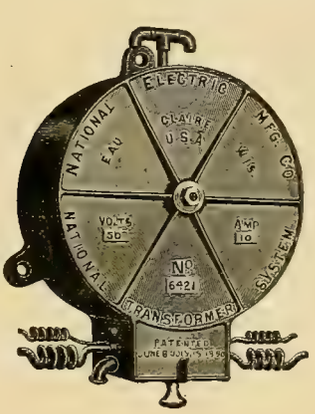

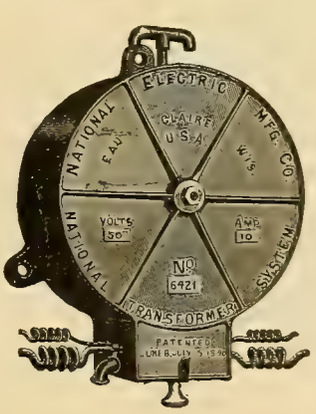

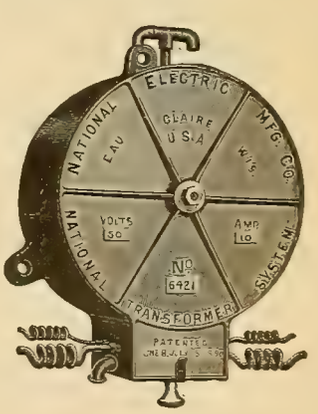

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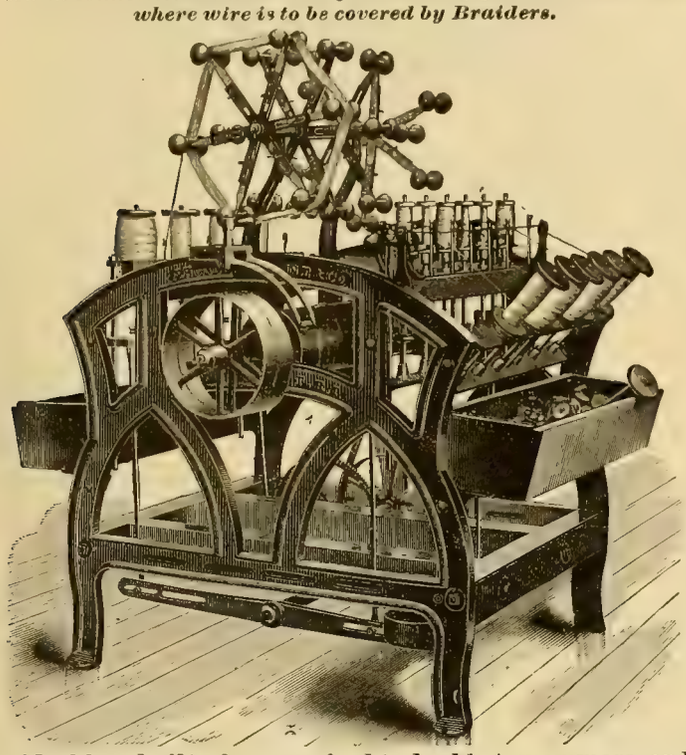

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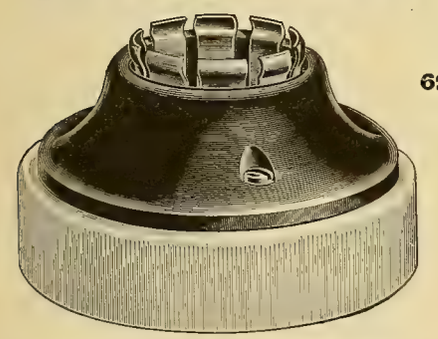

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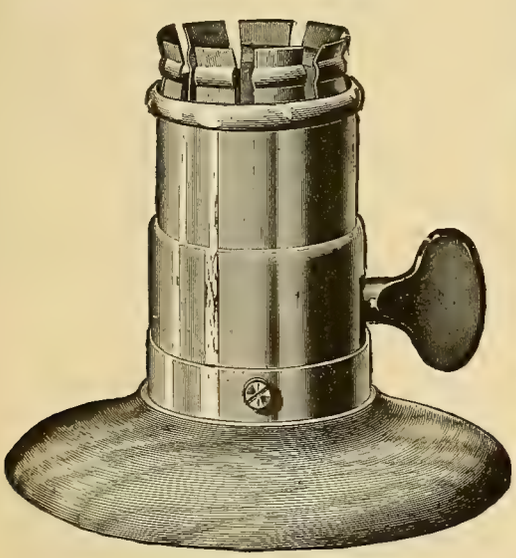

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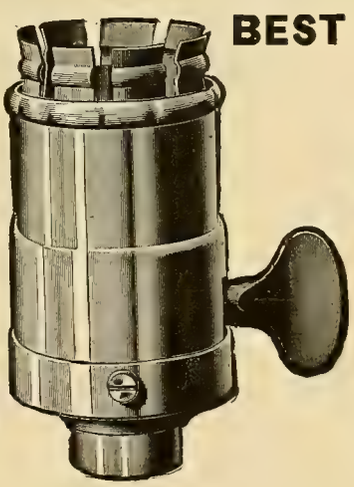

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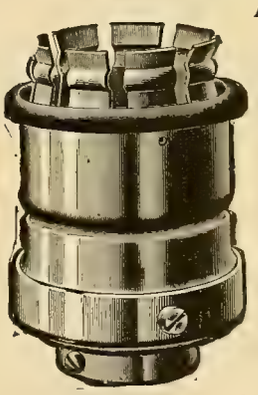

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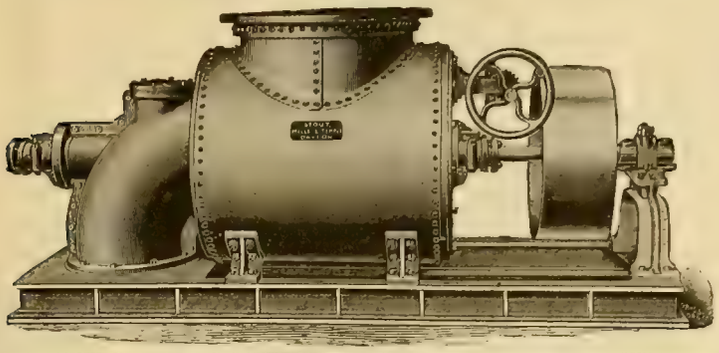

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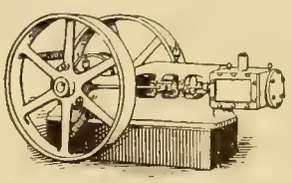

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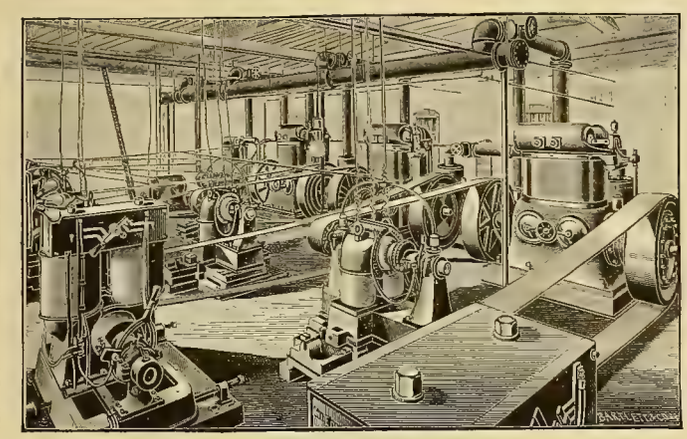

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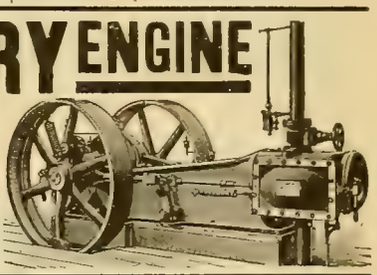

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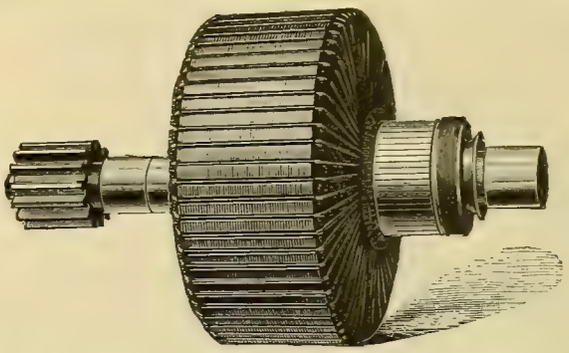

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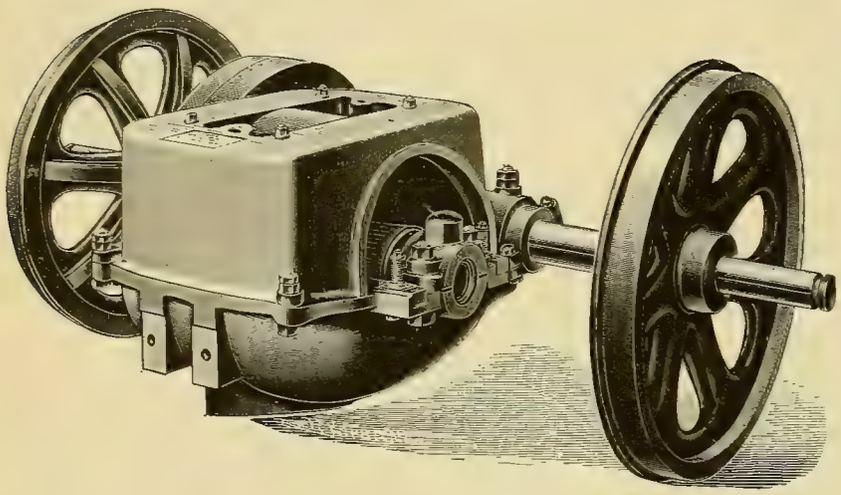

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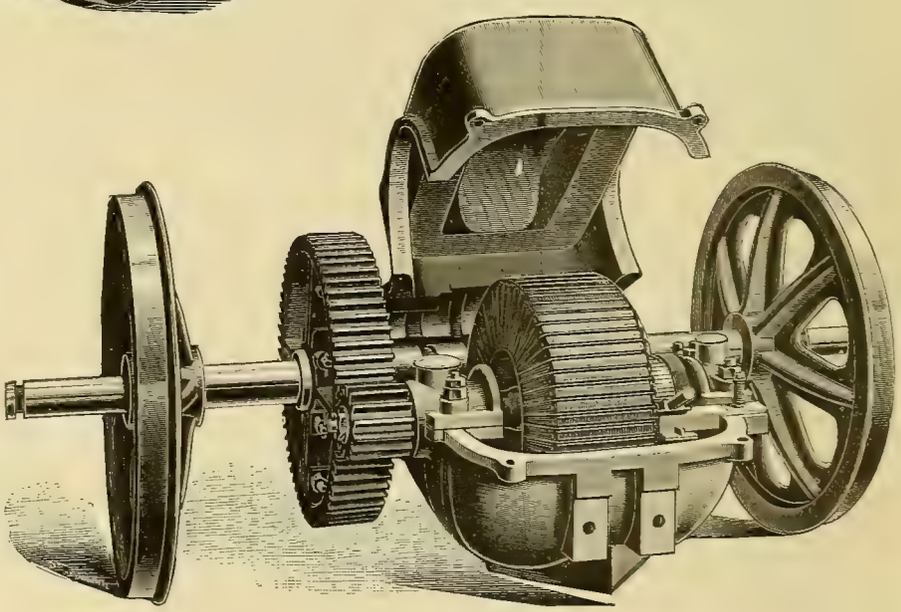

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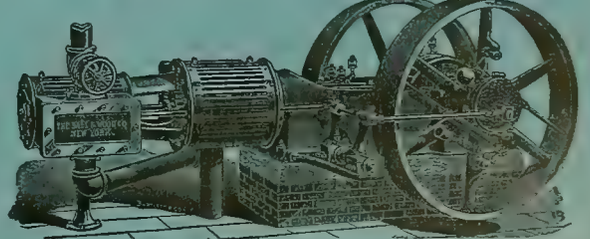

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CLASSIFIED LIST.

Aluminum.
Goodrich-Coleman Elec. Works.

Annunciators.
Central Electric Co.
Detroit Electrical Works.
Electrical Construction Co., The.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co.. The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Arc Lamps.
Beggs, J. E., Mfg. & Supply Co.
Brush Electric Co.
Easton Electric Co.
Electric Cons. & Supply Co.
Fort Wayne Electric Co.
Great Western Elec. Supply Co.
Mosher Arc Lamp Co
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Electrical Supply Co., The.
Knapp Electrical Works.
Samson Cordage Works.

Batteries.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Hirlimann, C. J.
Law Telephone Co.
Pumpelly, J. K.
Queen & Co.
Western Electric Co.

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Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Hemingray Glass Co.
Hirlimann, C. J.
Law Telephone Co.
Pumpelly, J. K.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co., W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Detroit Electrical Works.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

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Chicago Rawhide Mfg. Co.
Evans Friction Cone Co.
Jewell Belting Co.
Link Belt Machinery Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

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Abendroth & Root Mfg. Co.
Pond Engineering Co.

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Electrician Publishing Co.

Brass Goods.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Roeblings Sons Co., J. A.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Clutches, Friction.
Hill Clutch Works.

Cordage.
Samson Cordage Works.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Washington Carbon Co.
Western Electric Co.

Construction and Repairs.
Andrae, Julius.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Cons. & Supply Co.
Electric Supply & Contracting Co.
Electrical Construction Co., The.
Knapp Electrical Works.
Leonard & Co., H. Ward.
Smith, Thos. G. Jr.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Cons. & Supply Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Keller & Degenhardt.
Lasell, Edw.
Leonard & Co., H. Ward.
Pearson & Co., W. B.
Pond Engineering Co.
Racine Hardware Mfg. Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Short Electric Railway Co.
Smith, Thos. G. Jr.
Taylor Engine Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Insulated Wire Co.
Cutter, Geo.
Detroit Electrical Works.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Roebling's Sons Co., J. A.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cut-Outs and Switches.
Andrae, Julius.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Cutter, Geo.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Knapp Electrical Works.
Paiste, H. T.
Partrick & Carter Co.
Star Electrix Co.
Van Nuis, C. S.
Western Electric Co.

Drop Forgings.
Wilcox & Howe Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
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Colburn Electric Mfg. Co.
Detroit Electrical Works.
Easton Electric Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

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Electric Merchandise Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrical Instruments.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Queen & Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

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Crown Electric Mfg. Co.
Cutter, Geo.
Detroit Electrical Works.
Hussey & Co.
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Electrical Supply Co., The.
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Brush Electric Co.
Colburn Electric Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
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Keller & Degenhardt.
Leonard & Co., H. Ward.

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Ball Engine Co.
Ball & Wood Co., The.
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Pond Engineering Co.
Racine Hardware Mfg. Co.
Smith, Thos. G. Jr.
Stearns Mfg. Co.
Taylor Engine Co.
Westinghouse Machine Co.
Williams Engine Co.

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Union Electric Works.
Western Electric Co.

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Evans Friction Cone Co.

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Detroit Electrical Works.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

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Andrae, Julius.
American Electrical Works.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Electric Mfg. Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Cutter, Geo.
Detroit Electrical Works.
Electric Cons. & Supply Co.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co., The.
Star Electrix Co.
Western Electric Co.

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Gleason & Bailey Mfg. Co. Ltd.
Hemingray Glass Co.
Phœnix Glass Co.

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Butler Hard Rubber Co.

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Consolidated Elec. Mfg. Co., The.
Cushing, F. W.
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Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Hemingray Glass Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
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Nuttall, R. D., Company.
Partrick & Carter Co.
Standard Paint Co.
Vulcanized Fibre Co.
Western Electric Co.

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Bunnell & Co., J. H.
Central Electric Co.
Chicago Insulated Wire Co.
Cushing, F. W.
Cutter, Geo.
Day's Kerite Insulation.
Detroit Electrical Works.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
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New York Insulated Wire Co.
Partrick & Carter Co.
Roebling's Sons Co., J. A.
Sperry Elec. Mining Machine Co.
Western Electric Co.

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Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Cutter, Geo.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Co.
Knapp Electrical Works.
New York and Ohio Co.
Sawyer-Man Electric Co.
Somoff, J. L.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

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Powell Co., The Wm.

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(See Insulated Wire.)

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Partrick & Carter Co.

Mica.
Bowers Bros.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mine Signals, Electric.
Detroit Electrical Works.

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Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
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Bain Electric Mfg. Co.
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Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Chicago Electric Motor Co.
Detroit Electrical Works.
Easton Electric Co.
Edison General Electric Co.
Electric Supply & Contracting Co.
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Taussig, S.

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Central Electric Co.
Electrical Supply Co., The.
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Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas.

Poles.
Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Sterling, W. C.

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Electrician Publishing Co.

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Detroit Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co., The.

Securities, Electrical.
Gilman & Co., E. R.
Perry & Noyes.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

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Electrical Supply Co., The.
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Ostrander & Co., W. R.
Western Electric Co.

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Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway.
Detroit Electrical Works.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Andrae, Julius.
Central Electric Co.
Chicago Insulated Wire Co.
Cushing, F. W.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Standard Paint Co.

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Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Detroit Electrical Works.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Electric Mfg. Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

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Samson Cordage Works.

Trucks, Electric Car.
Detroit Electrical Works.
Edison General Electric Co.
Short Electric Railway Co.
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Westinghouse Electric & Mfg. Co.

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Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Stilwell & Bierce Mfg. Co.

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Beckerleg, Jas. G.

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Pelton Water Wheel Co.

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American Electrical Works.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Roeblings Sons Co., J. A.
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Short Railway Generators

ARE NO LONGER A NEW TYPE. THEY ARE

STANDARD,

And the record they have made for themselves cannot be surpassed. Inquire in Rochester, Jamestown, Covington, East Liverpool, Muskegon.

The Jamestown Street Railway Company report as follows: JANUARY 6, 1892.

* * * * * * * * * * * * * * * * * *

On Sunday morning last it commenced snowing very hard, and so continued all day Sunday, Sunday night and Monday. We were obliged to put forth every effort to prevent blockading of the road, which we succeeded in doing.

* * * * * * * * * * * * * * * * * * *

On Sunday morning we started your Generator No. 2 at 6:30 a. m, and continued to use the same until Tuesday morning at 3:30 a. m, when we shut it down. This Generator was in continuous service during the entire time, and was not even sanded, nor the brushes touched. It did not use to exceed one-half quart of oil. We consider this remarkable because of the hard work the Generator was doing. * * * * * * * *

Yours very respectfully, GEORGE E. MALLBY, Superintendent.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, OHIO.

Sometimes you forget to order

CARBONS

When you should; your supply gets low, and

YOU WANT SOME QUICK.

We are represented by the following concerns.
By ordering from the nearest one, you can

GET THEM QUICKLY.

They carry a large stock on hand.

THE WASHINGTON CARBON COMPANY,

WASHINGTON, PA.

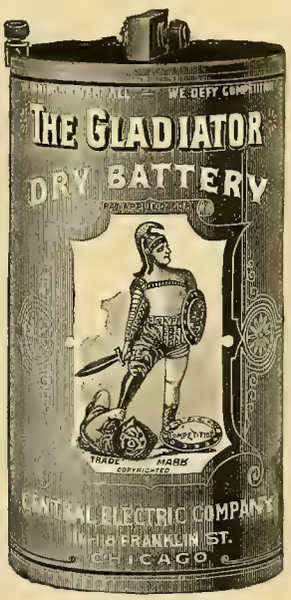
EDISON GENERAL ELECTRIC COMPANY,

— AT —

Boston, Buffalo, Cleveland, Detroit, Cincinnati,
Louisville, Atlanta, Chicago, St. Louis, Milwaukee,
Springfield, Mass., Minneapolis, Denver, San Francisco, Portland, Oregon.

HOLMES, BOOTH & HAYDENS, 25 Park Place, New York.
FRANK S MARR, 641 N. Broad St., Philadelphia, Pa.
ELECTRICAL SUPPLY & CONS. CO., Pi tsburg, Penn.
CENTRAL ELECTRIC CO., Chicago, Ill.

THE GLADIATOR DRY BATTERY.



The comparative tests of this battery with all other dry batteries show conclusive evidence of its superiority. Those who have used the battery in small quantities are now ordering it in large quantities, and its customers cannot speak too highly of its merits.

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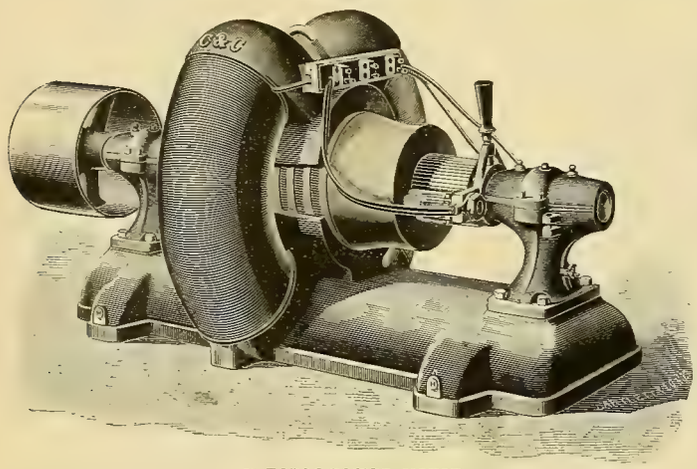
C. & C. Electric Motors & Dynamos.



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QUICK BREAK AND CONTACT.
NO MORE BURNED TERMINALS.
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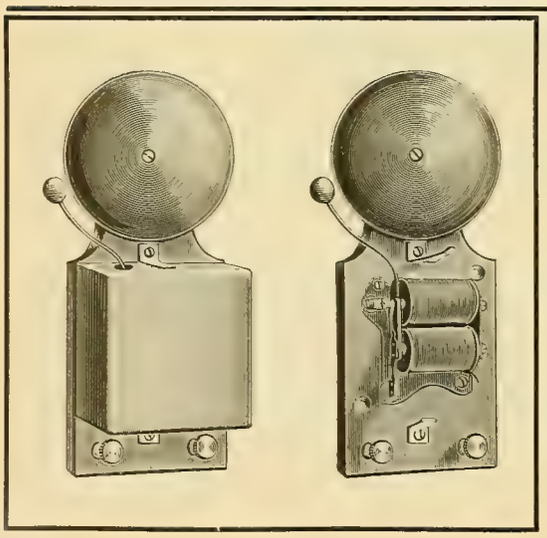
Ask your Supply House for them or write to

CROWN ELECTRIC MFG. CO.,
Bridgeport, Conn.



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TRADE MARK.

THE FATHER OF THE TELEGRAPH
USED KERITE WIRE.

NOTE THE DATE OF THIS LETTER:

New York Nov 19th 1858

To Austin G. Day, Esq

Dear Sir,

I have been much gratified in hearing your explanation of your newly discovered Compound called Kerite and in examining the various Specimens of it, in its application specially to Telegraphic Conductors, as an insulator whether in the atmosphere or beneath the earth water It appears to me you have discovered the most perfect as yet of all insulating substances for Submarine Telegraph Cables.

Its quality or rather property of resisting the deteriorating causes which tend to destroy sooner or later the insulation by gutta percha, or caoutchouc makes it an invaluable discovery in aid of Telegraphic extension. The tests to which it has been submitted and by which it has been proved to resist the deteriorating effects of the ozone of the atmosphere appear perfectly satisfactory, and I therefore, most cheerfully and cordially join with those who have tested its efficiency in congratulating you on your success in introducing so valuable an aid to the Telegraphic enterprize of the world.

In commending the Kerite specially for Telegraphic purposes I would by no means leave out of view its other various applications in the Arts not less extensive and useful than those which have had so wide an influence in the discoveries & inventions of your distinguished relative the late Charles Goodyear.

With hearty wishes for your success

Your Ob. Servt

Sam'l F. B. Morse

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W. R. BRIXEY, Supt.

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EDISON BUILDING, BROAD STREET, NEW YORK.

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10 Amperes—Double Pole.

5 Amperes—Single Pole.

5 Amperes—Single Pole.

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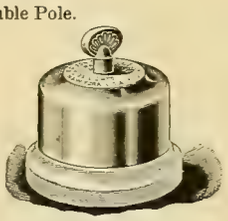

10 Amperes—Double Pole.

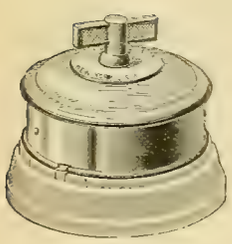
5 Amperes—Single Pole.

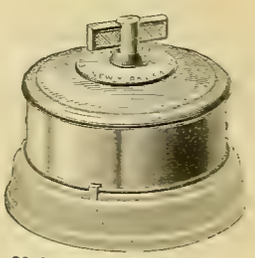
5 Amperes—Single Pole.

5 Amperes—Single Pole.

CHEAPEST, EDISON PATENTED. STRONGEST,

40 Amperes—Double Pole.


15 Amperes—Double Pole.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SWITCHES.

INCOMBUSTIBLE.

10 Amperes—Single Pole.

10 Amperes—Single Pole.

10 Amperes—Single Pole.

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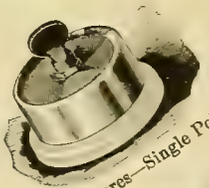
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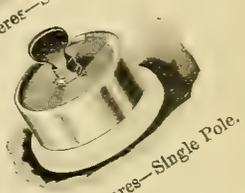
10 Amperes—Single Pole.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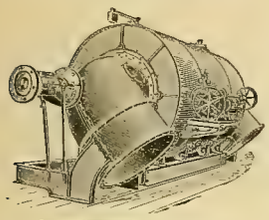

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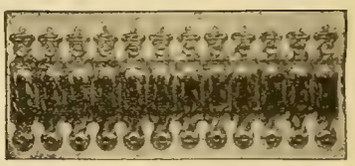

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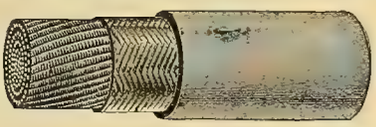

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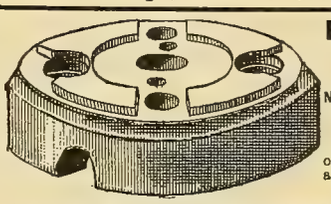

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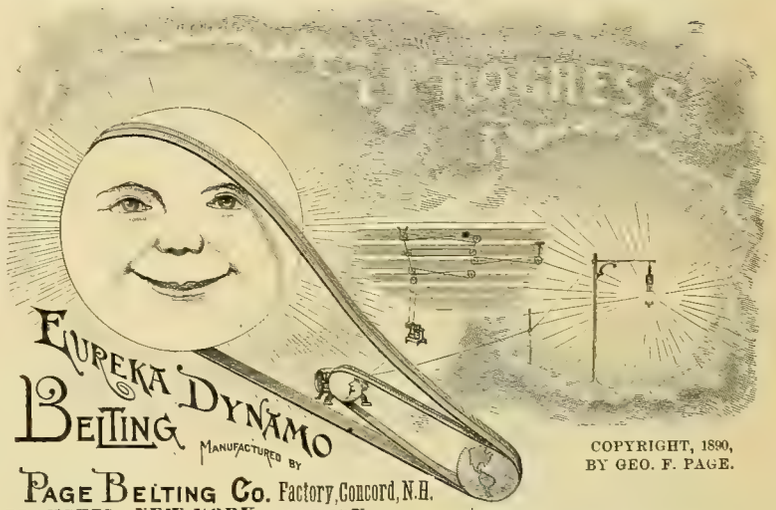

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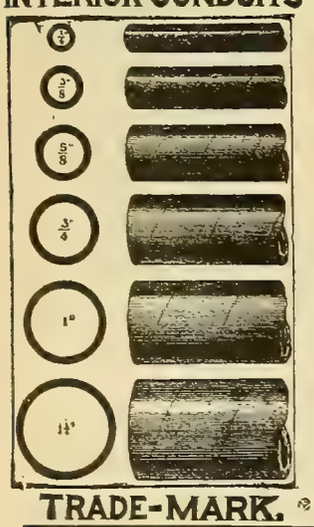

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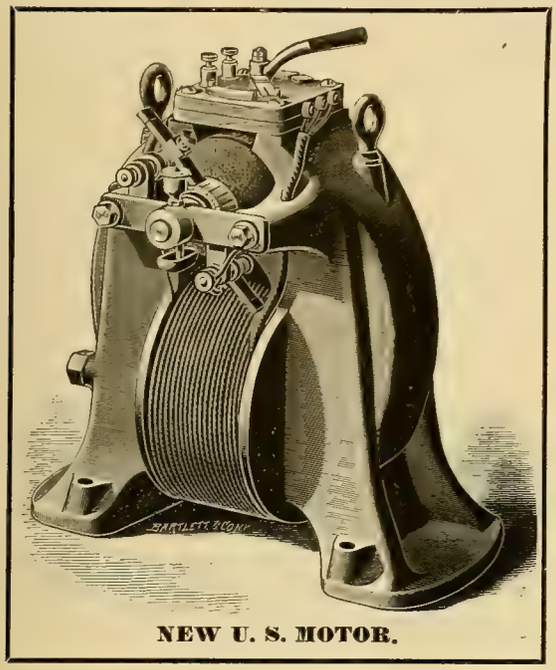

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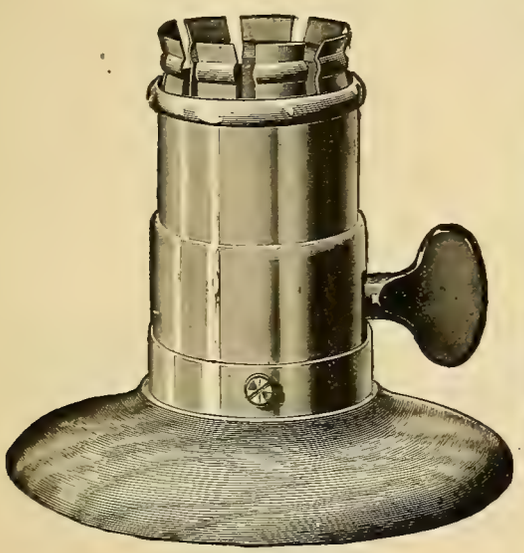

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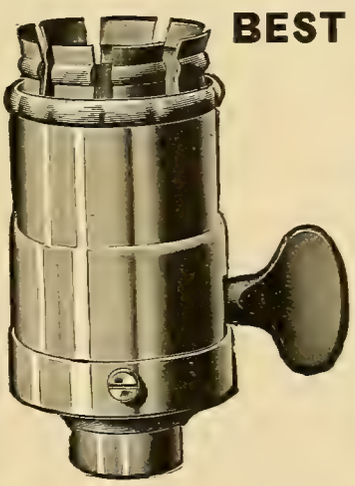

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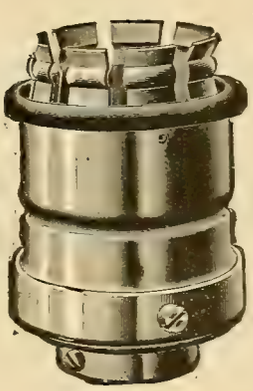

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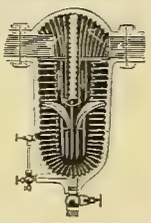

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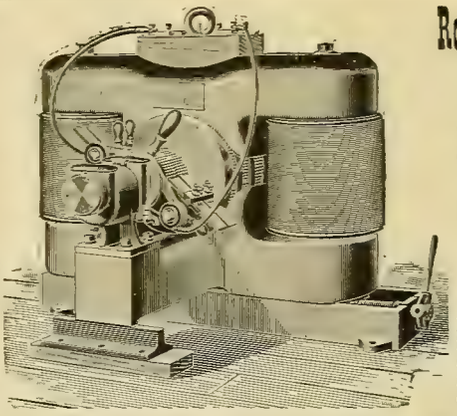

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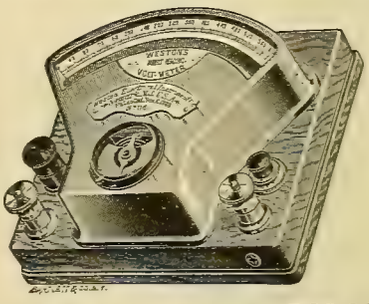

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Vol. X. CHICAGO, FEBRUARY 13, 1892. No. 7

Electrically Lighted Vestibule Train on the Chicago, Milwaukee and St. Paul Railroad.

"Yes; it is expensive, but we must have it." Such a remark as this relative to the electric lighting of train No. 1 on the Chicago, Milwaukee and St. Paul railroad, made recently by Assistant General Passenger Agent F. A. Miller, is significant of the growing appreciation of railroad men of the great advantages possessed by the incandescent lamp when employed as a train illuminant. About three years ago the Chicago, Milwaukee & St. Paul Railway company, through its mechanical engineer, George W. Gibbs, undertook to devise what might be called a combination system for lighting trains by electricity and heating them by steam. The problem presented was to supply a system of heating and of lighting that should contain no element of danger for the passenger in the event of a serious wreck, and yet be practicable in a train of from 10 to 14 cars running over lines built through a country noted for its cold waves and long continued range of low temperature at periods lasting seven months of the year.

In the two years of extensive experimenting which the company carried on with electric lighting apparatus much experience was gained with storage batteries. But Mr. Gibbs found that they were costly and unreliable. The depreciation of batteries and waste of power were discovered to be very great under heavy working loads. The cells, he states, gave constant trouble from freezing in the winter, shaking to pieces, buckling of plates, short circuiting and other operating failures. In short, the company concluded that the storage battery required too much skilled attention to be adapted for service in such a system of electric train lighting as was required on this road. After careful consideration, the decision was reached that the problem could best be solved for this particular road by construct. ing an independent "light and heat tender;" in other words, a central light, heat and power station on wheels.

In the development of this tender the question of heating was, perhaps, as important as that of lighting. It was found by careful experiment that 100 pounds of water per car per hour were needed to heat the train properly when the temperature was ten degrees above zero, and 70 pounds of water were required with the temperature 27 above zero. The through trains to which the tender was to be attached weighed about 500 tons, requiring about all the power of the locomotive to make schedule time, so the drain for heating and lighting would naturally be greatest at times when bad weather made the greatest demands upon the locomotive for traction. A separate tender car carrying its own boiler for heating and lighting, therefore, seemed the most feasible solution.

It may be mentioned that it was thought that the additional train load might go far to counterbalance the drain upon the locomotive for heating and lighting, but the experience of the St. Paul road is that for these purposes from ten to twelve per cent. of the steaming capacity of the locomotive is absorbed in severe weather, and it is the unanimous statement of enginemen that they would rather have the extra car than be obliged to supply steam for the train.

The light and heat tender system was put in service in January, 1890, and there are now in use on the road two tenders which serve on the runs between Chicago and Minneapolis, and supply each a load of about 154 lights.

With a view of giving the readers of the WESTERN ELECTRICIAN a comprehensive idea of the thorough manner in which the system has been worked out, a number of photographic views and diagrams showing the most important features of the lighting and heating equipment are herewith presented.

Figs. 2 and 3 are respectively an exterior and interior view of the light and heat tender which is used in winter. Fig. 1 shows the summer arrangement of the generating plant. It should be explained that when it is not necessary to heat the train a decrease in train load is obtained by placing the dynamo and engine in the end of the baggage car, as shown, and cutting off from the train the light and heat tender. By far the most artistic portion of the equipment is that in the drawing room car, an interior view of which is shown in Fig. 4. Over each chair in this car there is an incandescent lamp most conveniently hung under a fringed red lamp shade of tasteful design. The effect of the light shed by these lamps from beneath the two rows of colored shades on the sides of the car is most pleasing to the passenger entering from the darkness without. The lamps in the sleepers are arranged in a manner that delights the weary traveler. The man whose eyes have suffered from attempts to read his evening paper by the far-off and dim oil lamps hung near the car ceiling finds in the St. Paul sleepers a lamp not only at his elbow but one that gives him the light from behind and over the shoulder. Fig. 5 shows the admirable location of the berth lamps and their convenience to the traveler, not only before the berth is made up but after the curtains are drawn for the night. Each berth lamp is placed within a drum having two rotating shutters, Fig. 6, which can be raised or lowered when desired to use or to shut out the light. The hood formed by the upper half of the drum is so arranged that it shades the light from the eyes of the passengers who are facing it, and it also serves as a reflector to cast light upon the book or paper in the hands of the passengers sitting under it. As the shutters open on both sides, one lamp does for two berths, and the closing of the second shutter, when the occupant is through using the lamp, cuts it out of circuit. Should occasion arise during the night to use the lamp, the simple opening of either shutter places the lamp in circuit. In the dining car in summer small fan motors make their presence felt in a most satisfactory manner.

FIG. 1. ELECTRICALLY LIGHTED VESTIBULE TRAIN ON THE C., M. & ST. P. R R.

A few points as to the details of the generating equipment will be of interest. The tender follows immediately behind the locomotive tender. It is 34 feet long by nine feet in width, encased in ¼ inch plate steel, with steel doors, and supported on a heavy under frame of unusual strength resting on special trucks. Including full equipment, its total weight is 65,000 lbs. It is carried on four-wheeled trucks having 33 inch wheels, and the new Master Car Builders standard axle, with journals 4⅛x 8 inches. The interior of this tender is divided into two compartments, separated from each other by steel doors, the larger or forward section being 20 feet in length, and holding a tubular steel boiler to carry 125 pounds of steam, though but 80 pounds' pressure has thus far been used. This boiler is 13 feet 9 inches in length, with 136 two-inch tubes. The furnace is of the locomotive type, with safety lock on the door, the fire box being 4 feet 10 inches long and carrying but a thin bed of coals, the ashes being raked down to the road-bed. On each side of the furnace is placed a coal box, the two combined carrying an amount of fuel nearly sufficient for the round trip in midwinter, thus allowing for any delay not exceeding ten hours. The floor of this section is of iron. The rear section of the tender contains a No. 4 Edison compound-wound dynamo, belted direct to a standard 6½x6 inch Westinghouse engine, the distance between the centers of shafting being 7 feet 6 inches. The necessary switches, resistance boxes, Weston voltmeters and ammeter, etc., are arranged the same as in a regular station. The weight of engine and dynamo is counterbalanced by a steel tank placed on the opposite side of the section, and holding 270 gallons of water in reserve for use in the event of an accident or the absence of the locomotive tender, from which the water required in the boiler is constantly pumped. The boiler has a water bottom; that is, it is double, with water between the sheets as a precaution against fire. It is in one end of the car, and a straight smoke-stack extends through the roof. From a 24 inch dome on top of the boiler a

steam pipe goes to the engine and to both ends of the car to coupling joints for heating the train. A better understanding of the location of the boiler, engine, dynamo, etc, may be obtained from Fig. 7, reproduced from the *Railroad Gazette*, which shows the location and arrangement of the engine and piping, also of the boiler and the coal bunkers. The fire door has a safety catch, and the boiler having a water bottom the fire is held in a fireproof receptacle. As the draft is only a natural draft, and the fire very thin, little or no smoke issues from the stack.

The boiler shown in the cut has a sufficient capacity to heat ten cars, and furnish steam to drive the dynamo.

FIG. 2. ELECTRICALLY LIGHTED VESTIBULE TRAIN ON THE C., M. & ST. P. R. R.

With western coal this boiler can evaporate about six pounds of water per pound of coal. With the Westinghouse engine the best results were obtained, tests showing that with 57.8 pounds of water per horse power the average indicated horse power was 10.4. This was with a 15 horse power automatic engine running on 80-pound steam pressure.

The arrangement in the end of the baggage car of the apparatus for summer service is quite like that in the heat and light tender. The baggage car carries a No. 4 Edison dynamo, compound wound, and a 6½x6 inch Westinghouse automatic engine. In a 60 foot baggage car 12 feet of one end is given over to the engine and dynamo. This leaves a space for baggage which has so far been sufficient. A steam pipe from the engine is brought in through the end of the car, on the inside of which there is a "T," from which a pipe leads across under the roof of the car and down into a steam separator, where the water condensation is extracted from the steam. The pipe from the tender enters the bottom and the steam pipe of the engine leads out from the top. After passing the "T" on the train pipe, a reducing valve decreases the steam pressure from that necessary for the engine to that desirable for the train. The exhaust from the engine passes up through the roof and through a muffler.

For the lighting service four men are employed, each man making a round trip of 860 miles from Chicago to

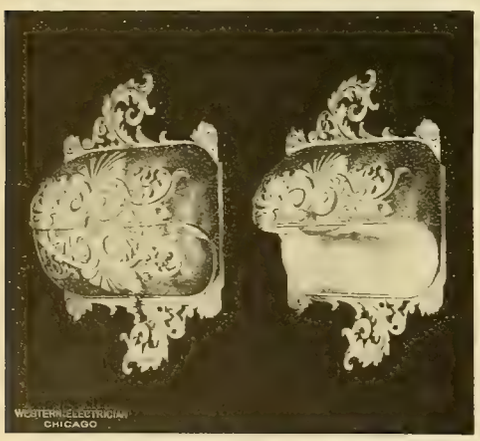


FIG. 6. ELECTRICALLY LIGHTED VESTIBULE TRAIN ON THE C., M. & ST. P. R. R.

Minneapolis and return, with a short rest at Minneapolis and 36 hours' rest at Chicago. Only one man is employed on a train at one time, and it is an easy matter for him to care for the entire heating and lighting of the train. Only one electrician is employed for all the trains.

When the train is being made up in the yards steam is brought up to pressure in the tender and the engine and dynamo started, the lamps being turned on as required till 11 P. M., when all are turned out save those on the end circuits in the vestibules, toilet rooms and passage ways. About 6 A. M. the necessary lights are turned on again, but the dynamo is continually in operation during the night.

It is an interesting fact that the work of designing and constructing the first tender was done in about sixty days, and up to this time very few improvements have been necessary.

Electricity at the World's Fair.

The specifications for the arc lighting and motor service for the World's Columbian Exposition have now been issued, and the specifications for the incandescent lights will be out in a few days.

Proposals for furnishing the plant, which will leased by the exposition, will be received by D. H. Burnham, chief of construction, 1143 Rookery, Chicago, until noon of March 15th in the case of the arc lights and until noon of March 18th for motor service.

The arc light contracts will be for the "general illumination of the grounds and main buildings," and the total capacity required is about 5,000 lamps for interior lighting and about 1,000 lamps for the illumination of the grounds. The machinery and apparatus required comprise dynamos, with full complement of station apparatus, including switch-board; also lamps, opalescent globes and globe nets. The erecting of machinery and apparatus in position, the external circuit, and connecting the latter to switch-board and lamps are not included in the specifications. All systems and generators of any capacity are eligible. Generators may be operated in series, but it is not desirable to operate any circuit at a difference in potential exceeding 3,000 volts. The lamps may be of any candle power, but units of 2,000 nominal candle power are preferred. Ten per cent. of the lamps shall be capable of burning at least fourteen consecutive hours without removing the carbon. The circuits will be erected and maintained by the exposition, although until lately it was supposed that the contrary would be the case. The successful bidder shall furnish one competent lamp man and one competent dynamo man to supervise the installation, operation and removal of the plant. The erection will be done at the expense of the exposition authorities. The lessor shall deliver the machinery and apparatus furnished under the specifications, free on board cars at Jackson Park, as follows: One-third of the capacity not later than July 1, 1892; one-third of the capacity not later than August 1, 1892, and the remaining one-third not later than September 1, 1892. The machinery and apparatus supplied may be listed and classified as an exhibit by the national commission of the World's Columbian Exposition, subject to the rules and regulations governing exhibits. The bids need not necessarily be for the whole number of lights, and the bidders are requested to state the terms at which they will furnish capacities up to 500, 1,000, 1,500, 2,000 or more lights.

The four sets of specifications for motor service include merely the generators and accessories and not the motors and circuits. The generators must be of the direct current constant potential type, with a maximum electromotive force of about 550 volts. The motive power, with connections to the generator pulleys, will be furnished complete by the exposition. The general requirements are the same as for arc lighting, except that all the machinery and apparatus must be delivered at Jackson Park not later than September 1, 1892. Proposals should state specifically the price at which the lessor will agree, if required, to supply within three months after date of order additional capacity of generators and apparatus not to exceed 25 per cent. beyond the amount stated in the specifications. The chief of construction reserves the right to accept only 75 per cent. of the capacity in generators specified, the contract price in that case to be reduced pro rata. The total capacities of the four power plants and the minimum capacity of each generator are as follows:

Manufactures and sundry other buildings—Total, 800 kilowatts; smallest generator, 100 kilowatts.
Machinery and agricultural buildings—Total 900 kilowatts; smallest generator, 100 kilowatts.
Mines and mining building—Total, 600 kilowatts; smallest generator, 80 kilowatts.
Transportation building—Total, 300 kilowatts; smallest generator, 50 kilowatts.

All bidders must furnish suitable bonds.

The temporary power and lighting plant for the work of construction now going on at Jackson Park is giving great satisfaction. Twelve motors, varying from 9 to 25 horse power, are now in operation on the grounds, principally employed in driving sawmills. This is one of the largest isolated electric power plants in the United States, possibly larger than any other. Arc lamps to the number of 100 and 350 incandescent lamps are now wired, and nearly all of these are burned nightly.

Work on the electricity building seems to lag somewhat behind that on the other structures, although operations are continuously carried on. Twelve steel roof trusses were placed in January. Contractor Johnson is installed in a temporary office erected on the flooring of the great building. The roof of the building will consist of 80,000 square feet of canvas, 150,000 square feet of composition, and 52,000 of glass skylights.

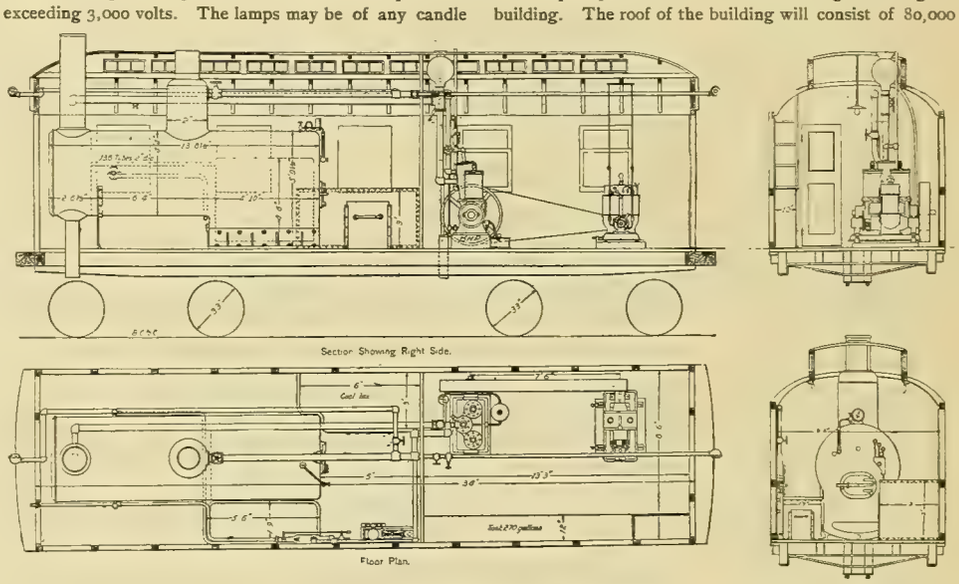


FIG. 7. ELECTRICALLY LIGHTED VESTIBULE TRAIN ON THE C., M. & ST. P. R. R.

The Thomson-Houston exhibit at the World's Fair will be in charge of a committee of the leading experts employed by the company. This committee will include F. B. Badt of Chicago and Lieut. Spencer of Lynn, together with other gentlemen representing the various departments. The company promises to make an elaborate display of commercial apparatus, with many novel features.

A meeting of the committee on electrical congress, World's Congress Auxiliary, was held on February 2d at the Auxiliary headquarters. Prof. Gray presided, and there was considerable discussion. Prof. H. S. Carhart of the University of Michigan was elected secretary of the committee, and F. W. Cushing was chosen as assistant secretary, as Prof. Carhart resides outside of Chicago. Prof. Gray is preparing an address to the electrical fraternity of this country and Europe, setting forth the aims of the congress, and it was decided to refer this document when completed to a sub-committee yet to be appointed.

Chief Burnham of the bureau of construction has recommended that the committee on grounds and buildings set aside a space 150x350 feet for an exhibit of the illuminating and fuel gas industries of the country. The building will probably be located southeast of machinery hall at the southern extremity of Jackson Park. C. K. G. Billings, president of the People's Gas company, Chicago, wants to furnish gas for lighting the north end of Jackson Park during the World's Fair. In order to secure the privilege he is willing, it is said, to put in the entire plant at his own expense, and also remove it without cost, at the close of the exposition. He will furnish the gas at 90 cents per 1,000 feet. There is some talk of lighting the state buildings at the north end of the park by gas.

The prospectus of the department of electricity, which was issued on Saturday, is short, but contains all the information that the directors think needful for exhibitors in this department. The scope of the department is stated to be "the demonstration in actual operation of the commercial and economic applications of electricity. It is desired, however, to make exhaustive tests of electrical apparatus in all possible directions with a view to establishing the actual efficiency of the same in comparison with other and older methods of accomplishment." Object lessons showing the development of the science and art from their earliest stages by means of an historical exhibit are also contemplated.

In relation to the lighting of the grounds it is stated that about 8,000 arc lamps of 2,000 nominal candle power each and about 130,000 16 candlepower incandescent lamps will be needed. Beside this from 3,000 to 3,500 horse power will be required for the operation of the machinery of exhibitors. This will be transmitted by electricity from the central power station. In relation to this central station the prospectus says: "To furnish and transmit this 24,000 horse power the Exposition company will construct a plant which, though a complete station in itself, will be composed of a number of smaller complete plants, installed by those who contract to furnish certain parts of the service. These plants will be primarily for the service of the exposition, but are not for that reason prohibited from becoming competitive exhibits as well, provided the usual course is taken by their owners of making the proper application of exhibitors, through the office of the director-general."

Electric power, it is expected, will be used for the intermural railway that will constitute a part of the service of the exposition, although this question has not been definitely settled. Arrangements for exhibition of electric cars in operation will also be made, although the necessary space has not yet been located. Displays of electrical mining and metal working machinery will constitute an important portion of the exhibits in the department

In relation to artistic lighting effects the prospectus states that small chambers illustrating varied effects promise to be popular with exhibitors, and all proper aid will be extended by the department, which looks for the best possible results.

The concluding paragraph of the general statement is as follows: "It is superfluous to add that every possible field of electrical work will be liberally considered, and that all systems of all countries will be placed as favorably as possible, to the end that the best results may accrue to the electrical people and the public at large."

The electrical building is described, and also the manner of securing space by applying to the director-general of the exposition. In reference to the installation of exhibits it is stated that all electrical apparatus, excepting generators and the adjuncts of the generating plant, must be shown in the electrical building, where electrical power only will be furnished. Generators to be operated by steam power can not be installed in the electrical building, but must be located at some other point.

Alluding to the much talked-about question of the relation of electrical exhibits and the service plant the prospectus says: "The power station will contain the plant under contract to serve the exposition, and will probably contain the generators of those exhibitors who contemplate exhibiting generating plants of sufficient capacity only to operate the balance of their exhibits in the electrical building. Steam power for the running of these generators will be furnished by the Exposition company at a moderate price, the figures to be fixed hereafter. In the event that it be found undesirable to combine the actual service machinery with the purely exhibitive generators some acceptable site will be found for the latter within reach of power. Appliances and apparatus, such as electrical elevators, search lights, etc., intended for exhibition, but offered and accepted for the service of the exposition, may be installed wherever their service is required without forfeiture of their rights as competitive exhibits, provided that such outside location shall have been approved by the director-general."

Ample facilities will be provided for moving pieces of machinery weighing not more than thirty thousand pounds. Any article weighing more than this will require an extra charge for installation. Empty packing cases may be stored at a maximum rate of two cents per cubic foot; with insurance, two and one-half cents will be charged for this service.

Foreign exhibits may be entered free of duty, in bond. If sold the regular duty will be collected.

In conclusion it is stated that the officers of the exposition must for obvious reasons assume arbitrary power in the acceptance of exhibits and the allotment of space. This power, however, will be exercised with the view to aiding the greatest possible number of exhibitors to make the most of the opportunity afforded by so great an exposition.

The special department rules, which have been already published, are appended.

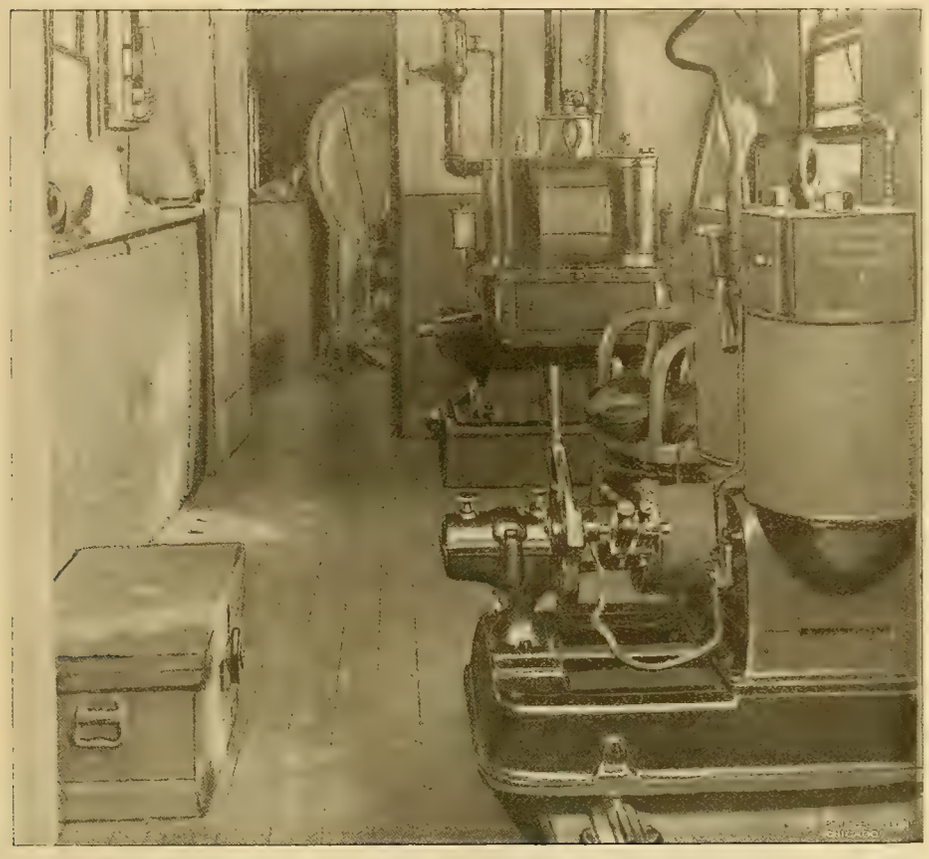


FIG. 3. ELECTRICALLY LIGHTED VESTIBULE TRAIN ON THE C., M. & ST. P. R. R.

The *Engineers' List* is the title of a neat little monthly that has just made its appearance in New York. The publishers intend to present in its pages announcements of the manufacturers and dealers in such steam specialties and engineers' supplies as are of known excellence in their particular lines.

Electric Signals on the Northwestern Railway.

The Chicago & Northwestern Railway company has contracted with the Hall Signal company to equip nearly 60 miles of its lines with automatic electric train signals. The first sections of road which the Northwestern is to equip will be on the Galena division from West Fortieth street, Chicago, to Turner, twenty-five miles; on the Milwaukee division, from Clybourn Junction to Waukegan, thirty-three miles, and on the Wisconsin division, from Clybourn Junction to Barrington, twenty-eight miles. There will

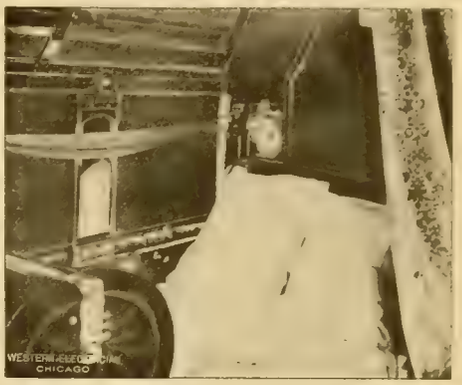


FIG. 5. ELECTRICALLY LIGHTED VESTIBULE TRAIN ON THE C., M. & ST. P. R. R.

be over 200 signals enployed, and as soon as this work is completed it is the company's intention to continue the system throughout the greater part of its main lines.

The signal is purely automatic, and is operated entirely by electricity, each signal being provided with a special battery, which is placed underground. The signal stands normally "safety," and is set to "danger" when the train passes it, by the depression of a lever, which is placed at right angles to the rails, by the wheels of the locomotive; this breaks the circuit carrying the current to the signal. The signal remains at danger until the train shall have set a second signal at danger, and the first signal is again returned to "safety" by a similar track lever placed about 1,500 feet beyond the second signal. The system is so constructed that the signal will always go to "danger" by its own gravity, should the battery become weakened or any of the connections broken. All of the switches in the block section are connected with the signal, so that the opening of any switch on the main line sets the signal a suitable distance in advance. When the signal stands at "clear" it is an indication not only that there is no train ahead within that block, but that all the switches are properly set for through traffic, and also that the apparatus is in perfect working order. The wires are to be placed underground, in boxing, between the tracks.

The Northwestern will be the first railway in the West to be provided with electric signals.

Will Not Use Electricity.

From time to time during the last two months the daily papers of Chicago and New York have contained state-

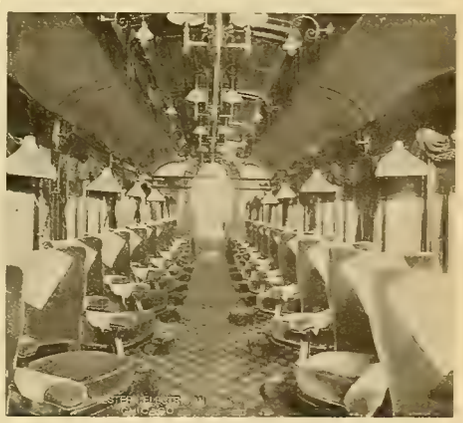


FIG. 4. ELECTRICALLY LIGHTED VESTIBULE TRAIN ON THE C., M. & ST. P. R. R.

ments to the effect that the Illinois Central Railroad company had decided to use electricity as the motive power for its suburban traffic in view of the changes that will be necessary to accommodate the enormous World's Fair business that this company will secure. This, however, is not the case, although the directors have had the idea under consideration. In response to a request for infor-

mation from the WESTERN ELECTRICIAN the president of the company writes: "Our company has had under consideration the possibilities of introducing electricity as a motive power on its proposed traffic to the World's Fair, but, after carefully considering the matter, our directors have come to the conclusion that electricity cannot be practically applied to the conditions which will apply in the case."

In an interview Superintendent Schlacks is reported to have said: "We did not report favorably on the electricity idea. Nor, for that matter, did we report unfavorably upon it. The fact is we, that is, myself and Consulting

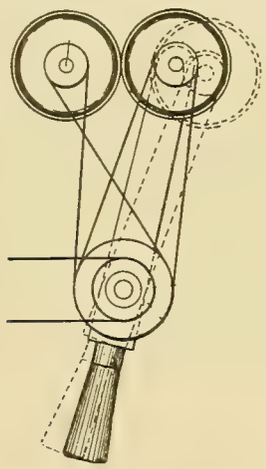


FIG. 3. PROF. ELIHU THOMSON'S CIRCUIT BREAKERS.

Engineer Wallace, were asked by the Illinois Central officials to get estimates of the cost of furnishing a thorough electric plant for our suburban traffic. Also the amount of power needed to operate successfully such a plant. The result of our investigations was very unsatisfactory. And for this reason: From all the largest electric concerns in this country the cost submitted for a thorough outfitting varied so much that we considered that they were really not in condition to fill the bill. From some concerns the price reached $1,200,000; others fell to $90,000. Then, too, the power needed for operation differed in about the same ratio of prices."

Prof. Elihu Thomson's Circuit Breakers.

Through the use of the switch shown in Fig. 1 it is proposed to overcome the difficulties often experienced in the present state of electrical engineering where it is found desirable to open and close circuits on which large currents of high potential are present. With the ordinary de-

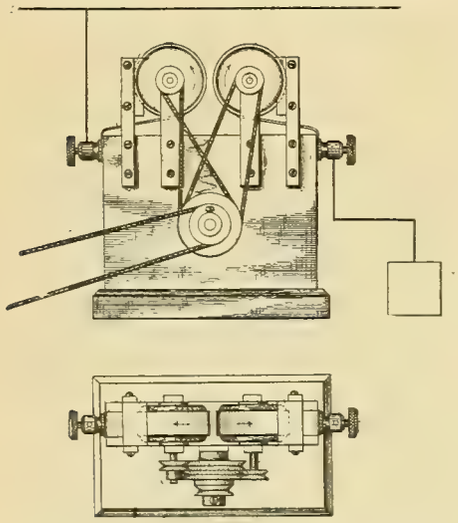


FIG. 2. PROF. ELIHU THOMSON'S CIRCUIT BREAKERS.

vices now in use it has been found that such circuits cannot be opened and closed without the presence of sparking and destructive arcs at the contacts. By the use of this switch, according to the designer, Prof. Elihu Thomson, it has been found that it is possible to avoid all such arcing, and to control these large currents with ease and perfect safety to the apparatus used.

The underlying principle of the switch consists in causing the contact to traverse successively a less and less perfect onducting path, so that the total resistance of the circuit when the switch is opened is gradually increased until the contacts are entirely separated, and the circuit ruptured. It is as though a closed path of practically no resistance between the switch contacts was gradually converted into a path of higher and finally infinite resistance.

As will be seen from the cut there is a receptacle made of insulating material, at one end of which there is a vertical plate of conducting material to which is connected a wire, forming a part of the line circuit. The vertical plate extends down and is therefore in contact with the fluid contained in the receptacle. This fluid is a partial but poor conductor of electricity—as, for instance, a solution of a salt like sodium sulphate. A conducting bar is carried upon the upper ends of two arms as shown and depending from this bar is a series of metal rods which dip in the liquid when the switch is closed, as indicated in the cut. These bars may extend down so as to touch the lower end of the vertical plate, forming a solid contact, or the plate is constructed with a trough-like lower edge, in which is held a body of mercury, into which the depending bars dip, as shown.

It is desirabie also in most cases to place upon the mercury and under the fluid a number of small iron balls or they may be replaced by hard carbon balls or, better still, the layer of iron balls may have a layer of carbon balls overlying them, the relative specific gravities of the mercury, the iron and carbon balls and the solution preventing them from mixture.

From the above it would seem that the different resistance conductors are arranged serially in the order of their respective conductivities and form a path for the moving switch of gradually increasing resistance as the yoke is swung to the left.

On opening the switch the break in the circuit is not a sudden one, for the depending bars first leave the mercury, then pass through the iron balls and then through the carbon balls and liquid, cutting each into circuit, and thereby gradually increasing the total resistance of the circuit until it is finally broken by the withdrawal of the bars entirely from the liquid.

Prof. Thomson has also devised another arrangement for avoiding excessive arcing on the interruption of electric currents of considerable potential. The device is adapted for use at the jumping spaces of lightning arresters, and also in connection with circuit-breaking switches, etc. The construction of the new circuit breaker is based upon the fact that rapidly moving conducting surfaces conveying current are not liable to arcs, and that arcs upon these rapidly moving surfaces may be extended or lengthened out without really moving the conducting surfaces from one another, so as to alter the actual discharge distance between them.

Prof. Thomson's idea, then, consists in causing a rapid movement of the discharge terminals at the point of interruption in the circuit where arcs are liable to occur. He does this in order to present a continual supply of new metal to the discharge at such a rapid rate that the arc cannot take up the new discharge points, and is extended by reason of its tendency to hang to the old ones. This preferred movement is one of rotation. Figs. 2 and 3 show the application of the principle to a lightning arrester, and also to an ordinary break switch. Referring to Fig. 2, the general arrangement of the lightning arrester will be understood. Two wheels of conducting material, serving as discharge terminals and separated by a jumping insulation space, are journaled on studs, the former being in circuit with the line to the earth-plate. These wheels are caused to rotate in opposite directions, as indicated by the arrows, by any suitable means. In the rear of the wheels and close to though not touching their peripheries, are placed arc-interrupting blocks of insulating material, such as hard porcelain or slate, which are shaped to correspond with the wheels. When the arrester is in operation the arc will tend to form at the point where the distance between the wheels is shortest, but owing to their rotation it will be carried upward and outward until finally it is disrupted upon reaching the insulating blocks, or, as more often occurs, before reaching the blocks, because the mere lengthening of the arc as it follows around the discharge terminals, is sufficient to extinguish it.

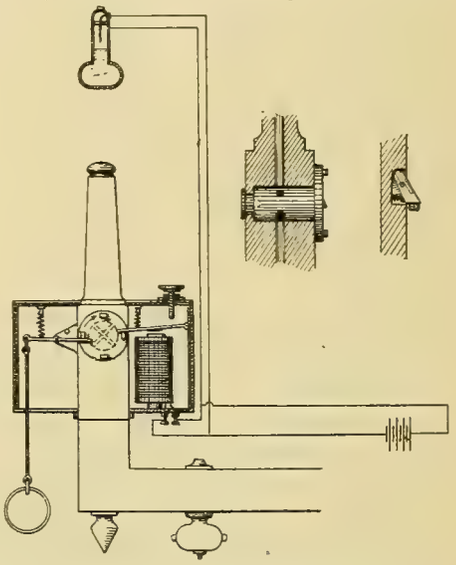
In the switch shown in Fig. 3 the circuit is closed by bringing the two discharge wheels directly into contact with one another, and this is accomplished conveniently by journaling one of the wheels upon a supporting arm, which is pivoted upon a stud likewise forming the bearing for a driving pulley, which is belted to the terminal wheels.

When it is desired to open the circuit, the arm is turned into the dotted line position, and this may be done without interfering with the continuous rotation of the wheels, as will be evident.

An electric drill has been put in the Candice mine in Ouray county, Colo. The owners will proceed to sink shaft to ore body.

Electrical Safety Cut-out for Gas Burners.

One would naturally think that when it became necessary to resort to electrical appliances to prevent accidents to those verdant specimens of unsophisticated humanity who blow out the gas, it was about time to adopt the electric light and do without gas altogether. There are, however—and there will be for some time to come—a large number of people to be protected from the "deadly" gas burner, and inventors seem to be fully aware of this fact.



FIGS. 1, 2 AND 3. ELECTRICAL SAFETY CUT-OUT FOR GAS BURNERS.

For example, J. E. Hogan of Oakland, Cal., has only recently devised a little fixture that he designates an "electric safety attachment for gas burners." The device is shown in Figs. 1, 2 and 3.

There is inserted in the burner, between the tip and the cock, a supplemental plug cock. This plug is perforated in two directions by holes, Fig. 2, at right angles with each other so that when either of the holes is in line with the passage to the burner-tip, gaswill be allowed to flow, but when they stand diagonally with the passage to the burner-tip the supply will be cut off. The plug is turned in one direction by intermittent movements, so as to first open the passage for gas, then cut it off, and continue thus alternately. This rotation is effected as follows: Upon the outer end or shaft of the supplemental plug there is fixed a disk which has four spring actuated stops fulcrumed in depressions in the face of the disk, as shown in Fig. 3. By means of a

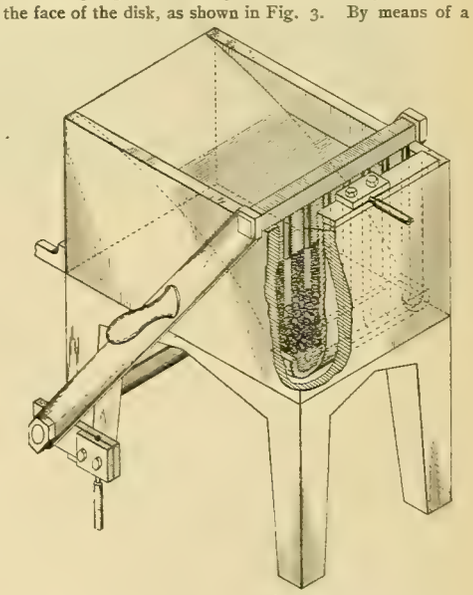


FIG. 1. PROF. ELIHU THOMSON'S CIRCUIT BREAKERS.

small spring the points of these lugs are forced outward, so as to be engaged by the operating levers acting in one direction. The lever at the left, with a cord and ring attached, is fulcrumed so that the cock may be turned by hand. The lever on the right is arranged as indicated, so that it may be pulled by the electric magnet and thus turn the cock.

Above the burner, or in such a position that it may be acted upon by the heat from the gas jet, is a copper bulb containing mercury. It is proposed, through this mercurial contracting device electrically connected as indicated, to control the supplemental cock through the agency of the electro-magnet.

Electric Fog-Bell at Ravenna.

The Italian port of Ravenna, on the Adriatic, is entered by a channel protected by two long piers. There is a large lighthouse about two-thirds of a mile from the end of the piers, but it was found necessary to establish a signal at the extremity of one of the piers in order to determine the entrance during fogs. The erection of a bell station was determined upon by the government, and the Abbe Joseph Ravaglia was intrusted with the task of devising an electrical installation by which the bell could be

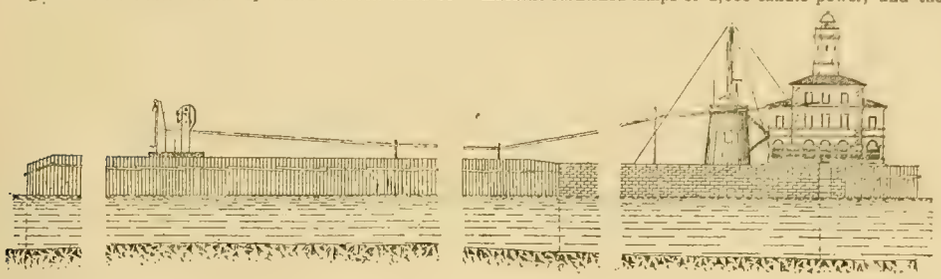


FIG. 1. ELECTRIC FOG-BELL AT RAVENNA.

rung automatically from the lighthouse during foggy weather. This course was decided upon, as a steam siren could only have been erected at great trouble and expense, and the construction of the pier was such that hand labor was impracticable. Electricity was found to be better adapted to the purpose in every way.

The working of Prof. Ravaglia's system, which has been operated with great satisfaction for several months, is shown in the accompanying diagrams. Fig. 1 gives a section view of detached portions of the equipment, showing the large lighthouse on the right and the bell, at the extremity of the pier, on the left. Eight battery cells placed in the lighthouse generate a current of four amperes at eight volts. These cells are of Prof. Ravaglia's invention, and it is claimed that the internal resistance is unusually low. The current is transmitted over an aerial copper conductor, supported on ordinary glass insulators, The total resistance of the battery, circuit, and motor is but five ohms. A current of slight electromotive force and a circuit of low resistance were employed in order to avoid expensive insulation on account of the almost constant dampness of the poles and wires.

The actuating mechanism, by which the bell is rung, consists of a series of gears attached to the armature of a small motor, Figs. 2 and 3. The first cog-wheel makes 600 revolutions to one of the last. The latter, Fig. 2, carrie six pegs, *a*, *a'*, etc., which, in turn, unlock the lever that moves the bell hammer. The mechanism is so geared that one blow is struck on the bell for every 300 revolutions of the armature.

The motor used has some peculiar features. The field,

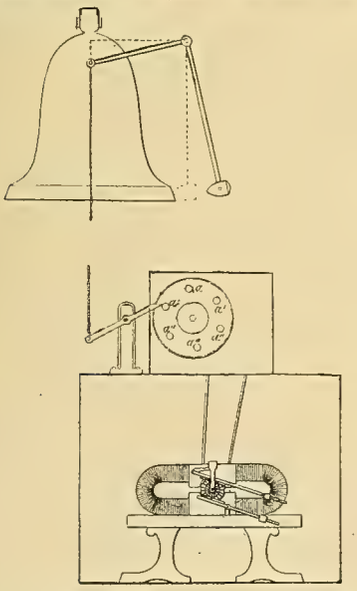


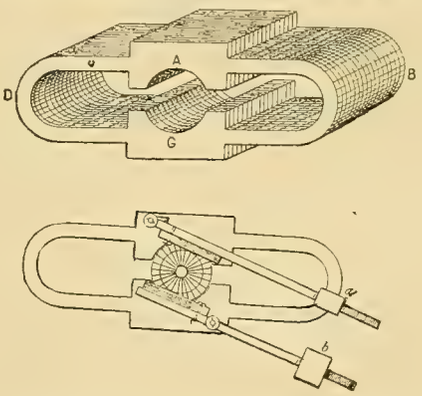
FIG. 2. ELECTRIC FOG-BELL AT RAVENNA.

Fig. 4, is composed of thin plates of highly magnetized steel, separated from each other by light strips of pasteboard, thus diminishing the Foucault currents and strengthening the magnetic field. The pole pieces, *A* and *G*, as seen, surround the armature space. The connecting portions, *B*, *D*, are wound with wire of low resistance. The brushes, Fig. 5, are attached to levers, with counter poises *a*, *b*, by which the pressure on the commutator can be easily regulated by moving the weights.

When the battery is in operation the bell rings every fifteen seconds. The cost of operation is about 22 cents for 24 hours. The description and cuts were taken from *Electricité*.

Driving an Arc Light Plant by Gas Engines.

In 1887 the Racine Gas Light company, Racine, Wis., started in the electric lighting business with a 12"x14" high speed engine and a Brush 65 light arc dynamo. This machine furnished lamps of 2,000 candle power, and the coal consumption, according to Superintendent John Rodgers, was 6 pounds of coal per lamp hour. In 1888, on account of receiving the city contract for 128 street lights, it became necessary to arrange to increase the capacity of the plant. There was no question as to what electrical apparatus should be added to the outfit, but the problem



FIGS. 4 AND 5. ELECTRIC FOG-BELL AT RAVENNA.

was as to motive power. At other plants the company had two 12"x12" engines and one of 60 horse power, all high speed; but still 6 pounds of coal per lamp hour was the most economical consumption that could be attained. At this time the Otto gas engine attracted the company's attention and the claims for this engine proved so alluring that it was decided to experiment with gas motive power. The company states that it has never regretted the venture. When it is taken into consideration that 6 pounds of Pittsburg coal, which the company is now using, would make 30 cubic feet of gas and that it would only take 27 cubic feet of gas per lamp hour, it will be seen that there is effected a saving of 3 cubic feet per lamp hour and also a saving of half the coke and all the tar the coal will make. This saving of the 3 feet of gas, half of the coke and all of the tar comes, according to Superintendent Rodgers, within 10 per cent. of paying the original cost of the coal. There is also no haulage to be charged up against the gas engine, as the gas is taken directly from the gas holder, and, further, as there is no increase in plant to make the additional gas the engines require there is no extra interest, taxes or insurance to pay. A few other small items of increased cost might be added, but these are almost too insignificant to be considered.

The station as it now stands has in it two 50 horse

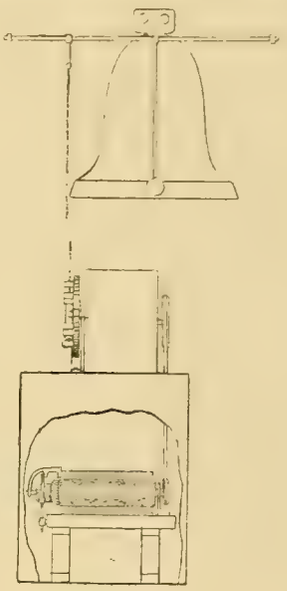
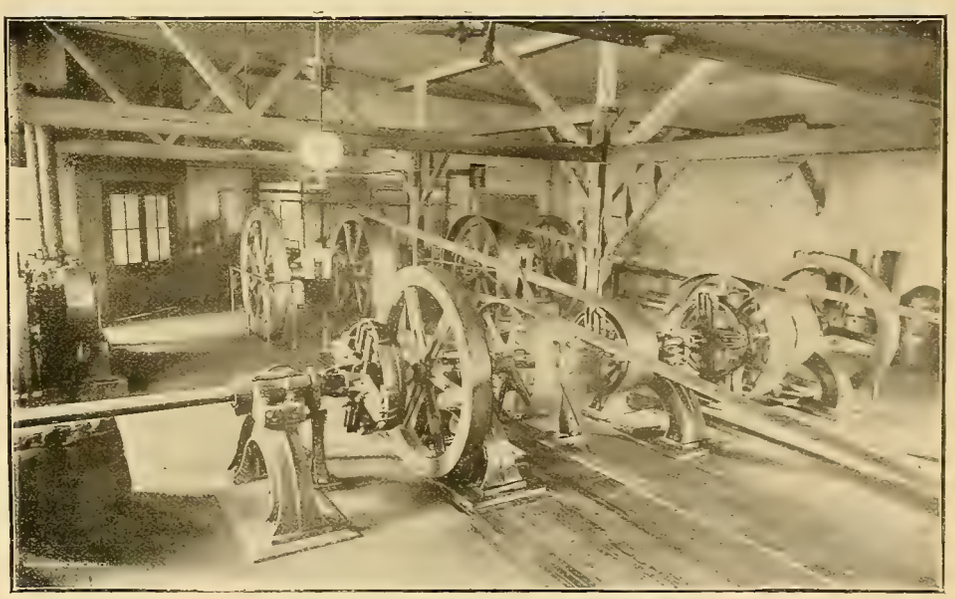


FIG. 3. ELECTRIC FOG-BELL AT RAVENNA.

power Otto gas engines belted to one shaft with 12 inch belts. From the shaft are driven one 65 lighter and one 20 light 2,000 candle power Brush arc dynamos. The cut shows the arrangement of the gas engine and shafting. The plant is equipped with the Eclipse friction clutch pulleys so that any part can be shut down without interfering with the operation of the balance. Every night one engine and one dynamo is shut off at 10 o'clock while the other engine and dynamo run until 12 o'clock. The power is so steady that a tachometer put in the center shaft shows only a variation of from 411 to 412 revolutions per minute. The gas used is the ordinary illuminating gas taken directly from the holder and the consumption of 27 cubic feet per lamp per hour equals about 1¼ pounds of coal per horse power per hour. It is estimated that the two engines represent a cost of about the same as a 100 horse power Corliss engine with boiler, heater, pump, etc.



DRIVING AN ARC LIGHT PLANT BY GAS ENGINES.

The Adelphi hotel, Liverpool, has lately been fitted with telephones in all the rooms on three floors. Each room is fitted with a call box and double Ader instrument (magnetic transmitter). There is a separate call bell, and a three-contact pear push is suspended near the bed. Visitors can communicate with one another, and with the hotel staff.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

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THE use of rotating contact points for switches operated on high tension and heavy current circuits is proposed by Prof. Elihu Thomson. It has been found that the rapid rotation of the contacts prevents the extension of the arc. The idea in its crude form is embodied in apparatus illustrated in another column.

THE plant of the Racine Gas Light company, Racine, Wis., may be taken as a good illustration of the manner in which a gas company can secure the advantages of the two systems of lighting. Here is a company that might very naturally have been expected to fight the advance of the electric light. Instead, however, of following the old fogy course which invariably results in some other more progressive corporation absorbing profits that they alone should have, how much more sensible it would be if certain of those stubborn gas companies would awaken to an understanding of opportunities neglected, but under their very noses, so to speak? Gas engines have their faults to be sure, but with a power transmission system, provided with properly weighted fly-wheels and designed especially for driving dynamos, there is no reason why a most excellent service could not be maintained, and especially in cases similar to that described in another column, where the plant takes care of a steady load.

AN electric street railway company of Utica, N. Y., in its annual report makes a statement to the effect that one of the greatest enemies of electric motors is rough and uneven tracks. The truth of this assertion is now only too evident to many short-sighted companies. At first it was thought that an electric motor was possessed of a supernatural endurance, could withstand rough usage both within and without, over any sort of roadbed, and at the same time give the most perfect service. The little machines in many cases did surprise their makers by an endurance under circumstances that another power equipment would never have been subjected to, but now careful managers of street railways know from costly experience that the electric motor, like the horse, must be properly cared for, or numerous break-downs will follow, entailing annoying delays and heavy repair bills.

GOVERNOR FLOWER has signed the bill under which newspaper men are allowed to be present at electrical executions and already the rapacious writers have had an opportunity for satisfying the public's appetite for sensational matter. Nearly every broad minded American citizen has believed from the first that it would only be a question of time until the very objectionable feature of secrecy in such proceedings would be stricken from a law horrible enough even when carried out in a civilized manner. While New York state is to be congratulated on having overcome this singular tendency to barbarism the change in the law is not without its disadvantages, for it will bring sadness to one class at least that is deserving of sympathy. We refer to the daily newspaper editor. This individual will now have to hunt up another stock subject upon which he can pour out those columns of righteous indignation.

THE electrical fraternity will no doubt be greatly interested in the specifications for the arc lighting and electric motor service at the World's Columbian Exposition which have just been issued. It may easily be believed that enterprising electrical companies, both in this country and Europe, will see the great advantage of securing these contracts and also those for incandescent lighting, the specifications for which will shortly be issued, and that some very low bids will be the result. The time for putting in tenders is short and the necessity for prompt action is obvious. In figuring on these installations electrical manufacturers may well bear in mind two facts. One is that manufacturers of steam engines have already outdone them in enterprise by furnishing free of cost all the engines, boilers and accessories that have thus far been found needful for the construction operations at Jackson Park; the electrical apparatus is leased. The other consideration is that the prices ruling for these first contracts will have great influence in determining whether the exposition authorities can afford to light the whole exhibition, practically, by electricity, or whether a considerable portion shall be lighted by gas.

TECHNOLOGICAL education has been neglected heretofore in Chicago, but the outlook at present indicates that the establishment of an institution devoted to this work will soon be assured. The meeting held last week under the auspices of the Chicago Electric club showed there was much general interest in the project. In addition to the club members there were present many prominent business men and others interested in educational matters. Mr. Parker's paper, presented elsewhere in this issue, is a strong argument in favor of an institute of technology. But it is hardly necessary to present arguments for such an institution. It is generally conceded that there is a great demand for the special training to be gained only in these schools. To-day the importance of technology training is recognized, and special departments are established in connection with many of the leading educational institutions in the East. Hence, it is reasonable to suppose that much assistance will be gained from the University of Chicago, the president of which has already displayed great interest in the work. Such a connection cannot fail to be advantageous to both the University of Chicago and the proposed technological institute, and it is probable that the latter will begin its work under the management, and as a part of, the former. This would certainly be a most desirable arrangement, and should be borne in mind while perfecting plans for the work. The fact that the Chicago Electric club does not feel content with directing public attention to the subject is shown in the appointment of a committee to look after the matter. This committee has already organized for work and had a conference with Dr. Harper and Secretary Goodspeed of the University of Chicago. Assurances have been received from capitalists that warrants the announcement that there will be no lack of funds. A sub-committee was appointed at the conference to arrange a public meeting at which the subject would be discussed and steps taken toward the formal inauguration of the movement.

ELECTRIC light men have an excellent programme arranged for the meetings of the National Electric Light association at Buffalo this month. President Huntley has succeeded in securing promises from prominent men in several departments to present papers of vital importance to all who are interested in central station management.

The list is presented elsewhere in this issue. In addition to those who have promised to read papers, there are assurances that many others, equally prominent, will be present to participate in the discussion. There will be, at this meeting, in all probability, the best representation of electrical engineers that has ever assembled in this country. In view of the fact that this will be the last convention before the World's Fair, an extra exertion will be made to make the meeting, at least in its literary and scientific features, superior to all preceding gatherings. As far as the entertainment is concerned, there will be plenty of amusement and many points of interest in and about Buffalo to occupy the attention of the visitors. There will be no excuse for a poor attendance, as the transportation committee has secured favorable rates from all points in the country. On the whole, it is expected that the Buffalo meeting will be a memorable event in the history of the association.

AFTER much delay, not due to any fault in the electrical department, the prospectus of this section of the World's Fair has at last received the several consents prerequisite to its final approval and transmission to the printer. A comprehensive summary is given in another column. The prospectus contains little that is new, save a hint that possibly the generators used for the service plant and those displayed by electrical exhibitors to operate other of their own exhibits in the electrical building may be installed in two places. This course should be avoided, if possible, as one of the chief attractions of the great electrical plant in machinery hall will be the varying types and sizes of dynamos seen working under load, side by side. One great display of this character would be preferable to two of smaller size and possibly placed some distance apart. Undoubtedly the management has this consideration in view, and will use its best endeavors to place the generators together. Mention is made of a small charge to be made for steam power supplied to generators not under contract to supply light or power for the exposition. It is not apprehended, however, that this toll will be so large as to prove burdensome to any exhibitor. The special rules of the department are included in the prospectus, and intending exhibitors will save themselves annoyance and delay by making themselves conversant with these requirements at an early day. Copies of the prospectus can be had by making application to the department of electricity, World's Fair.

FROM a recently published account of the unsuccessful operation of storage batteries in street railway work on a western line, one would be led to be somewhat skeptical as to the extent to which this method of propulsion will be employed in the near future. It must not be forgotten, though, that a system apparently a total failure under certain conditions, will, under others, prove thoroughly efficient and satisfactory. A case in point, and one in which the accumulator played an important but unsuccessful part, is referred to in an article presented in this issue. In the work of developing an electric train lighting system the Chicago, Milwaukee & St. Paul Railway company experimented with the storage battery with the idea of using it as an adjunct in its system. The company now gives out that the results of its tests were most unsatisfactory. But with the St. Paul railway company's experience in mind one almost involuntarily turns to the system in daily operation on the "Pennsylvania limited." The St. Paul people say that as far as their service is concerned the storage battery is a failure. On the other hand we find the Pullman company, after years of experience, still operating the accumulator system. Of course, the whole question hinges upon the work a battery is subjected to, and the St. Paul train has no easy run, to be sure; but it does seem singular that an appurtenance such a flat failure on one railroad should prove to be a brilliant success on another.

Chicago Electric Club.

The Chicago Electric club held a special meeting on Wednesday evening, February 3d. The attendance was large, the members appearing in evening dress. In addition to the club members there were many invited guests, including Hon. John A. Roche, ex-mayor of Chicago and Postmaster Sexton of Chicago. Many other gentlemen interested in educational work were attracted by the subject of the evening's discussion, and all appeared favorably impressed with the club and its members. An informal reception was held early in the evening, followed by the regular club meeting, at which the president, B. E. Sunny, presided. The paper of the evening was read by Francis W. Parker and is presented in another column. The subject was: "The Necessity and Present Opportunity for the Establishment of a Technological Institute with Physical Laboratory and Museum of Mechanical Arts in Chicago." Supplementary addresses were made by President Sunny, ex-Mayor Roche, Dr. W. R. Harper, president of the University of Chicago; Alexander H. Revell, representing the World's Fair, and Rev. Dr. Hensen. During the proceedings the following telegram was received and read by President Sunny:

NEW YORK, Feb. 3, 1892.

B. E. Sunny, Chicago Electric Club: We believe that an institute for the education of mechanical and electrical engineers would be an instrument of great benefit, and under proper auspices would receive ample financial support.

LYMAN J. GAGE,
J. J. P. ODELL,
F. W. PECK.

At the conclusion of the discussion F. S. Terry presented a resolution providing for the appointment of a committee of club members to confer with representatives of educational institutions and others interested in the establishment of a technological institute in Chicago. The following named gentlemen comprise the committee: Francis W. Parker, W. J. Chalmers, Col. Robert C. Clowry, F. S Terry, Prof. Elisha Gray, W. A. Kreidler and B. E. Sunny.

The meeting then adjourned to the dining room, where refreshments were served.

F. S. Terry, chairman of the literary committee, announces that on Monday, February 15th, a paper will be read before the Chicago Electric club by C. Kammeyer on "Photography as Applied to the Investigation of Electrical Phenomena." The paper will give some of the results obtained by photographing various fuse wire and fuse metals while in the act of fusing or exploding under an excess of current. The results obtained by using various kinds of fuse metal, subjected to currents of different volume and intensity, are very interesting indeed, and will be fully explained and described in the paper. There will be in all between 30 and 40 illustrations, which will be shown by means of lantern slides.

The committee appointed by the club to consider ways and means for furthering the cause of technological education in Chicago met at the club rooms last Saturday. The University of Chicago has manifested a great deal of interest in this subject, and was represented at the committee meeting by President Harper and Secretary Goodspeed. Chas. H. Besley was also present representing manufacturing interests. Dr. Harper stated the position of the University, which is that their plans comprehended the establishment of a technological institute on broad lines at some future time. Hearing of the movement initiated by the Electric club it was thought advisable to compare plans. The University was willing to co-operate with any one who could provide a building and apparatus. This the Electric club believes the citizens of Chicago are ready to do at once, as the committee has already received assurance of the hearty co-operation of some of Chicago's wealthiest capitalists. In fact it was the opinion of all present that the Electric club had inaugurated the movement at a time when very little effort would be required to secure sufficient funds for the establishment of such an institution as is contemplated. It was considered a great advantage to be able to prosecute the work from now on with the indorsement of, and in conjunction with, the University of Chicago. A committee consisting of Messrs. Parker, Sunny and Besley was appointed for the purpose of arranging for a general meeting of citizens interested in the project. The date of this meeting will be announced later.

EDITORIAL COMMENT.

A committee of influential citizens has been formed to take steps for the founding of a school of technology in Chicago

The project is not new, but its revival has the present advantage of being especially timely in view of the impetus to technical studies which the World's Fair will bring. Speaking broadly, there is to-day no better field in America than Chicago for a successful school of technology. For several years there has been a steady tendency toward the upbuilding of a great manufacturing district in this vicinity. It should be possible for students of the mechanical arts, whose future field is Chicago, to obtain their education here.

A school of technology is but a larger development of the manual training schools which have become such an important integral part of our educational system. The boy with a taste for mechanics should be stimulated by the knowledge that the higher departments in his favorite studies are not debarred to him. Modern educators say that the college curriculum of the future will scarcely be considered complete without one or two branches of technology. There should certainly be as free facilities for obtaining a technical as a classical education.

Chicago school builders and philanthropists have here a fruitful field for the exercise of public spirit.—*Chicago Daily News.*

There is the best ground for believing that the project for the founding of a great school of technology in Chicago will not be permitted to end in talk. The necessity for such an institution is a growing one, and it is a most encouraging sign that the matter is receiving the earnest support of men, the association of whose names with any enterprise is a guaranty of its success.

The fact that the electricians have taken a pronounced and leading position is also significant. In spite of the gigantic strides which the science has made within recent years there is every reason for believing that it is yet comparatively in its infancy, and every new wonder it presents only serves to open up new vistas for fascinating and profitable research. This fascination, however, must prove unfortunate if it results in attracting into the ranks people who after obtaining a smattering of first principles set themselves up before the public as "practical electricians." Quackery of this description is hardly less dangerous than quackery in medicine, the difference being that it is usually the electrician himself who first falls a victim to his ignorance.—*Chicago Evening Post.*

National Electric Light Association.

Following is a list of the papers to be read at the Buffalo convention of the National Electric Light Association:

How to Fire a Steam Boiler .....Richard Hammond
The Allied Powers .....Daniel Ashworth
Switch-boards, Their Safety and Operation. M. C. Sullivan
Aerial Wires .....E. F. Peck
The Alternating Motor .....Wm. Stanley, Jr
From the Tannery to the Dynamo ....Chas. A. Schieren
Underground Wiring .....E. A. Leslie
Underground Systems.....J. B. Craven
Municipal Franchises for Quasi-Public Works .....
.....Allen R. Foote
Electric Lighting from a Financial Standpoint .....
.....Erastus Wiman

L. B. Stilwell will also read a paper but the subject has not yet been announced. Carl Hering of Philadelphia will give an evening lecture on the "Transmission of High Potentials," illustrated by stereopticon views based on the work done at Lauffen and Frankfort. Prof. Elihu Thomson, Wm. Stanley, Jr., and H. Ward Leonard will take part in the discussion following the lecture.

Arrangements have been perfected for a special vestibule train composed of parlor, dining and buffet cars which will leave the Grand Central station, New York city, via N. Y. C. & H. R. R. R. at 11 A. M., Monday, February 22d, and will connect with the Boston party at Albany. Seat checks for this train can be procured from C. O. Baker, Jr., master of transportation, room 505, 136 Liberty street, at the rate of $2 each. It will be necessary in purchasing railroad tickets to request the agent to furnish a certificate which will entitle the purchaser to rebate fare on his return passage. These certificates are made absolutely non transferable.

John L. Martin announces that arrangements have been made with the Lake Shore & Michigan Southern Railway company for special vestibule sleeping cars leaving Chicago at 3:10 P. M., Monday, February 22d, and arriving in Buffalo, Tuesday at 7:30 A. M.

The following gentlemen have charge of transportation matters for their respective localities: H. A. Cleverly, 1018 Chestnut street, Philadelphia; Fred W. Royce, 1408 Pennsylvania avenue, Washington, D. C.; A. C. Shaw, 620 Atlantic avenue, Boston; John L. Martin, 148 Michigan avenue, Chicago; Morris W. Mead, Pittsburgh, Pa.; S. D. Nesmith, T. H. Electric company, Cleveland, O.; C. F. Hesser, Cincinnati Electric Light company, Cincinnati; H. D. Stanley, Bridgeport, Conn.; Prof. Henry T. Bovey, McGill University, Montreal, Can.; James I. Ayer, 322 Pine street, St. Louis, Mo.; N. J. Hart, New Orleans, La.; Frederic Nicholls, Toronto, Can.; John I. Sabin, San Francisco, Cal; E. W. Rollins, Denver Consolidated Electric company, Denver, Colo.

The commissioners of highways of the town of Jamaica, N. Y., have revoked the franchise granted to the Buckhout Electric Lighting company. The franchise was made on condition that the company should give a bond to the town in the sum of $5,000 as an indemnity against any possible loss. But the bond was never filed, it is claimed, and the company has shown no desire to avail itself of the privilege granted.

The Necessity and Present Opportunity for the Establishment of a Technological Institution with Physical Laboratory and Museum of Mechanical Arts in Chicago.[1]

BY FRANCIS W. PARKER.

The Chicago Electric club is usually addressed by gentlemen directly connected with some branch of engineering, and it is perhaps unfortunate that the great subject of technological education in Chicago should have been assigned to a mere layman. It sometimes happens, however, that the merits and accomplishments of a profession or occupation can be more vigorously urged by one who admires at a distance than by one to whom they are a matter of everyday familiarity. Whatever of merit this paper may have will therefore be due to the interest and enthusiasm which the magnificent results of modern engineering have created in a layman.

Engineering includes all means by which the forces of physical nature are utilized for the benefit of men, but in one of its most important senses it may be considered as the substitution of mind for mere force in the physical undertakings of men, and we are to consider whether there is a necessity and an opportunity for the introduction of the study of engineering and the establishment of a Musuem of Mechanical Arts and Physical Laboratory as a means for the furtherance of such study.

This age is remarkable above all things else for its advancement in engineering, for while we are content if only we can imitate the art and literature of antiquity, delight to borrow our philosophy from the earliest civilizations, and diligently search history for our legal and political precedents, we have only to look at the fragmentary slabs from the Assyrian temples and palaces and the Egyptian ruins and compare the rude engineering there depicted with the illustrations of a modern engineering journal to perceive how little the present age owes to that portion of the past and how certainly egineering is the peculiar domain of this age.

We are asked to consider whether there is a necessity or an opportunity for technological education here; but if there be one there must also be the other, for with Chicago a great want is but a great opportunity and a great opportunity for a great thing immediately creates or develops the want.

Now there is such a necessity and opportunity; first, because Chicago is so entirely the product of engineering; second, because she is so profoundly interested in, and her future is so largely dependent upon, engineering; third, because her wealth is so abundant and her citizens so liberal; fourth, because all other kinds of education are so abundantly provided for; fifth, because this is the highest and best form of education, and sixth, because the coming of the World's Fair necessarily provides both the occasion and in a large degree the means for the establishment of such institutions as proposed.

CHICAGO AS THE CREATION OF ENGINEERING.

It is a common saying that Chicago will be the greatest exhibit at the World's Fair, and this is true simply because Chicago is so pre-eminently the work of engineering. If Chicago has risen in stately splendor from the swamps and lagoons on the border of the lake; if the commerce of great states has, in ever increasing and magnificent volume, flowed back and forth through the channels which she has created or controlled, paying tribute to her; if her manufactures have assumed such proportions that the smoke of her factories literally darkens the sky and her name is celebrated the world over as a manufacturing center—it is because the architect engineers and the mechanical and electrical and civil engineers have contributed to her the best of which they were capable. Other cities have grown to greatness; Chicago has been built to greatness; others have increased by addition, Chicago by multiplication. With others the ratio of progress is arithmetical; with Chicago it is geometrical; and all this not because we have discovered any new philosophy or produced any great poet or artist, or devised any novel form of government or sent powerful fleets and armies like Rome or England to compel commerce to come our way, but simply because we have made the most of engineering and because engineering has done its best for us. Yes, Chicago, with her splendid architecture, her shipping, her railroads, her manufactures, her public works, her commerce—in short, Chicago as the creation of engineering, will, indeed, be the chief exhibit at the World's Fair, and yet, how that exhibit will be marred and disfigured in the eyes of every thoughtful man by the absence of any means of education wherewith may be acquired the arts whereby the city has been created. The first question asked by an intelligent stranger who has beheld our material advancement will be, "Where is your school of engineering or technology?" and our answer must be "Nowhere."

The argument for such an institution does not, however, depend alone upon considerations of the past or the idea of historic justice, for it must be evident to all that the destiny and future of Chicago depend on engineering.

We have passed from childhood to maturity, and have come to a period where the range of our vision is vastly extended. A superficial view of our situation and the conditions which surround us will suffice to show the altogether marvelous interest which Chicago has in engineering. Cast your eyes over this hemisphere from the gulf to beyond the lakes, and from one range of mountains to the other, and you will be amazed to observe how substantially all great engineering enterprises are referred to Chicago as a center. If it is a harbor, the object is to invite connection with some line of commerce whose other end is Chicago, or if it is a railroad one terminus is Chicago and the orher the lumber, iron, wheat or cotton fields about us,

1. Read before the Chicago Electric club Feb. 3, 1892.

or else some port which desires to place itself in the pathway between Chicago and the sea; if it is a bridge or tunnel it is to make quicker time and cheaper freights to and from Chicago; if it is a canal the prime object is to lay some or all of the water systems of America at our feet, or give us easy outlets to the open sea. Indeed, it may almost be said that the underlying idea of every great engineering enterprise in the vast region described, which has anything more than mere local interest, is to bind more closely to Chicago the mighty region outlined, or else to create the paradox of history converting a great inland city into a seaport.

In the address of the president of the American Society of Engineers at Chattanooga on the 23d of May, 1891, every one of the great engineering works enumerated as being complete or actively agitated during the preceding year were of direct immediate and paramount interest to Chicago, except the Croton aqueduct, while of seven great bridges mentioned five were directly tributary to Chicago. It is easy to show our present interest in the engineering of both land and water and in so doing we see at once by what means the present greatness of the city has been obtained and also along what lines its future greatness will be reached. Five million freight cars are received and forwarded at Chicago annually. This is the terminus for 55,000 miles of railway or nearly one-third of the total mileage of the United States; it is the chief objective point for 85,000 miles of railway or half the total of the United States; 13,000,000 tons of freight, carried by 24,000 arriving and departing vessels, the same being one-third the total tonnage of the lakes and rivers of the United States, annually float in our harbor and canal; the vessels of the lake, in whose business we have such tremendous interest, are valued at nearly $70,000,000 and in respect to size they have gradually increased until now eleven vessels of over 3,000 tons and one of 5,000 tons are in process of construction; in 1890 forty per cent. more steam tonnage was built on the lakes than on the seaboard, while the average vessel on the great lakes is twice the size of the average vessel on the seaboard; in 1890 there was fifty-seven per cent. more steam tonnage on the lakes in the class between 1,000 and 2,500 tons than on the entire seaboard; last year the total lake shipments were valued at more than $500,000,000. These figures are from the Cleveland *Iron Trade Review*.

These facts and figures show our great interest in engineering, and also show how we must be especially and peculiarly interested in every scheme for the improvement or development of the American waterway. The improvements of the great rivers and making of canals from the lakes to the Atlantic or to the Gulf, are not only destined, each in its own way, to more closely link this region to us, but they are parts of the great plan conceived, as it appears to me in counsels higher than those of men, to give Chicago what has been given to no other city in history, dominion over both the land and the water; for no loyal citizen of Chicago can doubt that some day the steamer from Liverpool will lie in the docks of Chicago alongside the steamer from New Orleans. The significance of this peculiar situation of Chicago, as concerns the theme of the evening, is found in the fact that the engineering enterprises which thus directly and immediately interest Chicago are phenomenally extensive, diversified and widespread—including everything which has to do with navigation, whether it be that of the canal, river, lake or open sea, and everything which has to do with land transportation, whether it be tunnel, bridge or railway.

A few examples will serve to show the truth of these propositions. The great reservoirs about the head waters of the Mississippi are calculated to maintain a normal depth of water, even in seasons of great drouth, from 90 to 150 days, thus regulating and developing the trade of the upper Mississippi. The Hennepin canal, when completed, will bring us in communication with this trade and thus give us a great part of a commerce which is no less than two and a quarter million tons or about one-third that of the Suez canal. The Illinois river and Chicago canal improvements, when properly completed, would put us in close touch by at least a 14 foot channel with the commerce of the lower Mississippi, which is another million tons; or, looking still farther, would by means of the Nicarauga canal, give us a shorter water route to the Pacific coasts than New York will have. The proposed canals across Michigan, at various points in the St. Lawrence, at Niagara from Lake Huron to Lake Erie, from the Georgian Bay to Lake Ontario, the proposed improvements in the Welland and Erie canals, the proposed ship railways over part of the same routes, have all of them far greater interest and importance to Chicago than to any other city, and indeed the one great cry of the commercial interests of the lakes, as illustrated in the voice of the recent water-ways convention at Detroit, is "Deep water from Chicago to the sea and Gulf."

When this system is completed so that there shall be deep water from Chicago to the sea and to the Gulf we shall have such a commanding position as was never before seen and Chicago will be not on the highway of commerce as were perhaps Damascus, Byzantium or Venice, but at the very center of commerce. You will search the map in vain for any city, ancient or modern, having a natural tributary domain so extensive and fertile as ours, or an inland water system so widely extended, or railway system so elaborate and extensive, or, having facilities approximating any one of these, such a free and open communication with the sea as this system when completed will give us. Therefore I repeat that in extent, diversity, number and distance the engineering enterprises which do now and in the future must still more interest us are unequaled elsewhere.

But we need not look beyond the confines of our own city to perceive how all kinds of engineering interest us. Last year our manufactures reached a total of five hundred and sixty million dollars or much more than one-third the total trade of the city. The peculiar condition of the soil has developed in Chicago a distinct style of architecture now justly celebrated throughout the world. This style of architecture together with the peculiar configuration of the river and lake and the characteristics of our business men have produced a small business section which for degree of compactness is altogether phenomenal. On the other hand the character of the outlying districts with our radiating railways gives us an unusually extended residence district. These conditions force upon us a problem which invites the highest degree of engineering skill and which is now approaching a point where its solution is imperative. This problem is the production of a city, with small, compact and intensely active business center and a widely extended and comparatively thinly populated residence district and quick and easy communication between all parts of the whole. When this problem is satisfactorily solved we shall not only have removed many of the evils and disadvantages of a great city but we shall have created the ideal city, wherein magnificent business facilities are coupled with the greatest liberty and freedom of home life. I shall not speak of the familiar questions concerning water supply and sewage disposal, all of which still invite the most serious consideration. If the establishment of a technological institution did no more than create an intelligent public opinion on the subject of our public works, it would pay many times over the cost of its establishment and maintenance, for there is no doubt that the positive ignorance of the public, reflected in the politicians, is as much responsible for misspent funds and prominent defects in our public works as the insufficiencies of the engineers themselves.

With all these engineering interests past, present and future, local and widespread, it is astonishing that we have not even the beginning of a school of engineering in our midst; but it is amazing that out of eighty-nine members of boards of trustees of six institutions of learning in and about the city taken at random, but eleven are immediately engaged in manufacturing or engineering. In other words less than thirteen per cent. of the men actively interested in institutions of learning are interested in engineering, and they have not secured as yet any recognition whatever for technological education.

THE WEALTH OF CHICAGO AND THE LIBERALITY OF HER CITIZENS

would surely justify the expectation that we would find here such institutions. The city is prosperous in every direction. Eleven thousand five hundred buildings on a frontage of fifty-one miles at a cost of fifty-five million dollars is the record of the past year. In the same time bank capital has increased from twenty-four million six hundred thousand to thirty-three million six hundred thousand, and deposits from one hundred and thirty millions to one hundred and sixty-three millions. The bank clearings of New York in 1890 were $37,458,000,000, and in 1891 $33,749,000,000 or a loss of $3,709,000,000 while for the same years Chicago's figures show an increase of $363,000,000. In 1890 New York's clearing house business was more than nine times that of Chicago, while in 1891 it was less than seven and one-half times that of Chicago. Five or six years of these ratios and our clearings would equal those of New York. The same increase is noticeable in manufactures, railways and shipping. Iron, the movement of which is to commerce what the flow of blood is to the body, testifies to the same degree of activity and development. The Cleveland *Iron Trade Review* says that in 1890 the Lake Superior region shipped about nine million tons of iron, of which Chicago and adjacent ports took one million two hundred and seventy-one thousand tons, while in 1891 the shipments were seven million three hundred and thirty-nine thousand tons, of which Chicago and adjacent points took one million five hundred and fifty thousand tons. In other words, in 1890 we took about one-seventh of the Lake Superior output, while in 1891 we took over one-quarter, and made an absolute increase of three hundred thousand tons.

This prosperity has revealed itself in the widespread disposition of Chicago's men of wealth to turn their money to public benefactions, and much of their time and attention to intellectual and artistic pursuits, and it is doubtful whether there has ever been a city where so many men intelligently, prominently and financially interested in the advancement of institutions of learning have been lifted by their own exertions from positions of comparative, if not absolute, poverty and ignorance. Nothing has so delighted or astonished the professional and literary men of this city, nothing has so amazed the world at large, and nothing has so demonstrated the elasticity of American character and the educating influences of trade and manufacture as pursued here, as the phenomenal manner in which business men, while in the very act of creating fortunes by the closest application to business, have put themselves in close touch with literature, art and charity, and have, by their example, effectually disposed of the old theory that it requires at least three generations to pass from poverty and a limited education to cultivation and refinement.

Strange as it may seem, however, these very men who have thus made their fortunes and their positions, many of them directly and all of them indirectly, by engineering, have millions for every worthy enterprise under the sun, but not a dollar for technological education.

THE ADVANCED CONDITION OF LEARNING IN CHICAGO

is comprehended by few if any of us. We have here four great and justly celebrated evangelical theological schools; we have in and about the city two powerful universities with all the faculties scattered and somewhat fragmentary, and sometimes too much removed from the center, but still wonderfully successful; we have also the new university of Chicago, with an endowment quite equal to that of either of the others, and in a condition which leaves no doubt of its early assuming the very highest position; we have an art institute, athæneum and manual training school, and we have a public school system second to none and for which we are appropriating for the current year about five million dollars. The libraries already founded and certainly established, with the funds set apart for their use, and the buildings which they are erecting and the land which has been given to them, will speedily give to Chicago library facilities unsurpassed, if equaled, by any city of the United States, and very much surpassing, in many important particulars, those of any city in the country. The University of Chicago has 450,000 volumes, the Chicago Public Library 170,000, the Newberry Library 80,000, and the law institute 25,000, and all these are rapidly increasing. The Newberry Library is erecting buildings capable of holding 400,000 reference volumes; the University of Chicago is erecting suitable buildings for its library; the Chicago Public Library is about to build a two million dollar building on free public land worth perhaps as much more. The Newberry Library has assets worth probably three million dollars, and the Crerar Library will have as much more, if the beneficence of the donor is not defeated by the cupidity of his heirs. The Chicago University is erecting buildings to cost about a half million dollars, and the art institute is about to erect an $800,000 building on land worth as much more. The aggregate of money and land provided for and dedicated to the purpose of increasing the educational institutions of Chicago other than the public schools during the past three years cannot be much, if any, less than fifteen million dollars. No well informed person can doubt that within three years Chicago will take very high, if not absolutely the first rank, among the cities of the United States with regard to its libraries and educational facilities, and yet we have not even the means for the rudiments of a technological education. The Manual Training School for boys, with three hundred students, fifteen thousand dollars out of a total appropriation of four and a quarter millions used in the public schools, for manual training last year, and certain more extended experiments for this year including especially the work provided for by R. T. Crane, constitute all of importance that is here done even in the direction of preliminary work or in the way of qualifying students for future studies in technology. Rival schools annually discharge their multitudes into the professions of the law, medicine and the like, which I may perhaps be excused for describing as the destructive professions, while not a school gives us a graduate in any of the constructive professions of engineering.

To one who will contemplate and fairly consider the facts here presented it will almost seem that there must be some law of nature or decree of Providence against the existence in Chicago of technological education. Certainly you would have supposed that the first kind of education to be here established would have been that of Technology, but the very men who have grown rich as engineers, or in engineering, will give their money and time to the establishment of literary institutions and art institutes, and send their sons East to learn the professions which they themselves have half forgotten. You would have supposed that the first educational idea of the successful manufacturer would have been to secure home education for his artisans and engineers, but he will lavishly contribute to theological institutions and libraries and rest content to bring his educated help from distant points and schools. You might have thought that the municipality, the public corporations, and the far-seeing and widely interested capitalists who project the distant engineering schemes of which we have spoken, would have desired to take engineers educated among themselves and in the midst of the undertakings upon which they are to be engaged; but the municipality, the corporations and the capitalists seem satisfied to import their engineers from a distance, and sometimes, I think, from beyond the seas.

Really with all these interests at stake, and all these inducements, it seems difficult to believe that Chicago has done as yet nothing for the higher technological education of which we are speaking.

ENGINEERING IS THE NOBLEST STUDY OF MAN,

if we take the word in its broadest signification. It would be a great injustice to let the claims of technological education rest upon expediency alone. In this age, when engineering is the spring of all great movements in peace or in war, on land or sea, and when its work influences, affects and surrounds us in all of the experiences of life, from the cradle to the grave, no man can be well educated who is not at least generally acquainted with engineering, and no man can properly contemplate the great social, political and industrial questions of the age unless he sees them in part at least through the eyes of an engineer. The engineer has, by reason of the changed condition of modern life, passed with startling rapidity, both abroad and in our own land, during the past few years, from a position of comparative insignificance to one of the highest importance and the greatest distinction, and he is a factor in the life and intellectual activity of the day not to be disregarded. You can reach more certainly and affect more powerfully the opinions of a given community by means of an engineer of high standing in such a community than by any other one man. I do not wish to seem to discredit or discourage the older branches of education, and I believe that no man witnesses with more delight than myself the advancement of learning among us, and yet it is with profound sorrow that I find what appears to me to be the noblest study omitted from the curriculum. Though passionately fond of history and the literatures and philosophies which it discloses, let us rather prefer to see the face of Chicago resolutely turned toward the future and her duty and destiny. Let us not make less of history, philosophy and literature; but rather, in response to the true spirit of this age, let us make more of technology, of engineering, of the science of substituting mind for mere force and of bending to man's will the forces of nature. It is not the past but the future toward which we should be looking. This age progresses not so much by past experience as by present experiments, always trusting that the future has for us something better than the best which

the past can offer. A day among the practical activities of Chicago is better than a year among the ruins of Egypt. These great buildings, by reason of their construction and their uses, are more truly beautiful than the fairest temples of antiquity. It is the present which speaks and the future which moves, but the past, like the Sphinx of the Lybian desert, does neither, or if it does, it speaks only in accents now half intelligible and intended for other ages and conditions, and moves, like the Sphinx, downwardly, only to sink deeper under the sands of obscurity. The only man who thinks ill or little of engineering is the man who knows little about it.

It is hoped that something may be found in what has preceded to show that there is an imperative necessity for technological education in Chicago, and also to indicate that there is a present opportunity for the establishment thereof.

THE WORLD'S FAIR

is, however, the singularly propitious event which seems to point to this subject as the next proper to receive the attention of our public spirited citizens.

A technological institution should be situated in close proximity to a great manufacturing and industrial city. That condition is certainly present here. It should be operated, to some degree at least, in conjunction with a great university of the highest standard, and that condition we certainly can supply. It should have an abundant endowment, though that is not so serious as might be expected, for the reason that such an institution is more nearly self-supporting than perhaps any other kind of educational enterprise. Probably the greatest engineering school west of the Alleghenies is maintained on an annual expenditure of less than $30,000, against which it has very considerable revenues derived from tuition charges. Such an institution, to reach the degree of excellence which alone would satisfy Chicago, must have the best possible laboratory and museum, for by such alone can original research and comprehensive instruction be carried out.

MUSEUM.

As yet no museum of mechanical arts of any considerable importance has been established in the United States. The patent office models are not of a character to have much value in this connection. The National Museum collection is fragmentary and of little technical value. Yet we are the inventors and machine builders of the world, for while it may be true that foreign nations have surpassed us in theory, in the practice of machine building they have uniformly borrowed or stolen from American producers. Now, if this be true, there must be, and indeed it is well known that there are, many exceedingly valuable collections more or less complete, in private hands, of machines showing the development and the processes thereof from the rude originals to the present perfected devices. Individual firms have frequently collected types of many of their important machines, and have thus preserved the history of their development. Those who have not done this, often wish they had. Such individual cases indicate the necessity for a great collection, in which there would be room and opportunity for the preservation and proper classification of all these precious memorials. Our country is not so old as to make it impossible to collect the original types of by far the greatest number of the important machines produced by Americans. It is not to be doubted that very many of those having such material in their hands will be glad to see it devoted thus publicly to useful purposes in connection with a great institution of learning in Chicago, and especially if some or all such material should be first exhibited at the World's Fair. The interest, the value and the importance of such a museum is not to be discussed; the possibility of making it and securing the necessary material is hardly to be doubted; the only question would appear to be, does Chicago want to take the initiative in this move, and secure for itself as the center of industrial America the greatest museum of mechanical arts which it is possible to create?

LABORATORY.

For the actual work of such an institution a thoroughly complete collection of instruments and devices practically illustrating all of the principles and facts to be taught, and affording those opportunities for demonstration and experiment which alone can produce practical results in education, is indispensable. The World's Fair will bring together probably an absolutely complete collection of such instruments and devices; at any rate a collection undoubtedly superior to any before made. If this proposed institution were at once put on a proper footing, it cannot be doubted that arrangements could be made with intending exhibitors, whereby all the desired machinery, instruments and appliances could be obtained, substantially free of cost before or after exhibition, to give to such an institution a physical laboratory absolutely the best, because the newest and most complete in the world. Several thousand dollars' worth of such materials has already been promised by manufacturers in Chicago and elsewhere. Here, as with regard to the proposed museum, the only question is as to whether Chicago cares to avail itself of the great opportunity thus offered.

This is not the time or place for eloquence, nor would I, if it were, affect the orator, but, gentlemen, this great metropolitan city, the center of industrial America, with such a magnificent destiny before her, contingent only on the success of engineering, so wealthy, so famous for her manufactures, so endowed and equipped with educational institutions; this great city of a million and a quarter inhabitants, itself the proudest product of modern engineering, must have absolutely the best technological institution in the world, with the best physical laboratory possible, and museum of mechanical arts such as only a mighty nation of inventors, manufacturers and engineers can produce and I am persuaded that now is the time and the World's Fair the occasion for the establishment of these noble institutions.

This fair will live in history as an exposition of engineering when all its other features are forgotten, and while it has all ready to leave behind its monument in the Art Institute, its great work remains to be done.

The Law of Hysteresis.[1]

BY CHARLES PROTEUS STEINMETZ.

PART III.

In the following are given the magnetic curves of a piece of magnetic iron ore, apparently pure Fe_3O_4 of the dimensions, 1 in. $\times$ 1 in. $\times 2\frac{3}{32}$ in.

TABLE XI.

MAGNETIC CHARACTERISTIC.

F in ampere turns per centimeter length of magnetic circuit.

B in lines of magnetic force per square centimeter.

F	B	F	B	F	B
10	75[illegible]	7	[illegible]	14	377
20	151	8	308	160	[illegible]
3	[illegible]	[illegible]	32[illegible]	18	407
40	232	[illegible]	335	[illegible]	42[illegible]
50	256	[illegible]	347	[illegible]	431
60	276[illegible]	[illegible]	358[illegible]	24	440[illegible]

FIG 15. LAW OF HYSTERESIS.

TABLE XII.

CYCLIC MAGNETIZATION.

I			II.		II.		
F	B_r	B_d	B_r	B_d	F	B_r	B_d
0	± 900		± 1020		130	3640	3740
10	0	+1520	— 200	+1660	140	3730	3820
20	+1200	1920	+1000	2020	150	3 20	3900
30	1800	2230	1750	2280	160	1910	3980
40	2160	2500	2150	2520	170	3990	4050
50	2450	2700	2390	2710	180	4050	4110
60	2670	2850	2610	2880	190	4120	4170
70	2850	3000	2800	3020	200	4190	4230
80	3020	3120	2980	3150	210	4250	4280
90	3190	3250	3140	3280	220	4320	4340
100	3340	3360	3280	3410	230	4360	4370
110	3440		3410	3530	240	4400	
120	(106.5)		3530	3640		(240)	

$H_{obs} = 9{,}340$ ergs $\qquad$ 13,780 ergs

$\eta = .02049$ $\qquad$ .02041

Average, $\eta = .02045$

Curve of hysteresis,

$$H = .02045\ B^{1.6}$$

$H_{calc} = 9{,}320$ ergs $\qquad$ 13,810 ergs

$H_{calc} - H_{obs} = -20$ ergs $\qquad$ +30 ergs

$= -.2$ per cent. $\qquad$ +.2 per cent.

As seen, the coefficient of hysteresis of magnetic iron ore, $\eta = .020$, ranges between that of cast-iron, $\eta = .016$, and of hardened steel, $\eta = .025$.

The magnetic conductivity is approximately 20 per cent. of that of wrought-iron.

In Fig. 15 is given a comparison of the hysteretic curves of

Hardened steel,
Annealed steel,
Cast-iron,
Magnetic iron ore,

in the same size.

This figure shows well the three characteristic forms of hysteretic curves:

1. The hardened steel curve, of high coercitive force, has the bend or "knee" on the negative side, so that for zero magneto motive force the "remanent" magnetism is still in the saturation part of the curve—that is, in stable equilibrium therefore permanently magnetizable.
2. The soft iron curve, with the bend on the positive side, so that for zero magneto motive force the "remanent" magnetism though still very high is already below the range of saturation, on the branch of unstable equilibre. Therefore the remanent magnetism is very unstable and easily destroyed, the more as the coercitive force is very small.
3. The cast-iron curve, which has no marked knee at all, but a steady curvature of low remanent magnetization, but with regard to coercitive force ranging between 1 and 2.

The curve of the magnetic iron ore shows all the characteristics of a cast-iron curve.

Having derived, now, a larger number of values of the hysteretic coefficient η for different kinds of iron and other material, we shall put them together for comparison in Table XI.

It is remarkable, in these results, that for several samples of each set, the quotient $\frac{\eta}{C}$ gives almost exactly the same value, while other values disagree therefrom. From this average value of $\frac{\eta}{C}$ are calculated the values of the coercitive force C of sheet-iron, given in the brackets.

For convenience, in the following table are given the values W of consumption of energy in watts per cubic inch, for 100 complete periods (magnetic cycles) per second, and for the magnetization of H lines of force per square inch, giving as coefficient of hysteretic resistance the value $\gamma = 8.3 \times 10^{-6}\eta$.

In Table XII. I have given a number of experimental values of the consumption of energy by hysteresis and believe to have shown that this consumption of energy can fairly well be expressed by the empirical formula,

$$H = \eta\ B^x$$

where the exponent x is equal, or at least very nearly, to 1.6, and the coefficient η a constant of the material, which ranges from .002 up to .025 and more, and may possibly have a slight dependence upon the velocity wherewith the magnetic cycle is performed, as the second set of alternate-current readings seems to indicate.

In the following table, I give the values of the hysteretic resistance η for some iron samples, subjected to a magnetic cycle between $F = +190$ and -190 ampere turns per centimeter, calculated from Hopkinson's tests[1] by the assumption of the law of hysteresis.

η denotes the coefficient of hysteresis.

B the maximum magnetization in lines of magnetic force per square centimeter.

R the remanent magnetization in lines of magnetic force per square centimeter.

TABLE XIII.

Material.	Condition.	η	B	R
Wrought-iron	Annealed	.00202	18,250	7,250
Soft Bessemer steel.	.045 per cent C annealed	.00262	18,200	7 860
Soft Wittworth steel.	.09 " " "	.00257	19,840	7,080
	.32 " " "	.00598	18,740	9,840
	.89 " " "	.00786	16 120	10,740
	.32 " " oil-hard	.00954	18 800	11,040
	.89 " " "	.01844	16,120	8,740
Silicon steel	3 44 " Si , wrought	.00937	15,150	11,070
	3.44 " " annealed	.00784	14,700	8,150
	3 44 " " oil-hard	.01282	14,700	8,080
Manganese steel	4 73 " Mn , wrought	.05963	4,620	220
	8 74 " " "	....	747	....
	12 36 " " "	....	310	....
	4 73 " " annealed	.04146	1 ,58	5 850
	8 74 " " "	.08184	1,985	540
	4 73 " " oil-hard	.06706	4,770	2,160
	8.74 " " "	.....	733	..
Chrome-steel........	.62 " Cr , wrought	.01179	15,780	9,320
	1 2 " " "	.01851	14,680	7,570
	.62 " " annealed	.00897	14,850	7,570
	1.2 " " "	.01638	13,230	6,490
	.62 " " oil-hard	.03958	13,960	8,600
	1.2 " " "	.04442	12,870	7,890
Tungsten steel,.......	4 65 " Wo , wrought	.01516	15,720	10,140
	4.65 " " annealed	.01435	16,500	11,010
	3 44 " " oil-hard	.04776	14,480	8,640
	2 35 " " very hard	.05778	12,130	6,820
Grey cast-iron	3 45 p. c. C.; 17 p. c. Mn	.01826	9,150	3,160
White cast-iron	2 04 " C ; 34 " "	.01616	9,340	5,550
" "	4.5 " C.; 8 0 " "	.....	385	77

These values of the hysteretic resistance vary from .002 up to .082, 41 times the first value.

But especially marked is, that η depends much less upon the chemical constitution of the iron sample, than upon its physical condition, annealing decreasing, and hardening increasing, the hysteresis very considerably.

So far as the chemical constitution is concerned, the purer the iron the lower is its hysteresis, while any kind of foreign matter increases the hysteresis. Especially manganese increases the hysteretic loss enormously, much less wolfram and chromium, least silicon and carbon. Connected with the increase of hysteresis is always a decrease in susceptibility.

I wish to add a few remarks on two alleged phenomena connected with hysteresis, which have been talked about considerably, without yet being made clear; the decrease of hysteresis for open magnetic circuit, and the decrease of hysteresis of a transformer with increasing load.

With regard to the first, as shown, actual tests do not show a smaller value of hysteresis for open than for closed magnetic circuit.

And it cannot be understood how that could be.

For consider an iron molecule of the magnetic circuit exposed to the harmonically varying magneto motive force and performing a magnetic cycle. Evidently it can make no difference for this iron molecule, whether some trillion molecules farther away, the magnetic circuit ends in air, or is closed entirely in iron, supposed that the magneto motive force and the magnetism, and therefore also the magnetic reluctance, are the same in both cases.

Neither can it make any difference whether the magneto

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1. Read before the American Institute of Electrical Engineers, January 19, 1891.

1. From "Kalender fur Electrotechniker," by Uppenborn, Berlin, Germany.

motive force is caused only by one sine-wave of electric current, or is the resultant of several magneto motive forces, as in the loaded transformer. It is the same as with the electric current, where the energy converted into heat in each molecule of the conductor does not depend either, whether the material of the conductor on some other point changes, or whether one or more electromotive forces are acting upon the circuit.

Hence, until absolutely exact and undoubtable determinations of the hysteretic loss for fully loaded transformers are at hand, the assumption of a decrease of hysteresis with increasing load must be rejected.

That an apparent decrease with increasing load has been observed several times may be conceded, for besides the exceedingly great liability to errors in these tests, where the hysteretic loss comes out as the small difference of two large values, primary energy and secondary energy, and therefore is very much affected by the slightest errors in any one of the components, it must be understood that the main possible errors in the determinations on fully loaded transformers all point this way. Neglection of secondary self-induction, decrease of magnetization with increasing load, slowing down of the dynamo-alternator, etc., all cause an apparent decrease in the hysteretic loss for increasing load. At least in one set of tests, those made by Prof. Ryan, at Cornell University, on a small Westinghouse converter, I was able to show in my "Elementary Geometrical Theory of the Alternate Current Transformer" that the observed decrease of the hysteretic loss disappears by reducing the different readings to the same magnetization and the same frequency.[1]

If, indeed, the shape of the wave of magneto motive force varies, then a certain difference in the value of the motive force acting upon the iron is that of the primary current, and this current is rigidly determined in its shape by the electromotive force of the dynamo and the electromotive force of self-induction. But in a fully loaded transformer the secondary current is proportional to the changes of the magnetism, therefore increases very considerably in the moment of a sudden change of magnetism. Hence, if a sudden and abrupt change in the primary current occurs, just as suddenly the secondary current increases in the opposite direction, and thereby makes a sudden change of resulting magneto motive force and magnetism impossible, so that the fully loaded transformer compares with the elastic spring which oscillates freely, while the open circuited transformer compares with a spring, where the motion is determined by a rigidly-acting outside force.

Hence, if the shape of the alternating primary current differs considerably from the sine law, a certain decrease of the hysteretic loss for increasing load can be expected, though certainly not such an enormous decrease as some former tests seemed to point out. These tests must undoubtedly have given erroneous results, perhaps caused by the neglection of the secondary self-induction, which, even if very small and causing only a slight error in the secondary energy, must cause an enormous error in the hysteretic loss, the small difference between the two large values—primary and secondary energy.

That an electromagnet without a keeper loses its magnetism quicker than a magnet with keeper, or a closed magnetized iron ring, is a phenomenon which has nothing whatever to do with the loss of energy by hysteresis, but is merely due to the demagnetizing force of the remanent magnetism. For the remanent magnetism in an open magnetic circuit causes between its poles a certain difference of magnetic potential, which in the moment of breaking the electric circuit acts as a demagnetizing magneto motive force, and, if the coercitive force is small, as in wrought iron or annealed steel, almost entirely destroys the remanent magnetism, while in an iron of large coercitive force it affects the permanent magnetism very little. In the closed magnetic circuit the remanent magnetism causes none or very little difference of magnetic potential, and therefore no destruction of the remanent magnetism by its own demagnetizating magneto motive force takes place. But with the hysteretic loss of energy this phenomenon has nothing to do.

To combine the results, what I believed to have proved is that loss of energy in iron caused by reversals of magnetism can be expressed by the analytical formula:

$$H = \eta\, B^{1.6} + \varepsilon\, N\, B^2$$

where η is the coefficient of hysteresis, ε the coefficient of eddy currents, N the frequency of the alternations of magnetism, $\eta B^{1.6}$ the loss of energy by hysteresis proper, or by molecular friction, and $\varepsilon N B^2$ the loss of energy by eddy currents, per magnetic cycle and per cm.^{3}, proportional to the frequency N.

TABLE XI.

$$H = \eta B^{1.6} [+ \varepsilon N B^2]$$

H in ergs per cycle and cm.^{3}; B in lines of magnetic force per cm.^{2}; F in ampere turns per cm.

Material.	Hysteretic Coefficient. η	Magnetization at the M. M. F. $F=10$	$=40$	$=90$	Residual Magnetism R For $F=40$	$=90$	Coercitive Force C. For $F=40$	$=90$	$F=40$	$\frac{\eta}{C}$ for 90
Very soft iron wire (Ewing)	.0020	12800	14700	16600			(1.5) ¶	(1.9)		
Westinghouse converter, sheet-iron	.0024	14400	17800	20800			(1.8)	(2.0)		
Very thin sheet-iron, standard *	.0030	13100	17100	20700			(2.3)	(2.8)		
Thick sheet-iron †	.00333	13100	17500	.....			(2.5)	(3.1)		
Sheet iron ‡	.00421	.....	.....	.....			(3.2)	(3.9)		
Sheet-iron §	.00450	.....	.....	.....			(3.4)	(4.2)		
Soft annealed cast-steel	.0080	7800 ‖	14000	16300	5100	8200	6.0	7.0	.00137	.00114
Tool steel	.0094	5800	14800	18800	8300	9000	9.1	11.1	.00103**	.00085**
Cast steel of low susceptibility	.0120	2000	6400	9800	2600	3300	9.1	11.6	.00135	.00104
Cast-iron	.0162	1600	6700	10100	2100	3400	10.4	15.2	.00156**	.00106
Hardened cast-steel	.0250	1200	8000	12900	4500	7500	19.0	23.5	.00132	.00107
Magnetic iron ore	.02045	750	2320	3220		900		10.0		.00204
							Average		.00132	.00108

*, For $N = 100$.

†, $\varepsilon = .746 \times 10^{-6}$.

‡, $\varepsilon = .2083 \times 10^{-6}$.

§, $\varepsilon = 1.16 \times 10^{-6}$.

‖, This and the following values of this column are derived as average of rising and decreasing branch of the magnetic characteristic, because at $F = 10$ the magnetism is still very unstable.

¶, Computed by means of the average values of $\frac{\eta}{C}$ .00132 and 0 1 8.

**, Left out by taking the average of $\frac{\eta}{C}$

TABLE XII.

$$W = \gamma H^{1.6}$$

W in watts per cubic inch and 100 complete periods per second.

H in lines of magnetic force per square inch.

	γ	$H =$ 10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,000	120,000	150,000
Very soft iron wire (Ewing)	.166 X 10^{-10} $W =$	.042	.13	.26	.38	.55	.73	.94	1.16	1.40	1.66	1.94	2.23	3.18
Westinghouse converter, sheet-iron	.201	.051	.15	.29	.46	.66	.89	1.14	1.41	1.70	2.01	2.34	2.69	3.84
Very thin sheet-iron	.249	.063	.19	.36	.58	.82	1.10	1.41	1.74	2.11	2.49	2.90	3.34	4.77
Thick sheet-iron	.277	.070	.21	.40	.64	.91	1.22	1.56	1.94	2.34	2.77	3.22	3.71	5.30
Sheet-iron	.350	.089	.27	.50	.81	1.15	1.55	1.98	2.45	2.96	3.50	4.07	4.69	6.69
Sheet-iron	.374	.095	.29	.54	.87	1.23	1.66	2.12	2.62	3.17	3.75	4.36	5.02	7.17
Soft annealed cast-steel	.663	.17	.51	.97	1.53	2.19	2.93	3.75	4.64	5.60	6.63	7.73	8.88	12.7
Tool steel, soft	.778	.20	.59	1.14	1.80	2.57	3.44	4.40	5.45	6.57	7.78	9.06	10.4	14.9
Cast-steel of low susceptibility	.994	.25	.76	1.45	2.30	3.28	4.39	5.62	6.95	8.39	9.94	11.6	13.3	19.0
Cast-iron	.1346	.34	1.02	1.96	3.11	4.44	5.91	7.60	9.41	10.9	13.4	15.7	17.6	25.8
Hardened cast-steel	.2077	.52	1.58	3.03	4.80	6.85	9.18	11.7	14.6	17.5	20.7	24.2	27.8	39.8

$H = 25{,}000$; alternate current transformer, American style (high frequency).

$H = 35{,}000$; " " " European " low "

Only the values smaller than .25 W, can be of practical use; in those larger than 10 the iron gets at least red hot if in larger quantities.

hysteretic loss can be imagined. Compare it with a mechanical or elastic cycle. A moving pendulum, or an oscillating spring, for instance, continuously converts potential energy into kinetic energy and back: in each oscillation consuming, that is, converting into heat, a part of the energy by internal and external friction. Now, if this motion of spring or pendulum is truly harmonic, less energy is converted into heat than if the motion varies abruptly, is jerking, etc. So, in a magnetic cycle, between the same limits of magnetization the hysteretic loss might be smallest where the cycle is entirely harmonical, but might be larger if the magneto motive force varies abruptly, for instance, when caused by an intermittent current.

Now, in a transformer with open secondary the magneto

1. The latest tests of Ewing prove that in a fully-loaded transformer the loss by hysteresis is not smaller than for open secondary circuit.

TABLE XIV.

B	$B^{1.6}$	Increase per 100	B	$B^{1.6}$	Increase per 100	B	$B^{1.6}$	Increase per 100
500	.0208	42	9000	2.122	378	17,000	5 870	55
1000	.0631	85	9500	2 313	389	17,500	6.148	56
1500	.1206	115	10,000	2 511	400	18,000	6 434	57
2000	.1913	142	10,500	2.716	41	18,500	6.722	58
2500	.2732	164	11,000	2 925	42	19,000	7.017	59
3000	.3659	185	11,500	3 141	43	19,500	7.312	60
3500	.4684	205	12,000	3 363	44	20,000	7.613	63
4000	.5800	223	12,500	3 589	45	22,000	8 868	66
4500	.7000	240	13 000	3 821	46	24,000	10.193	70
5000	.8288	258	13,500	4.060	47	26,000	11.59	73
5500	.9662	275	14,000	4.303	48	28,000	13 05	76
6000	1 111	292	14,500	4.580	49	30,000	14 57	82
6500	1.261	308	15,000	4 807	50	35,000	18.65	89
7000	1.420	324	15,500	5.062	51	40,000	23.09	96
7500	1.583	339	16,000	5 429	53	45,000	27.87	103
8000	1 758	353	16,500	5 598	54	50,000	33 00	
8500	1 936	366						

For convenience, I give in Table XIV, the values of the 1.6M power of the numbers, from 500 to 50,000 with the parts proportional, or the increase of $B^{1.6}$ for 100 lines of magnetic force.

Improvements in Small Switches.

The Edison General Electric company is placing several improved forms of small switches upon the market. In the accompanying cuts are shown ratchet switches of 5 and 10 amperes capacity. The bases and ratchets are of hard vitreous porcelain. The ratchet is of peculiar construction, its sides being of unequal length. When the switch is "on," the shorter side of the ratchet is presented to the contact brushes. These sides are rounded and the brushes specially curved, so that when the contact is made the brushes and contact sides of the ratchet fit with precision. The ratchet itself is made of the best insulating material known. The cover is of metal which can be finished in any color, and is, therefore, peculiarly suitable for use in houses and buildings where artistic interior decorations are desired. The ratchet is removable, and can be discarded in case of accident, and another substituted, without destroying the entire switch. Special switches are furnished with a small collar fitting outside the cover and firmly screwed down upon the ratchet pin, which cannot be turned except by means of the key in the possession of a competent person.

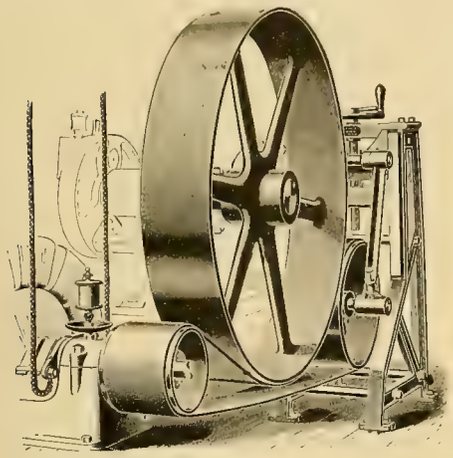
IMPROVEMENTS IN SMALL SWITCHES.

IMPROVEMENTS IN SMALL SWITCHES.

A French engineer recently employed a disconnected incandescent lamp as a test of stability. He desired to test the stability of two stone supports. Upon one he placed a telescope, and upon the other a Khotinsky lamp, so arranged that the vibrations of the filament could readily be observed through the telescope. He waited about ten minutes until there was complete repose, and then gave several sharp taps upon the floor of the laboratory, noting the number of seconds taken by the filament in again coming to the state of rest. The usual mercury tests were entirely incompetent to show vibrations which the incandescent lamp readily responded to.

Bates' System of Transmitting Power.

While Chicago in particular is a place in which space saving devices are thoroughly appreciated, the general tendency both in this country and abroad at the present time is toward a closer connection of engine and dynamo. Among those builders of power transmission machinery that have paid special attention to the development of a device through the use of which an ordinary type of engine might be connected to a dynamo so as to take up a

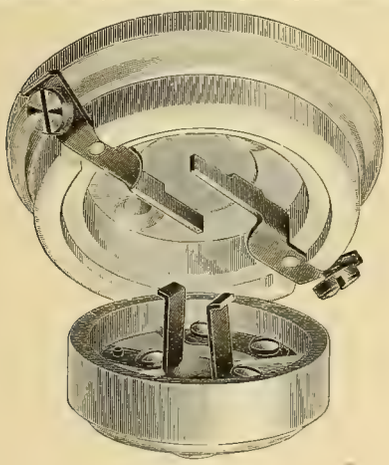


BATES' SYSTEM OF TRANSMITTING POWER.

minimum amount of room is H. N. Bates & Co. of Boston and New York. This concern now has on the market a most convenient and simple device for driving dynamos or other machines running at high and medium speeds. The illustration shows the improved rigging as it is applied in electric lighting service. By this arrangement the dynamos may be started instantly at full speed and immediately stopped without the slightest concussion. In the device there are no tight and loose pulleys. It operates easily and insures for the driving belt increased arc of contact with the smaller or driven pulley and relieves the bearings which support the shaft carrying the driving pulley from belt pressure at all times. By reference to the cut it will be seen that a remarkably short space is required and a perfect control is obtained by turning the crank at the top of the machine.

Ceiling Rosette.

The facility with which porcelain lends itself to all commercial purposes, finds endless examples in the great variety of ceiling rosettes, switches and other articles called for in electrical work. The new detachable rosette shown in the cut is intended to expedite interior construction and permit rapid inspection and replacing of fuses. The fuses are held in a removable cap, which can be quickly turned out by hand, or by means of a receptacle grip fixed at the



CEILING ROSETTE.

end of a long pole. This disposes of screws, screwdrivers and step-ladders, and will be be of great value and convenience where the rosettes are used on high ceilings, in public halls, theaters, etc. This rosette is manufactured by the Electrical Supply company, Chicago, with either inside or outside connections for the main leads.

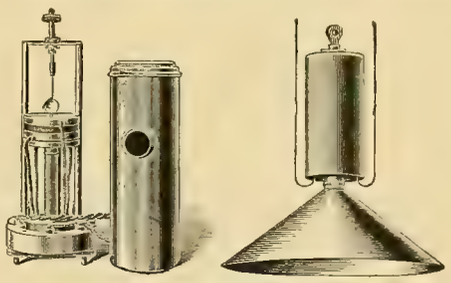
The establishment of an electric power plant at Ogden Canyon, Utah, for supplying Ogden with power for manufacturing purposes seems now probable. The plant will be planned to convert 1,800 horse power, but the start will be made with 500 horse power. At a recent meeting of the committee on solicitation, it was reported that 400 horse power had already been contracted for.

English Electrical Specialties.

English manufacturers of electrical specialties are showing increased interest in electrical work in this country, and many of the leading houses will no doubt endeavor to place their apparatus in commercial use in this country before the opening of the great exposition. Swinburne & Co. are desirous of introducing their specialties in this country.

Fig. 1 shows an electrostatic instrument for experimental work in connection with alternate currents. Instead of quadrants there are two pairs of half disks, so that the angle of deflection can be large. The needle consists of two half disks fastened on a metallic arbor. It is held by top and bottom suspensions. One disk is in the upper box and the other in the lower. The boxes are connected, not to ordinary terminals, as they are not suitable for high pressures, but to highly insulated flexibles. This instrument can be used as a voltmeter or it may be connected up to measure power by any of the methods involving two readings. It can also be connected up as a direct reading wattmeter. The electromagnet below the boxes acts on a copper drum, and renders the instrument dead beat. This magnet is excited by a cell. For large readings the torsion head and pointer on the top of the instrument are used, but for small readings the mirror is employed. Four of these instruments have been placed at the disposal of Dr. Fleming to be used in experiments on the measurement of power by different methods.

Another specialty, illustrated in Fig. 2, is a two thousand



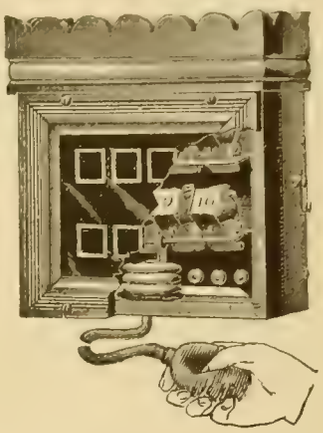
FIGS. 1 AND 2. ENGLISH ELECTRICAL SPECIALTIES.

volt street lamp. Street lighting by alternating current has presented considerable difficulties. In most cases transformers are arranged in houses, and the stations have high pressure leads only. To run incandescent lamps it is therefore necessary to employ transformers and a system of low tension leads. Swinburne & Co. have brought out a lamp which contains a small transformer and is connected directly to the high pressure system without any low pressure leads. A 32 candle power lamp with protector is arranged under a large enameled iron shade, which is secured to the base case of a small transformer. The efficiency of the little transformer is high, considering how small it is, being, according to the makers, slightly less than 90 per cent.

It will cost $1,000,000 to equip the Lowell and Suburban railroad with the electric system.

Schoenberg's Pneumatic Annunciator Reset.

The principal feature in the operation of this pneumatic reset for electric annunciators is that all fallen drops can be instantly reset from any reasonable distance. In the device all the cross shafts for raising the drops are connected to one perpendicular rod. This rod terminates at its base in a circular plate resting on top of a bellows, as is indicated in the accompanying cut. The air is expelled



SCHOENBERG'S PNEUMATIC ANNUNCIATOR RESET.

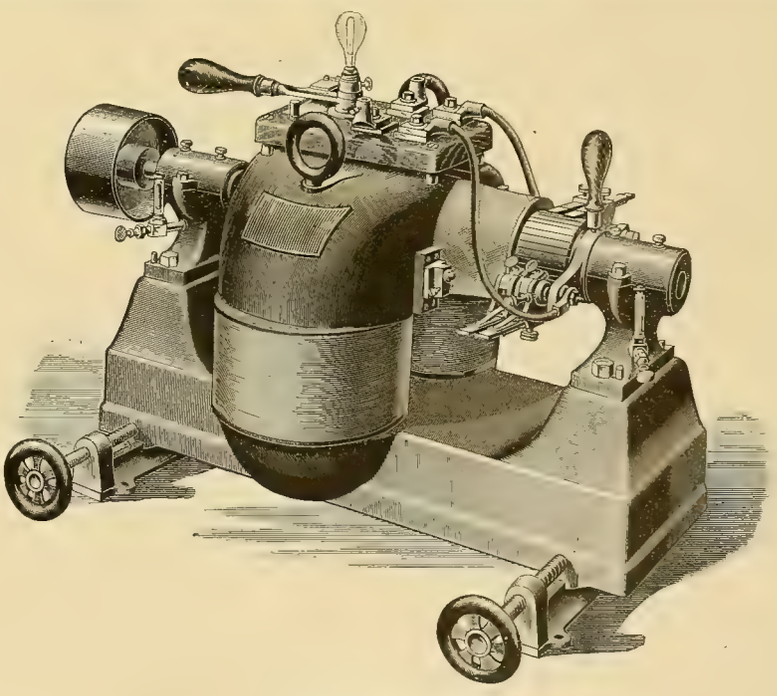
from the bellows by its contraction and the weight of the rod resting on it. When the bellows is empty one or all the drops are free to fall. The drops are reset by inflating the bellows by means of one or more hand bulbs connected by tube with the bellows. The E. S. Greeley & Co. is New York agent, and Partrick & Carter are Philadelphia agents for the device.

New Type Detroit Generator.

About a year and a half ago the Detroit Motor company began the manufacture of a new type of motor, to be used as either generator or motor.

The accompanying illustration shows the solidity and mechanical beauty of the machine. The shaft is large and made of fine steel, while the commutator and brushes are of bronze and tempered copper. It has self-oiling bearings and bronze boxes. The large cross section of the pole pieces and magnet cores of soft forged iron, instead of cast, with its very compact form, makes a magnetic circuit of very low resistance.

The armatures of these machines have received especia



NEW TYPE DETROIT GENERATORS.

scare in their design and construction, and the windings are strictly symmetrical, securing absolute balance in the output of each coil. The insulation of the armature is a special feature, and during the eighteen months which this type of apparatus has been on the market not an armature has been burned out. The resistance of the armature is unusually low. The generators are so compounded as to

secure a perfect automatic regulation, maintaining the pressure constant in the lamps.

The motors are shunt wound, thoroughly insulated, and made for hard and continuous service; they are in all cases furnished with the Detroit Motor company's automatic starting switch.

Reported Consolidation of the Thomson-Houston and Edison Companies.

It is generally believed in electrical and financial circles that there have been negotiations pending between the Thomson-Houston and Edison companies looking toward an early consolidation of these interests. What purports to be the terms of an alleged agreement between the companies have been published in the New York papers. Although there have been agreements and negotiations before between the same companies, they have not been so generally accepted as in the present instance, and it is agreed that the arrangements had not reached such an advanced stage. In the event of the consolidation it is stated by officials of the companies that not only the present factories will be continued but there will be many extensions and additions to the facilities of both companies.

Notice to Delegates.

Delegates to the annual meeting of the National Electric Light association at Buffalo will leave Chicago Monday afternoon, February 22d, and arrangements are being made for conveying them in special vestibule sleeping cars attached to the 3:10 P. M. train of the Lake Shore & Michigan Southern Railway, arriving in Buffalo at 7:20 A. M. (eastern time) the next morning. Any who finds it more convenient to leave later can take the Limited at 5:30 P. M., arriving at 8:40 A. M., eastern time. Of the trains returning, the most convenient leave Buffalo at 11:50 A. M., 7:20 P. M., and 11:08 P. M., all central time, arriving in Chicago respectively at 7:35 A. M., 9:30 A. M., and 3 P. M. the next day. It will thus be seen that the trip in either direction may be made in a single night's travel, an advantage that this line offers over any other of half a day's time saved on the return journey. Tickets for the round trip $18, on the certificate plan; berths, $3 each way, $1 extra going on the Limited. For reservations, certificates, or any information, address John L. Martin, of committee on transportation, care of Chicago Electric club, Chicago, or C. K. Wilber, western passenger agent, Chicago.

CORRESPONDENCE.

New York Notes.

New York, February 6.—It has been said that blessings never come singly, and it would seem that there was some foundation for the belief, at least as far as the introduction of the trolley system in the neighborhood of the metropolis is concerned. Brooklyn is fairly on the road to reform in the matter of facilities for rapid transit, and now comes the good news from Staten Island to the effect that on Monday evening the franchise was granted by both the New Brighton and Port Richmond boards of trustees for an electric street railway, to be operated by the overhead wire, between Port Richmond and the National Prohibition Park, Staten Island. The contract provides that the road shall be constructed and equipped in a first-class manner, that it shall be built to Prohibition Park within a year and extended to Richmond Road, along Jewett avenue, within two years, and that twelve round trips shall be made over the road each day between the hours of 6 A. M. and 9 P. M.

There is, of course, a great deal of talk about Henry Villard, and the rumored consolidation of the Thomson-Houston and Edison interests. Mr. Villard is reported to have said that the negotiations which commenced last week are progressing rapidly. Nearly two years ago he used his best endeavors to bring about such a result, and after long negotiations an agreement was reached, but failed for reasons which do not now any longer exist. The parties to the present negotiations, according to Mr. Villard, have all but agreed upon a basis that seems fair and just to both sides.

New York is now connected with the Bahama Islands by cable. The work of laying the new cable was completed Thursday, February 5th. The first message sent over the cable from Nassau, the capital of the Bahamas, came to Messrs. Isaacs & Heineman of this city from the senior member of the firm. It was sent at ten minutes past two P. M., and was delivered by the Western Union Telegraph company inside of thirty-five minutes.

There was a large fire on Thursday night at the works of the John A. Roebling's Sons company at Trenton. The wire braiding department was destroyed, and the loss is said to be $150,000. The building occupied about an acre of ground, and the firemen had hard work in confining the flames to one building. Much valuable machinery was destroyed, and the building was wrecked. It is stated that the fire started in a lot of inflammable material in a fireproof vault. Four hundred hands are thrown out of work.

Gov. Flower has signed the bill which allows newspaper reporters to be present at electrical executions.

February 8.—A dispatch from Sing Sing states that Charles McElvaine was electrocuted at 11:15 this morning. McElvaine went to his death calmly. When he was brought into the execution-room he looked quickly about and then fixed his eyes on the chair. At a sign from the chief keeper he walked over to it unflinchingly, and sat down. Then he stared straight ahead of him as the deputies quickly adjusted the straps and drew them tight. As the face strap was adjusted McElvaine grew excited and shouted: "Let her go." Instantly the current, at a pressure of 1,600 volts was turned on, and McElvaine was silenced.

Among the witnesses to the execution was Assemblyman Stein of New York, author of the law permitting newspapers to be represented, and a few medical men and electricians, while nearly all the New York papers and the leading press associations had representatives present.

W. F. O.

Kansas City, Mo.

Kansas City, Mo., February 6.—The time for filing an acceptance of the Thayer-Enright electric street railway franchise in Kansas City, Kan., expired last week, and the company did not deposit the required guarantee of a $5,000 government bond with the city treasurer. The company alleges that the ordinance, passed at a special meeting of the city council was worthless as far as enabling the company to float the bonds. The company will ask the council to pass the ordinance again at a regular meeting.

The Inter-state Elevated Railway Company of Kansas City, Kan., introduced an ordinance in the city council at its meeting last week, in which it asked permission to change the motive power from steam dummies to electricity over the entire road, converting the entire system into an electric road. The company also asks the right to make such extensions of the present lines as to virtually cover the territory proposed by the Thayer Enright franchise.

The company has now an application in the Argentine city council asking for a franchise to operate its line along the streets of that city. The franchise, if granted, will make the "L" road system one of the largest in the two cities, comprising nearly twenty miles of double track road.

The first lecture in the course on "Electricity and its Modern Application" under the auspices of the Kansas City Society of University Extension was given on Thursday evening, February 4th, at 8 o'clock. For the last two weeks W. W. Smith of the Telephone company, Manager McMillen of the American Electric Light company and Manager Woods of the Western Union Telegraph company have been in conference with the executive committee and have been enthusiastic in their efforts to promote the success of the course.

The annual meeting of the stockholders of the Missouri & Kansas Telephone company for the purpose of electing directors and officers, reviewing the work of the year and discussing plans for the future was held last week at the offices of the company in the Telephone building. The following named directors were elected for the ensuing year: John E Hudson, Boston; George Albree, Boston; C. E. Yost, Omaha; John R. Mulrane, Edward Wilder and T. B. Sweet, Topeka; S. A. Walker, St. Joseph; J. S. Chick, and N. R. Furguson, Kansas City. At a meeting of the directors, the following named officers were elected: John R. Mulrane, president; W. W. Smith, secretary and superintendent; N. R. Furguson, treasurer. It was decided at the meeting that an effort would be made at once to have the council pass an ordinance authorizing the company to put its wires underground. The officials of the company are extremely anxious to know positively whether they will have to put the wires underground before they begin the work of removal of the exchange.

Superintendent Smith said that it would take fully six months to make the change as an entirely new system would have to be constructed. Another story is to be put on the building at Sixth and Wyandotte streets, to be used as an operating room. Here there will be capacity for 4,800 connections, while in the present exchange there is room for but 2,600. The public will never know that any change is being made, as far as interference with the wires is concerned, as it will require but five minutes to make the change when the new system is completed.

G. M. P.

Louisville, Ky.

Louisville, February 6.—Superintendent Minary of the Louisville Street Railway company is of the opinion that if nothing unforeseen occurs to delay the work on the Second street electric line, the cars will be running in a month or six weeks. The poles have been erected and the supporting wires put up, and about all that remains to be done is to string the circuit wires. This will require only a short time, however, and will probably not be done until everything else is in readiness. The inability of the company to secure a sufficient number of motors has been the cause of delay. The line will be about four and one half miles in length, and the cars will be run on a four minute schedule. When this line is completed Louisville will have about twenty miles of electric street railways.

The Louisville Electric Light company, which has a contract with the city to light the streets, has met with the greatest difficulty recently in the fulfilling of the agreement because of inferior wiring. For several weeks lights in different localities failed to burn, causing much inconvenience to the public, and many uncomplimentary remarks. The trouble was remedied this week, however, and the circuit is now working perfectly.

C. C. Y.

Denver, Colo.

Denver, February 6.—Electricity as a motive power is to supersede the cables on the Denver Tramway company's lines, and the company is now preparing to vacate its big power house at Colfax avenue and Broadway. The building will be used as an auditorium, and Denver will have a structure capable of seating 12,000 people. The change will necessitate many improvements in the Tramway's system in the way of additional electrical machinery and buildings. About sixteen miles of cable service, single track, will be abandoned. The electric cars will run over the same rails.

Leading citizens of Longmont are encouraging a movement to purchase the Longmont Electric Light Works, and a company will undoubtedly be formed for that purpose. The works can be bought for $12,000.

Greeley's electric street lights have been shut off by order of the aldermanic board. On January 5th, in a fit of economy, the council ordered the lighting stopped, two weeks' grace being allowed. Now, in spite of numerous protests from taxpayers, the city is plunged in darkness.

E. C. D.

PERSONAL.

George E. Mumford, president of the Brush Electric Light company of Rochester, N. Y., died in Florida on February 2d. Mr. Mumford was a prominent banker in Rochester, and was highly respected.

NEW INCORPORATIONS.

Pink Granite company, Alexandria, Va.; capital stock, $200,000; to quarry granite, mining, building, telegraph, telephone, water, gas and electric works.

Ithaca Electric Lighting company, Ithaca, Mich.; capital stock, $20,000; to manufacture and sell electricity for lighting, etc.; Jas. Moore, Ithaca, Mich.

Lebanon & Myerstown Street Railway company, Lebanon, Pa.; capital stock, $100,000; operating an electric street railway; C. H. Killinger, Lebanon, Pa.

Freeman-Holland company, Portland, Me.; capital stock, $500,000; to manufacture and deal in electrical appliances of all kinds; E. W. Freeman, Portland, Me.

City of Pekin Electric Light & Power company, Pekin, Ill.; capital stock, $15,000; furnishing electric light and power to the city and citizens of Pekin; the city clerk of Pekin, Ill.

Carbon County Electric Railway company, Philadelphia, Pa; capital stock, $60,000; operating an electric street railway; F. H. Cheyney, 216 South Third street, Philadelphia, Pa.

Arlington Heights Electric Light company, Fort Worth, Tex.; capital stock, $100,000; to supply light, heat, and electric motor power to the public; Robt. McCart, Fort Worth, Tex.

Quinsigamond Electric Power & Light company, Worcester, Mass.; capital stock, $10,000; to manufacture and sell electricity for light, heat, and power; Eben F. Thompson, Worcester, Mass.

Springfield Electric Light company, Springfield, Ore.; capital stock, $10 000; building, owning, operating, leasing and purchasing or otherwise disposing of electric light; B. J. Pengra, Springfield, Ore.

Enterprise Mining, Milling & Smelting company, Seattle, Wash.; capital stock, $1,000,000; to deal in and operate mines, mills, smelters, furnaces, coke ovens, railroads, steamboats, gas and electric light and waterworks; F. F. Boynton, box 1620, Seattle, Wash.

Pioneer Carriage company, Seattle, Wash.; capital stock, $10,000; to manufacture and deal in street cars and other cars and other goods, wares, or material used in construction and equipment of street railroads, electric street roads,

telephone and electric light wires and plants, wagons, buggies, etc., and necessary real estate and buildings; Fred. E. Sander, Seattle, Wash.

Hartford Insulating company, Hartford, Conn; capital stock, $75,000; to manufacture and deal in all goods pertaining to the use of electricity, to insulate and manufacture fire proof and waterproof goods, also enamel goods of all kinds, etc.; F. E. Fowler, Hartford, Conn.

Colby Specialty Supply company, Chicago, Ill.; capital stock $100,000; inventing, manufacturing, selling, leasing and otherwise operating various electrical and mechanical devices, appliances and chemical products, sale and leasing territorial rights and United States and foreign letters patent; Harry Fox, 604 Chamber of Commerce, Chicago, Ill.

Northern Electric Subway company, Duluth, Minn.; capital stock, $100,000; to construct and operate plants and manufacture and deal in electrical appliances for producing light, heat and power, and construct and operate subways, conduits, pipes, mains and poles, and all necessary appliances; Cash, Williams & Chester, Duluth, Minn.

ELECTRIC LIGHTING.

A $10,000 stock company has been organized to erect an electric light plant at Elizabeth City, S. C.

It is likely that the city of Denton, Tex., may soon contract for the establishment of an electric light plant and waterworks.

The Camden, Ark., Waterworks & Electric Light company will, it is stated, rebuild its electric light and waterworks plant recently burned.

It is said that plans are being prepared for an electric light plant to be operated in connection with the waterworks at Mossy Creek, Tenn.

An electric light company is endeavoring to secure from the city council of Greenwood, S. C., a franchise for the erection of a $10,000 electric light plant.

A central station is shortly to be built in Baden by the firm of Brown, Boveri & Co. of that town. The multiphase system is to be applied, and the dynamos will be driven by turbines.

The electric light plant erected at Marion, Ind., by the Fort Wayne Electric company has been accepted by the city. The total cost of the plant was $23 415. The city has issued twenty year bonds to pay for the plant.

The latest shades for electric lights are made of perfumed Indian grass and tinsel in the shape of a tiny umbrella. They are very dainty and effective, and the slight heat of the electric light causes the grass to give off a faint perfume.

Owen Durkin has commenced an action against the Edison Electric Illuminating company of Rochester to recover $15,000 damages. He alleges that on the 24th of last August he was in the employment of the company, that his clothing was caught in unguarded machinery, and that he was severely injured in consequence and put to great pain and expense for medical treatment.

Application has been made to the provincial legislature of British Columbia to incorporate electric lighting companies, to construct and maintain works, and use so much of the waters of the Capilano river and Lynn river, Burrard inlet, and of the Coquitlam river, both in New Westminster district, as may be necessary for the purpose of generating electricity to be used as a motive or illuminating power.

The Allgemeine Elektricitaetsgesellschaft of Berlin has entered into contract with the Koenigliche Eisenbahn Betriebs-amt Berlin-Anhalt for the erection of an electric lighting plant for the lighting of the railway station. The plant will be a large one, consisting of two power stations, and the cost is estimated at from $125,000 to $150,000. It is expected that it will be in working order by the middle of the present year. The Edison system will be used.

According to the *Daily Advertiser* of Portland, Me., Mount Washington is to be capped with the largest electric arc light ever made, and the highest beam of artificial light in the world. It can be easily seen from Portland, and, under proper conditions, it can probably be seen even from Boston. The company which is to be organized to carry out the scheme will be made up of prominent railroad and hotel men interested in the future development of New Hampshire. It is believed that this light on the summit of Mount Washington will be such a novel and beautiful spectacle that it will benefit the state of New Hampshire, simply viewed as an advertisement.

ELECTRIC RAILWAYS.

The electric railway system at Pueblo, Colo., is to be extended this year.

The Thomson-Houston company equipped sixty-three new electric roads in this country last year.

The City & Suburban Railroad company of Savannah, Ga., contemplates the introduction of electricity as the motive power.

A company with $50,000 capital is being organized to construct and operate an electric street railway between Waltham and Watertown, Mass.

The San Francisco and San Mateo electric railway will soon be in operation. Already $600,000 has been spent in its construction and equipment.

A New York syndicate has purchased the Wilmington street railway. The purchase price was $100,000, $75,000 of which was paid in cash. Arrangements will be pushed for changing the road so as to be operated by electrical power.

Over 100,000 persons have been carried on the Roundhay Park road since the opening. This is the line at Leeds, England, constructed on the American overhead trolley system.

The annual report of the electric street railway company at Colorado Springs shows that its system covers 25 miles of track. The capacity of the power plant has been doubled since the road was started eighteen months ago.

The Baltimore Traction company has purchased the North Baltimore system of street railways. The price paid was $45 a share. The par value is $25 a share. Electricity, it is said, will be the motive power used when horses are discarded.

A bill was filed in the Circuit Court at Chicago on February 3d, to restrain the Calumet Electric Street Railway company from constructing and operating a railway along Madison avenue, from South Chicago avenue to Sixty-seventh street, and on the latter thoroughfare. It is claimed that all of the needful consents of property owners were not obtained.

Chauncey M. Depew was recently asked what the railroads of the next quarter century would be like. He replied that in less than twenty-five years "steam as a motive power will have given way to another far greater one. That will be electricity. It is certain to be, and it will be within a very few years, judging from what has been done by electricity during the last sixteen years."

About 300 voters of the Twentieth, Twenty-first and Twenty-second wards of Chicago recently held a meeting to consider the construction of the Evanston electric surface road. The result of the gathering was an indorsement of the road, provided the company building it would start the elevated portion south of Clyborn avenue and east of Southport avenue. Mr. Clark, a representative of the company, was present, and agreed that the road would be built on the conditions suggested.

A dispute has arisen between the Baltimore City Passenger Railway company and the new Baltimore & Curtis Bay Electric Railway company. Both companies claim the right of way from the end of Light street to Light street bridge via the road which runs along Spring Gardens; and both companies have laid tracks thereon. The tracks of the two roads in many places are not more than six inches apart, and it will be utterly impossible for cars to run on either line if both companies try to operate.

The annual report of the Lancaster City Electric Railway and West End Passenger Railway companies of Lancaster, Pa., shows that 1,249,250 passengers were carried during 1891. It is only a few years ago that horse car lines were introduced in Lancaster, and financially they were not a success. The last year that the horse car lines were used, 183,000 passengers were carried, and the first year of the electric system the number was 426,000. These companies have now fifteen miles of track, and during the summer they will build belt lines in all sections of the city.

The Inter-state Street Railway company has completed surveys and by December of the present year the entire system will be in operation. The lines from the Attleboros in Massachusetts, to Pawtucket, R. I., are nearly completed, so far as the laying of rails is concerned. The surveys of the loop-line running through various streets in Pawtucket intended to be devoted to local traffic and the surveys of the lines from Pawtucket to Providence and from Pawtucket to Cumberland Hill through the numerous thriving villages of the towns of Lincoln and Cumberland have not yet been made, but as they are practically straight lines with little or no difficult grades to overcome, that work will occupy but a short space of time. The two Attleboro lines will be in operation by the first of next April, the line to Cumberland Hill will be completed so that cars will be run upon it next winter, the line to Providence will be running by the middle of the summer; the loop-line in Pawtucket will also be in running order by that time; and it is intended to have the Bullock's Point line to the various shore resorts in operation by Memorial Day next—May 30. It will take about 4,000 horse power to run the system and the company is now negotiating for the purchase of the plant of the Richmond Paper company at Rumford, in East Providence, to use as a power station. If secured it will make a very desirable station, being favorably located, and of sufficient capacity to allow of an extension of the system if desired.

TELEGRAPH.

Edward Stokes has obtained a judgment of $75,000, with interest from Dec. 26, 1888, against John W. Mackay and Hector de Castro. This is the full amount claimed. The court also granted an extra allowance of $1,000. The action was brought on a contract made between Stokes and De Castro, by which Stokes agreed to give telegraph securities to Mackay in consideration of $100,000 and the absolution of a debt of $350,000 due Mackay from the Hoffman House.

Wall street has been greatly agitated during the last week over Western Union stock. The following item appeared in the street talk of the *Daily Financial News*, which probably explains the matter: "Western Union infused some vitality into itself in the earlier trading, the shares advancing to 88¼ upon reports that a syndicate had taken 50,000 shares held by the Baltimore & Ohio company. This, with the talk of an extra dividend, induced considerable buying, but subsequently these rumors were denied, and the stock lost its entire gain and a fraction more." The same paper contains the following editorial paragraph: "The rumors of the sale of the Western Union stock held by the Baltimore & Ohio company continue current, but officials of the Western Union company deny that any of it has yet been sold. It is stated, however, that a syndicate is being formed which will underwrite the entire amount practically giving the Baltimore & Ohio a put at certain prices at which it is expected the stock will soon be transferred."

MISCELLANEOUS.

The Edison General Electric company is now occupying its new building in Pittsburg.

Judge Jackson of the United States court at Nashville, Tenn., has rendered a decision in the case of the Thomson-Houston Electric company against the Capitol Electric company. He gave judgment in favor of the plaintiff for $54,535 85 on first mortgage bonds and $26,048.03 due on notes. It was also decreed that the property should be sold as one plant to be paid for in six, twelve and eighteen months, with interest.

The first of a series of instructive lectures on the subject of electricity and its industrial applications was given on Saturday afternoon, January 30th, to the employes of the Ries Electric Specialty company, Baltimore, by the president of the company, Elias E. Ries. These lectures, which are to be given at regular intervals, are intended to familiarize the young men and young women employed by the company with the theory and principles underlying their practical daily work. The initial lecture was illustrated by numerous attractive and interesting experiments, and was thoroughly appreciated by the employes of the company, for whose instruction it was given, and also by a number of ladies and gentlemen who were present by invitation. During the course of the lecture the principles of electricity and magnetism, and some of their more important applications, were fully explained and illustrated. Among the many practical experiments shown were the generation, transmission and utilization of electric currents, the construction and use of transformers and reaction coils, the operation and regulation of alternating current incandescent lamps, the operation of alternating current motors, electric heating apparatus and other devices by transformed currents, etc. The lecture was held in the company's testing room, which was fitted up for the purpose with electrical apparatus of almost every conceivable kind from Mr. Ries' private laboratory.

TRADE NEWS.

C. E. Chapin, Electrical Exchange building, New York, returned this week from Boston, where he closed a number of contracts.

A "two mouse power" electric motor and battery is being introduced by the Electro Novelty company, 9 Knapp street, Boston. The little machine is said to be a perfect working model of the Edison dynamo.

W. C. Sterling, an extensive dealer in cedar poles and railway ties at Monroe, Mich., is arranging for storage grounds at St. Louis, where he expects soon to put in a large stock of cedar poles, ties and posts for the wholesale trade.

The Himmere & Anderson Dry Battery company, New York, has lately increased its facilities for the manufacture of dry batteries. The cell exploited by the company has recently been perfected, and is said to be giving universal satisfaction.

The Electric Light company, Albuquerque N. M., recently sent a telegraphic order to the Pond Engineering company, St. Louis, for a 100 horse power Armington & Sims engine. This is the third order from this company within one year.

The New York Insulated Wire company is now settled at 15 Cortlandt street, and a 15 mile order just received for Grimshaw white core wire has had the very natural effect of making the management quite cheerful as to prospects for spring trade.

George Cutter has just returned from a trip to Boston where he secured the general western agency for the new interior conduit, "Buildite." This conduit has been thoroughly tested in the East, and will undoubtedly find a good market in this vicinity.

The Partrick & Carter company of Philadelphia, sole proprietors of the patent model annunciators, reports January's business almost double that of the same month last year. This firm is to take the agency for Schoenberg's pneumatic annunciator reset, which is shortly to be placed on the market.

The Pond Engineering company has found it necessary to secure larger offices in Chicago, and its headquarters are now at room 8, Rookery building, extending from the rotunda to the Rookery court; the front part will be devoted exclusively to office use, and the rear for drawing room and shipping.

S. F. B. Morse, the inventor of Morse's lightning calculator, which is having a large sale among electrical people generally, has completed a similar calculator for motor circuits, motive power and street railway service and available efficiency of water powers, which will be placed on the market in the near future by Edward Lasell of Kansas City, Mo.

The La Roche Electric Works, Philadelphia, have just issued a general catalogue illustrating some of the apparatus made by this company, and giving also a rudimentary idea of each machine. The entire mechanical and electrical construction of the machinery turned out by this well known house is original with the inventor, F. A. La Roche, and the apparatus is used in some of the best known lab-

oratories in the world. The company will make any special machine for laboratory or other work.

Alfred E. Kornfeld, New York, formerly connected with the *Electrical World*, has been appointed business manager of the Himmer & Anderson Dry Battery company, 123 Chambers street, New York. Mr. Kornfeld is one of the rising young men in the electrical field, and there is no doubt that he is well able to fill his new position to the satisfaction of his company.

When, in addition to five months of dull business, a manufacturing company is subjected to a six months' stoppage of the factory's water power during the busiest season, and yet overcomes all losses and shows profits of $1,000, one naturally concludes that the results are brought about by able management. Such is the record of the Wilcox & Howe company of Birmingham, Conn., as shown by the company's balance sheet. The company at the recent annual meeting elected directors for the ensuing year. E. J. Keeler and Henry C. Riker resigned their positions. Isaac P. Howe continues in charge of the business.

The Detroit Motor company is placing a new generator on the market and is meeting with considerable encouragement. B P. Van Court, until recently of the firm of Van Court & Conklin, wholesale iron and steel dealers, Detroit, has purchased an interest in this company, taking the active management, Mr. Van Court has occupied a prominent position in business circles in Detroit for eighteen years and will undoubtedly meet with success in this field. F. A. Blades retains his interest in the company and has been re-elected secretary and treasurer. The company has ample capital and now carries on the pay roll 100 men. The following are the officers of the new organization: Hon W. C. Mayburg, president; J. Huff Jones, vice-president; B. P. Van Court, general manager; F. A. Blades, secretary and treasurer.

H. N. Bates & Co. of Boston and New York have just issued a revised annual catalogue, or more properly a revised handbook, under the title "Machinery for Transmission of Power." There is quite a fund of useful information, and contractors for electric lighting or power plants will find the little volume a handy one to keep on the desk. H. N. Bates & Co are now working with facilities largely increased, both by new buildings and the introduction of the latest and most improved labor-saving tools, and they are in a position, workmanship and material considered, to meet the trade in a manner that will insure them a full share of the best business. It should be mentioned in connection with this firm that when an order is placed with them a draughtsman is sent without expense to lay out the work and to make all necessary drawings.

BUSINESS.

The Partrick & Carter company of Philadelphia has presented a new box bell possessing many points of merit. These bells are made in three sizes only at present.

The Vulcanized Fibre company, New York, reports the receipt of a number of large orders from foreign countries for its hard vulcanized fibre in different shapes and colors.

It is reported that the Crocker–Wheeler Electric company has just placed four of its perfected fan outfits in the turrets of the new United States steamship Miantonomoh to blow the smoke away from the guns.

John E. Beggs, of the John E. Beggs Machinery & Supply company, New York, has just returned from a southern trip, during which he closed a number of contracts for enlarging central stations. He reports business as being very good, especially in Baltimore, where he found the electrical concerns rushed with spring trade.

Alexander, Barney & Chapin, 20 Cortlandt street, are going to issue $50,000 new stock, consisting of preferred shares, bearing interest at 8 per cent. With this additional capital it is promised the A. B. C. company will enter more vigorously into the supply business than they have done before, and the large clientele which they enjoy will be better served than ever.

T. J. Murphy, 136 Liberty street, New York, is offering to the trade a handsome sample of a section of a slate switch-board. The section is 18 inches square, and is made up of six different colors of "marbleized" stone, showing the character and appearance of the different styles of material. As most of the New York concerns are mounting their instruments directly on the marble or slate, doing away with all bases, Mr. Murphy will drill all the holes necessary from a drawing or templet.

The Interior Conduit & Insulation company of New York is making large shipments of new Johnson switches. The company is thirty days behind in its orders, one illuminating company alone having ordered 1,100 switches in two days. The company has in preparation a handsome illustrated catalogue setting forth the features of this switch. This catalogue will be issued, together with a revised edition of No. 4 catalogue, in the course of the next ten days or two weeks.

The Illinois Electric Material company, Chicago, made an assignment on February 8th to Frank Hamlin, of the legal firm of Hamlin, Holland & Boyden. The capital stock of the company was $15,000. The assets are placed at $10,000, and liabilities at the same amount. But the assets are said to be so tied up in heavy contracts that the company has been unable to provide for maturing obligations. The suspension of the Continental Electric company some weeks ago is said to have crippled the Illinois company and added to the strain.

The Electric Construction & Supply company, New York, is building a large number of focusing lamps for photographing, theatrical and search light service. This company's search light is now in use on a number of large steamship lines. It is made up in two styles. One type is constructed for river and inland use, and the light is placed on top of the pilot house, with a shaft extending through to the interior, where there is a wheel to enable the pilot to revolve and elevate or lower the light. The other type, for ocean steamers, is similar in construction except that it can be lifted out of the frame carrying it when not in use, and thus is not subjected to the effect of bad weather.

J. H. Bunnell & Co., New York, have presented to the trade the twelfth edition of their yearly catalogue. In preparing this very necessary little volume it has been their aim to list only the best goods in every department, and, as far as possible, to omit from the pages of the catalogue all old style, out of date, or inefficient instruments and material of every kind. The rapid progress made in telegraphy and other departments of electrical development is such that if this rule had not been followed the pages would soon be crowded with such a list of mixed grades of instruments, wires and general supplies that a selection of the best and most practical goods would be a difficult matter.

ELECTRICAL STOCK MARKET.

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, February 6th, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	102½	103
Edison Illuminating company of New York	80½	81½ Ex. Div.
" " " Brooklyn	72½	77½
" " " Boston	100	105
" " " Chicago	130	140
Edison Ore Milling company	15	20
United States Electric company of New York	15	25
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomas-Houston Electric company	51	52
" Preferred "	26	27
Westinghouse Electric company	13	13½
North American Phonograph company	2½	5
New York " "	2½	5
Automatic Exhibition company	2	3

ELECTRICAL PATENTS.

Issued February 2, 1892.

467,917. Telephone Holder. James A. Christy, San Francisco, Cal.

467,919. Electric Cut-Out. Albert L. Clough, Manchester, N. H.

467,922. Burglar Alarm. John I. Covington, Brooklyn, N. Y.

467,924. Electric Motor. John W. Darley, Jr., Baltimore, Md.

467,940. Trolley Wire Hanger. Charles T. Lee, Boston, Mass.

467,941. Insulator. Charles T. Lee, Boston, Mass.

467,942. Insulator. Charles T. Lee, Boston, Mass.

467,958. Incandescent Lamp Socket. William L. Silvey, Lima, O.

467,969. Electric Railway Motor. Henry M. Byllesby, St. Paul, Minn.

This invention consists in employing an improved type of motor in which the fields and armature are concentric with each other and independently rotatable about their common axis, the armature being connected to one of the car axles and the fields to the other by such intermediate gears or other connections that the opposite rotations of the armature and fields impart motion to the car axles in the same direction.

467,982. Incandescent Electric Lamp. David H. Piffard, Piffard, N. Y.

467,983. Incandescent Lamp Socket. David H. Piffard, Piffard, N. Y.

Claim six reads:

"In an incandescent lamp socket and switch, a tube of elastic material forming at one end a socket for the lamp and at the other end having a solid chamber containing the turn-off switch and a cam mounted on the outside of said tube for operating the switch-contacts within said chamber."

467,985. Electric Signal for Mine Shafts. Frederick W. Bacorn, Marysville, Mont.

468,020. Electrical Measuring Instrument and Current Direction Indicator. James J. Wood, Fort Wayne, Ind.

This invention consists of an electric measuring instrument comprising an electro magnet, its inclosing coil and a repellant armature, the construction of said magnet with its core subdivided into two sections magnetically separated or insulated, whereby upon the cessation of the magnetization current the like magnetic poles of the two sections mutually repel each other and thereby assist in the suppression of residual magnetism whereby the instrument is rendered more sensitive.

468,053. Insulating Swivel. Axel H. Englund, Chicago, Ill.

The sixth claim is:

"In an insulating swivel, the combination, with an insulated bolt having exposed metallic connecting devices at its ends, of an intermediate annular rib or flange of insulating material, forming an insulating water-shed."

468,086. Electric Wire Coupling. William B. Lillard, New Orleans, La.

468,099. System of Electrical Distribution. Harry W. Leonard, New York, N. Y.

468,100. Electric Elevator. Harry W. Leonard, New York, N. Y.

This invention consists in the method of reversing the motion of an electric motor, which is accomplished by reversing the field magnet of the generator supplying the armature of the motor.

468,101. Cut-out. John B. Murphy, Cincinnati, O.

468,107. Electric Signal System. Howard F. Eaton, Quincy, Mass.

468,108 Weighing Apparatus. Charles W. Hunt, West New Brighton, N. Y.

468,119. Electric Switch. Elihu Thomson, Lynn, Mass.

Claim four follows:

"The combination, in an electric switch, of a receptacle containing a conducting-liquid of low conductivity in circuit with one of the switch-contacts and balls of better conducting material through which passes the moving contact when opening or closing the circuit."

468,120. Method of and Means for Interrupting Electric Currents. Elihu Thomson, Swampscott, Mass.

The method consists in causing a rapid movement of the discharge terminals relatively to one another at the interrupted point, such that the said movement does not alter the distance between the terminals.

468,121 Dynamo Electric Machine. Elihu Thomson, Swampscot, Mass.

Claim seven is presented:

"The combination in a dynamo electric generator or motor, of the stationary magnet frame having inwardly projecting polar extensions between which the generating coils are disposed with straps surrounding the coils and adjustable means for securing the said straps to the frame."

468,122. System of Electrical Distribution. Elihu Thomson, Swampscott, Mass.

This invention consists of the combination in a multiple series distribution system of a motor serving as an equalizer and coupled with the main generator and switch for shifting the motor from one side of the system to another.

468,123. System of Electrical Distribution. Elihu Thomson, Swampscott, and Edwin W. Rice, Jr, Lynn, Mass.

This invention consists of a generator of electromotive force in circuit with the outer mains and driven or energized by the excess of energy shunted around one of the multiple groups.

468,125. Electric Switch. Augustus Wright, Providence, R. I.

468,128. Electric Motor Regulation. Francis O. Blackwell, New York, N. Y.

This invention consists of the combination in an electrically propelled vehicle, of two motors therefor and a common reversing switch with connections therefrom extending separately through the armature to the field magnet of the two motors, respectively, whereby each motor will be in series with its own armature.

468,148. Process of Separating Aluminum. Charles Bradley, New York, N. Y.

468,159. Device for Raising and Lowering Suspended Electric Lights. Solon M. Terry, Pittsfield, Mass.

468,163. Electric Railway. Malone Wheless, Nashville, Tenn.

468,164. Electric Railway. Malone Wheless, Nashville, Tenn.

468,165. Electric Railway. Malone Wheless, Nashville, Tenn.

468,166. Conduit Electric Trolley. Malone Wheless, Nashville, Tenn.

The first claim reads:

"The combination of three lines of wire, each line being in sections insulated from one another and two such lines being parts of the same circuits, with a trolley having three pairs of wheels, one pair for each line of wire, and the two pairs which are for the lines of wire in the same circuit being insulated from each other."

468,170. Electrical Annunciator. William Ebert, Chicago, Ill.

468,172 Electric Fare Register. Willard H. Gilman, Boston, Mass.

468,185. Illuminating Sign. Lawrence J. Webster, Boston, Mass.

468,186. Electric Light Tower. Carlton A. Beardsley, Detroit, Mich.

468,246. Telephone Receiver. Elwood A. Grissinger, Mechanicsville, Pa.

468,253. Electric Elevator. Albert Neuburger, Kansas City, Mo.

Of the seventeen claims the fifteenth is given:

"The combination with a main line, a car, suitable hoisting mechanism, and a motor circuit, of the divided circuits embracing the rheostats, the switch, the cam slotted plate, the carriers actuated independently by said plate, and the series of traveling shoes carried by said carriers and each having the contact surface held by springs into engagement with the contacts of the divided circuit."

468,260. Regulator for Electric Current Generators, Gustav Pfannkuche, Cleveland, O.

The object of this invention is to so regulate the action of the generator that the amount of current generated shall correspond to the varying work interposed in the main or working circuit and the consequent varying load imposed upon the generator.

468,281. Cut-off for Telephones. Edwin Cann, Winnipeg, Canada.

468,293. Connector for Electric Wires. Clyde J. Coleman, Chicago, Ill.

468,314. Conduit for Electric or Cable Roads. Clarence H. Bates, Minneapolis, Minn.

Claim two is given:

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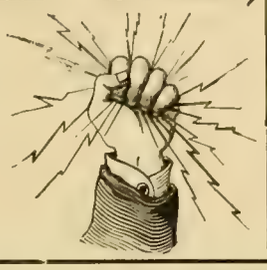

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Information regarding place of death of John Eicher who probably died in 1881 or thereabouts. He is known to have been in employ in an electric light company, to which he contributed $1000, probably in stock of the company. Remainder of his effects were bequeathed to his natural heirs. Any information as to place of death or as to identity of the electric light company to which he was interested, will be suitably rewarded if sent to William Eberhart, 80 State St., La Porte, Ind.

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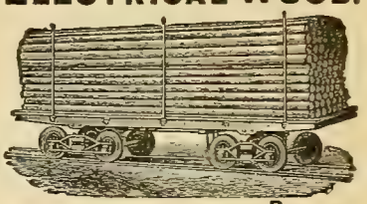

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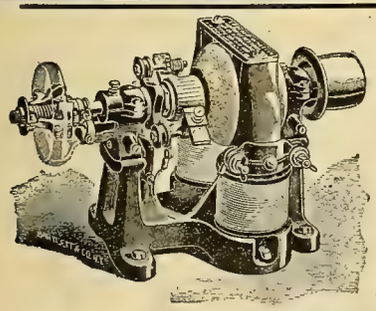

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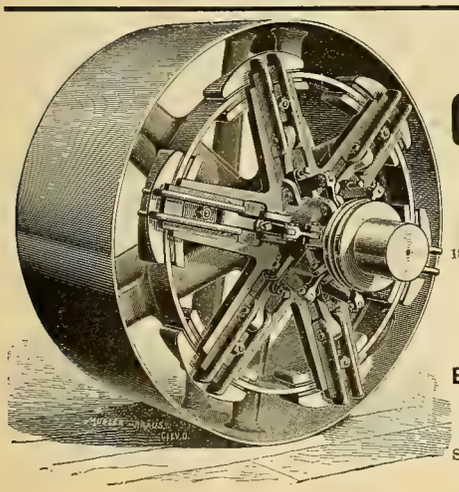

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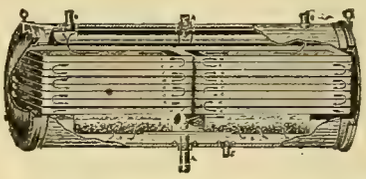

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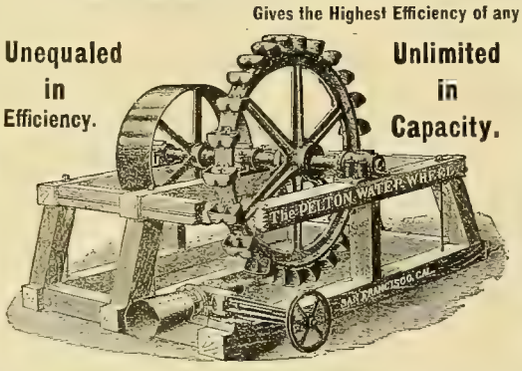

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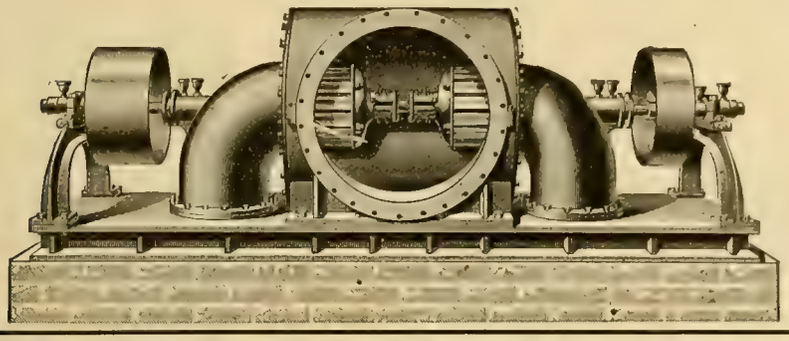

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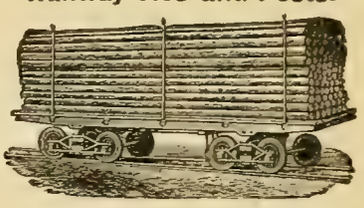

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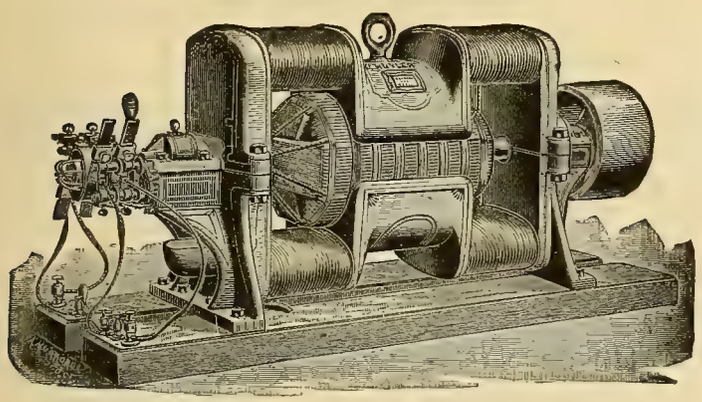

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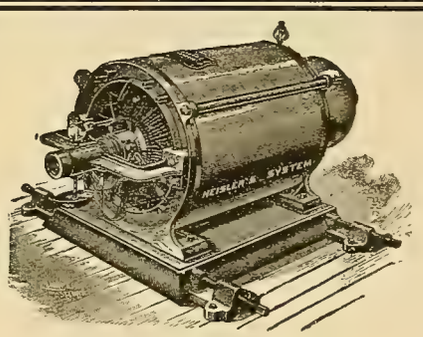

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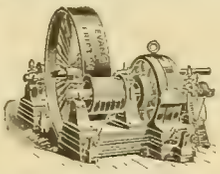

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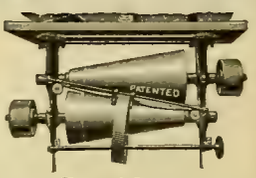

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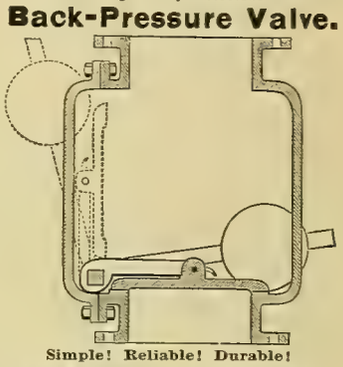

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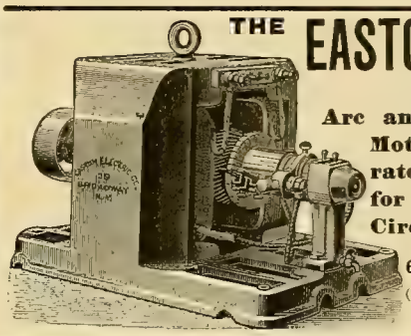

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Bernstein Series Incandescent Lamps.

Lamps and Series Sockets for all Arc Systems for Street and Inside Lighting.

THOUSANDS IN USE.

Reduction in Price of Series Socket.

16	C. P.	4	to 6	Amperes.
25	"	3	" 10	"
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100	"	8.5	" 10	"

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High Efficiency. Full Candle Power. Long Life.
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TRY A HUNDRED AND YOU WILL ORDER A THOUSAND.

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Wood, with Mica Insulation,
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SAFETY ARC LAMP WINDLASS

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Key Sockets,	25c.	23c. 22c.
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LONG DISTANCE TRANSMISSION.

We manufacture transformers of any size and any desired voltage for special uses, and

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Send for our **Pamphlet No. 3,** devoted to the subject of **Large Transformers.**

This subject is worthy of consideration by all **Station Managers.**

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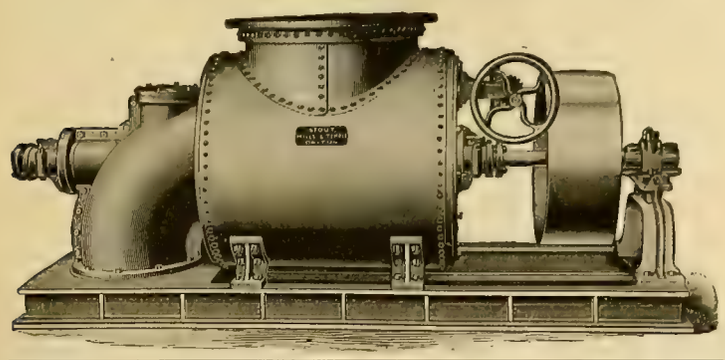

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On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

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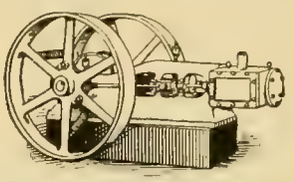

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Pullman's most modern Sleeping Cars are run on all through trains via this line, and on their Vestibule Limited, Pullman's Dining Cars. No extra fare charged on this train. In fact, the rates via the ERIE are lower than via any other route offering equal facilities.

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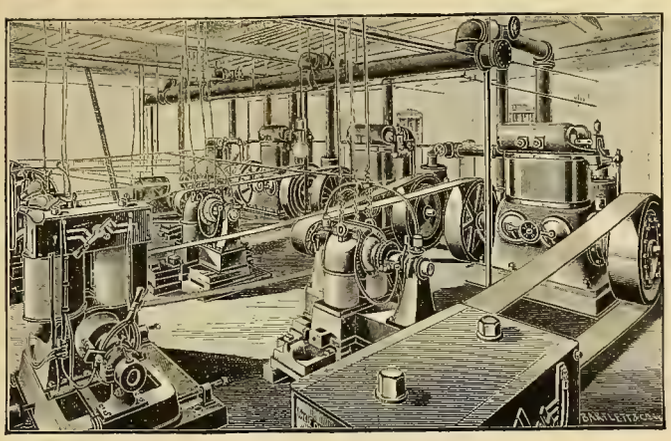

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WITH BOILER PLANT COMPLETE.
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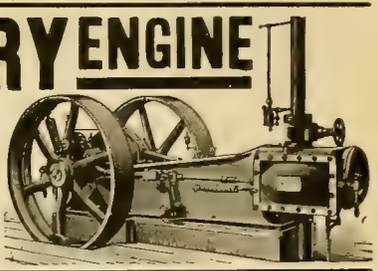

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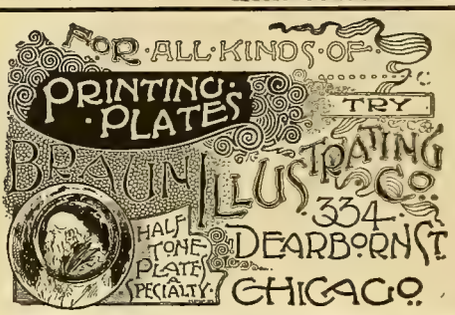

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The Pond Separator is guaranteed to relieve the steam of all entrained water and return this water to the boiler, thus effecting a large saving in fuel.

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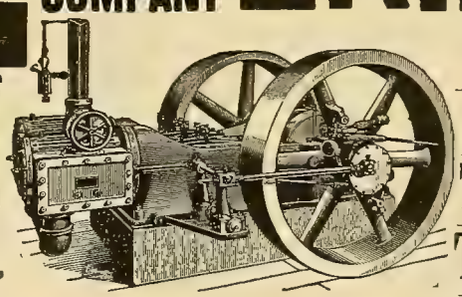

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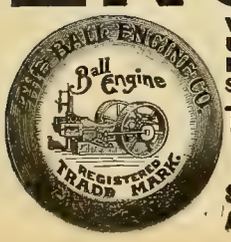

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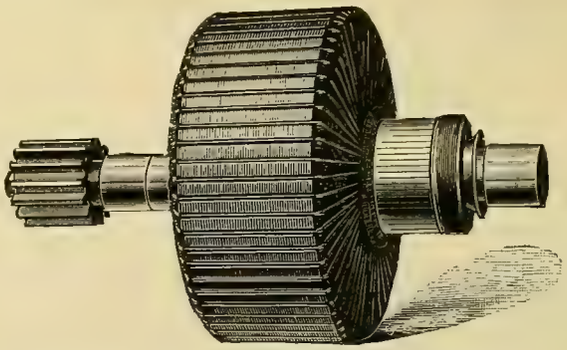

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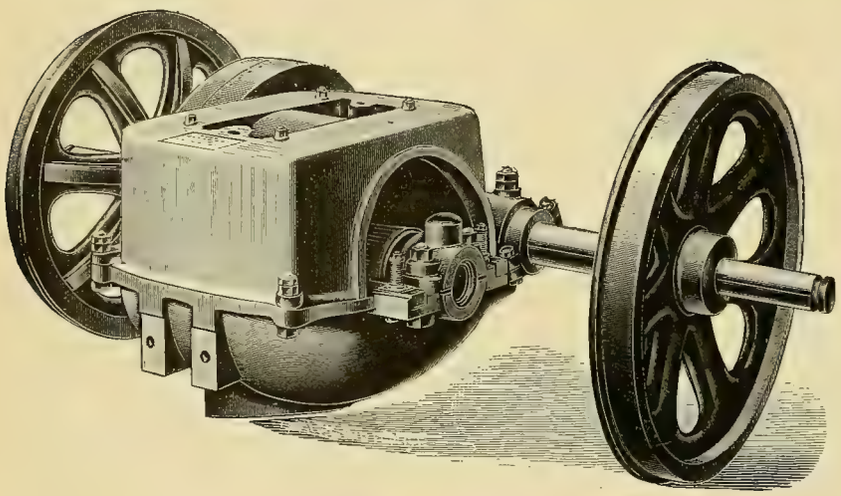
NEW STREET RAILWAY MOTOR.



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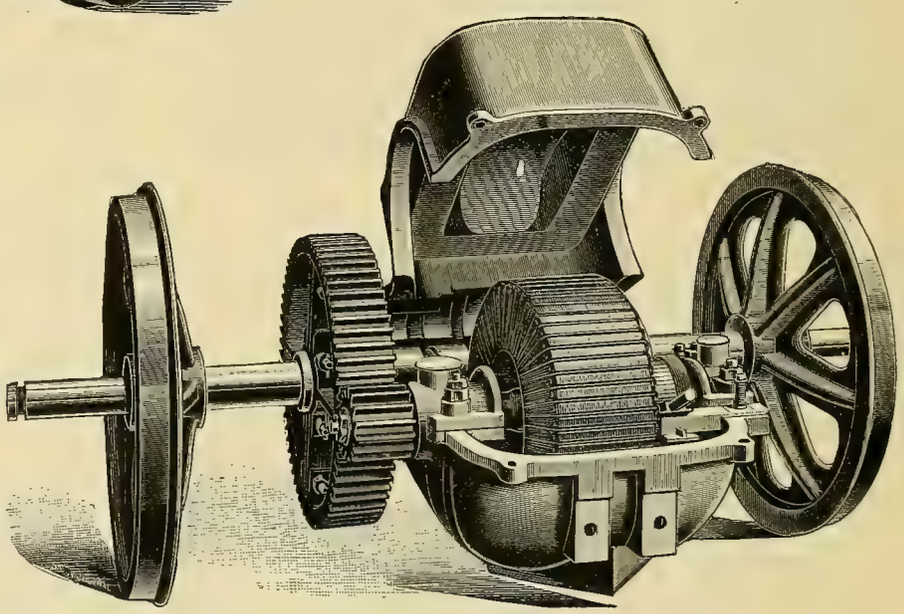

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Boston Office: 620 Atlantic Ave. **Chicago Office: 148 Michigan Ave.**

Cold Bottom Facts.

1st Fact: The Perkins Incandescent Lamps have a higher efficiency than any lamp on the market. We would like to send you a barrel, if you are not already using them. We know you will never regret it.

2d Fact: Safety White Core Wire is an entirely new product. It is an IDEAL wire for inside use. Seamless rubber insulation and fireproof braid. Send for sample.

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5th Fact: Last but not least. We want your business.

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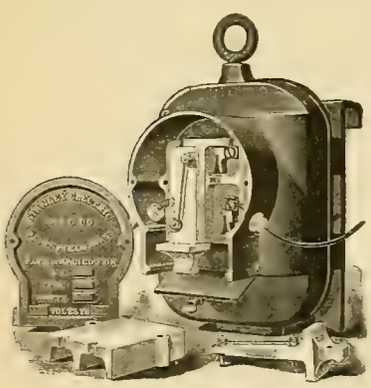

Wherever the current pulsates, you will find the Stanley Transformer (*filtre electra*) an indispensable factor in its proper and perfect assimilation.

Combined with *Shield Brand* and *Sunbeam* it forms one of the most economical and powerful aids to the recovery of a jaded and worn out SYSTEM. Don't be deceived by something "just as good." THERE IS NO SUBSTITUTE.

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THE RUBBER USED IN

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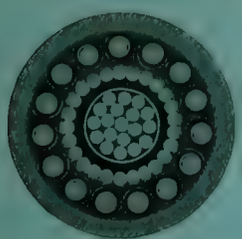
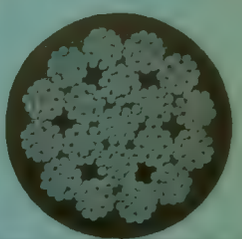
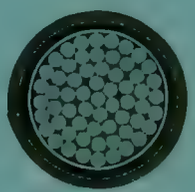


Underground Core.

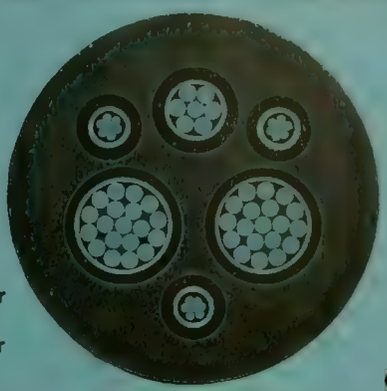


Feeder Cable. Brooklyn Edison Electric Light Co.

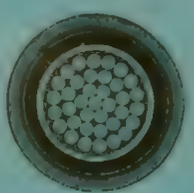
Underground Core, N. J. Central R. R.



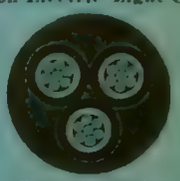
Feeder Core. Broadway Theater.



Submarine Work, Edison Electric Light Co., Easton, Pa.



Naval Core, United States s. s. "Chicago."



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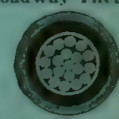

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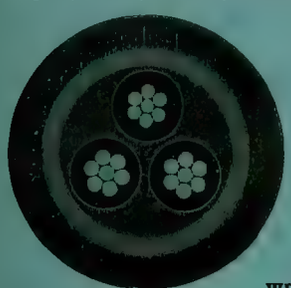

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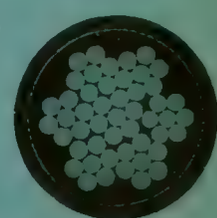

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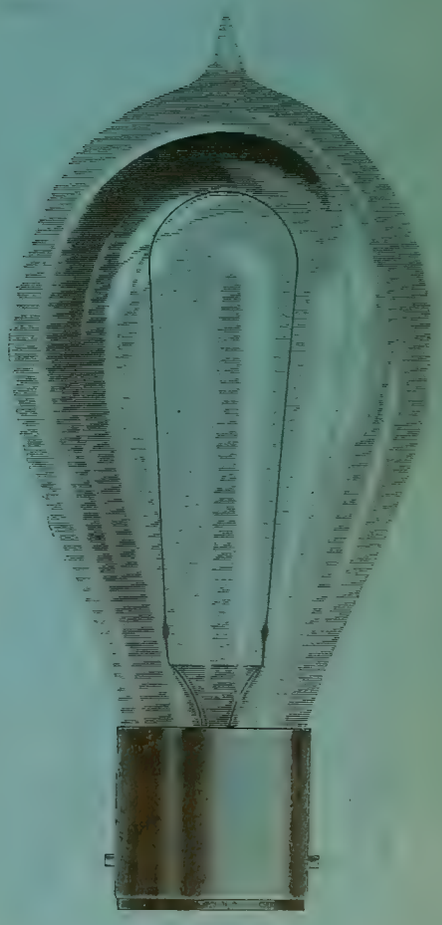

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THE MOST PERFECT OF ANY.

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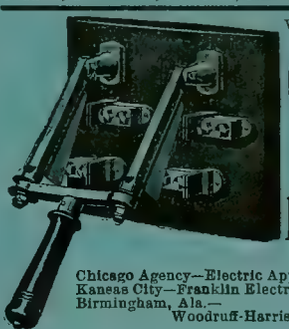

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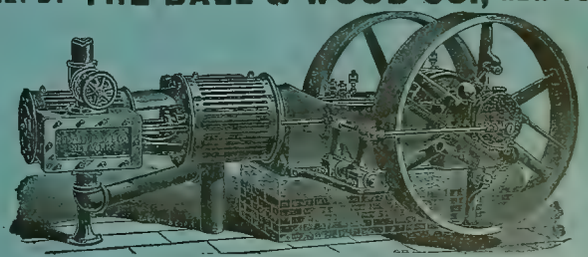

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And Every Necessary Appliance for the Construction, Maintenance and Operation of

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POWER GENERATORS.

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750,000
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WESTERN OFFICE,
148 Michigan Ave., CHICAGO, ILL

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Williams Engine Works..... xxiii
Woodbridge & Turner Eng. Co. xiv
Woodhouse & Rawson, Ltd.... ——
Worthington, Henry R..... ——

CLASSIFIED LIST.

Aluminum.
Goodrich-Coleman Elec. Works.

Annunciators.
Central Electric Co
Detroit Electrical Works.
Electrical Construction Co., The.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co.. The E. S.
Knapp Electrical Works.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Arc Lamps.
Beggs, J. E., Mfg. & Supply Co.
Brush Electric Co.
Easton Electric Co.
Electric Cons. & Supply Co.
Fort Wayne Electric Co.
Great Western Elec. Supply Co.
Mosher Arc Lamp Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Electrical Supply Co., The.
Knapp Electrical Works.
Samson Cordage Works.

Batteries.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Hirlimann, C. J.
Law Telephone Co.
Pumpelly, J. K.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Hemingray Glass Co.
Hirlimann, C. J.
Law Telephone Co.
Pumpelly, J. K.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co., W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Detroit Electrical Works.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Chicago Rawhide Mfg. Co.
Evans Friction Cone Co.
Jewell Belting Co.
Link Belt Machinery Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.
Stearns Mfg. Co.

Books, Electrical.
Electrician Publishing Co.

Brass Goods.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Roeblings Sons Co., J. A.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Schindel & Schindel.
Western Electric Co.

Clutches, Friction.
Hill Clutch Works.

Cordage.
Samson Cordage Works.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Washington Carbon Co.
Western Electric Co.

Construction and Repairs.
Andrae, Julius.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Detroit Motor Co.
Electric Cons. & Supply Co.
Electric Supply & Contracting Co.
Electrical Construction Co., The.
Knapp Electrical Works.
Leonard & Co., H. Ward.
Rae, Frank B
Smith, Thos G. Jr.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Detroit Electrical Works.
Detroit Motor Co,
Edison General Electric Co.
Electric Cons. & Supply Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Keller & Degenhardt.
La Roche Electric Works.
Leonard & Co., H. Ward.
Pearson & Co., W. B.
Pond Engineering Co.
Racine Hardware Mfg. Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Short Electric Railway Co.
Smith, Thos. G. Jr.
Taylor Engine Co.
Thomson-Houston Electric Co
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Cutter, Geo.
Detroit Electrical Works.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Roebling's Sons Co., J. A.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cut-Outs and Switches.
Andrae, Julius.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Cutter, Geo.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Knapp Electrical Works.
Paiste, H. T.
Partrick & Carter Co.
Star Electrix Co.
Van Nuis, C. S.
Western Electric Co.

Drop Forgings.
Wilcox & Howe Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
C. & C. Electric Motor Co.
Colburn Electric Mfg. Co.
Detroit Electrical Works.
Detroit Motor Co.
Easton Electric Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
La Roche Electric Works.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Heating.
Electric Merchandise Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Rae, Frank B.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Queen & Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Engravers.
Braun Illustrating Co.

Electrical Specialties.
Andrae, Julius.
Crown Electric Mfg. Co.
Cutter, Geo.
Detroit Electrical Works.
Hussey & Co.
Ries Electric Specialty Co., The.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co., Ltd.
Thomson-Houston Electric Co.

Elevators.
Link Belt Machinery Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.
Rae, Frank B

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Pearson & Co., W. B.
Pond Engineering Co
Racine Hardware Mfg. Co.
Smith, Thos G. Jr.
Stearns Mfg. Co.
Taylor Engine Co.
Westinghouse Machine Co.
Williams Engine Co.

Fan Outfits.
C. & C. Electric Motor Co.
Diehl & Co.
Edison General Electric Co.
La Boiteaux Elec. Mo. & Fan Co.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Fuse Wire.
Electrical Supply Co.
Knapp Electrical Works.
Sperry Elec. Mining Mach. Co.

Gas Lighting, Electric.
Detroit Electrical Works.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Andrae, Julius.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Cutter, Geo.
Detroit Electrical Works.
Electric Cons. & Supply Co.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works
La Roche Electric Works.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co., The.
Star Electrix Co.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Brookfield, Wm.
Gleason & Bailey Mfg. Co. Ltd.
Hemingray Glass Co.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Andrae, Julius.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Cushing, F. W.
Delaware Hard Fibre Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Hemingray Glass Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Standard Paint Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Cushing, F. W.
Cutter, Geo.
Day's Kerite Insulation.
Detroit Electrical Works.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
New York Insulated Wire Co.
Partrick & Carter Co.
Roebling's Sons Co., J. A.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Cutter, Geo.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Co.
Knapp Electrical Works.
New York and Ohio Co.
Sawyer-Man Electric Co.
Somoff, J. L.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Detroit Electrical Works.
Partrick & Carter Co.

Mica.
Bowers Bros.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mine Signals, Electric.
Detroit Electrical Works.

Mining Apparatus, Electric.
Bain Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Chicago Electric Motor Co.
Detroit Electrical Works.
Detroit Motor Co.
Easton Electric Co.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
La Boiteaux Elec. Mo. & Fan Co.
La Roche Electric Works.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Thomson-Houston Electric Co
Westinghouse Electric & Mfg Co.

Office Furniture.
American Desk & Seating Co.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Packing.
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M & Sons Lumber Co.
Schindel & Shindel.
Western Electric Co.

Platinum.
Schawel & Co., Jas.

Poles.
Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Schindel & Schindel.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Detroit Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co., The.

Securities, Electrical.
Gilman & Co., E. R.
Perry & Noyes.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway.
Detroit Electrical Works.
Electric Merchandise Co.
Nuttall, R. D. Co.
Schindel & Schindel.

Tapes, Insulating.
American Electrical Works.
Andrae, Julius.
Central Electric Co.
Chicago Insulated Wire Co.
Cushing, F. W.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Standard Paint Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Detroit Electrical Works.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Detroit Electrical Works.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Stilwell & Bierce Mfg. Co.

Water Wheels.
Pelton Water Wheel Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works
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ARE NO LONGER A NEW TYPE. THEY ARE

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* *

On Sunday morning last it commenced snowing very hard, and so continued all day Sunday, Sunday night and Monday. We were obliged to put forth every effort to prevent blockading of the road, which we succeeded in doing.

* *

On Sunday morning we started your Generator No. 2 at 6:30 a. m, and continued to use the same until Tuesday morning at 3:30 a. m., when we shut it down. This Generator was in continuous service during the entire time, and was not even sanded, nor the brushes touched. It did not use to exceed one-half quart of oil. We consider this remarkable because of the hard work the Generator was doing. * * * * * * * * *

Yours very respectfully, GEORGE E. MALLBY, Superintendent.

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ALTERNATORS FOR CENTRAL STATIONS.
MOTORS FOR ANY CIRCUIT.
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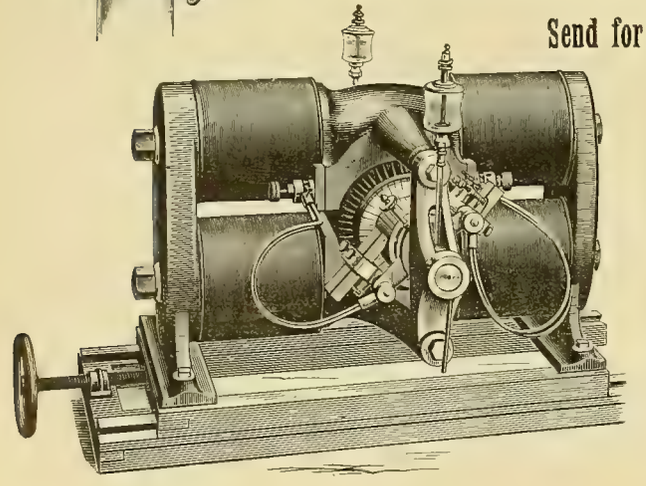
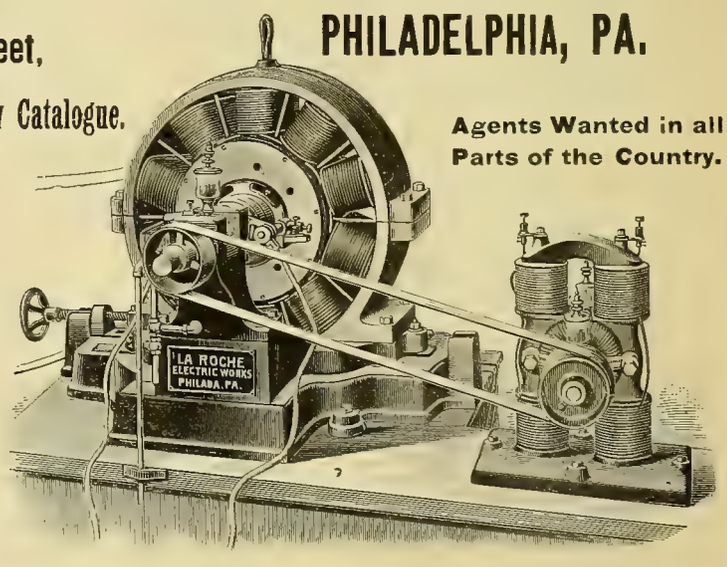
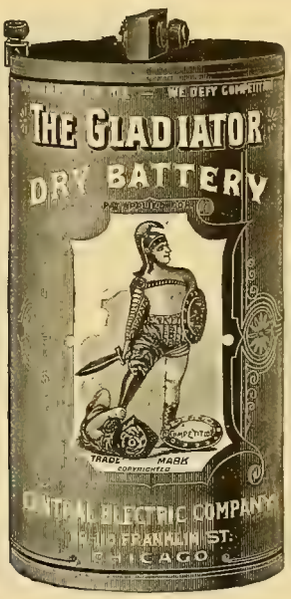




THE GLADIATOR DRY BATTERY.



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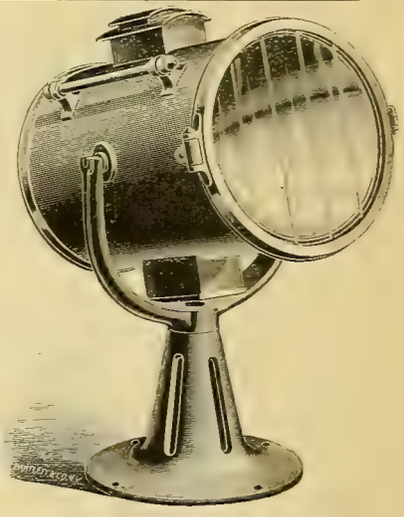
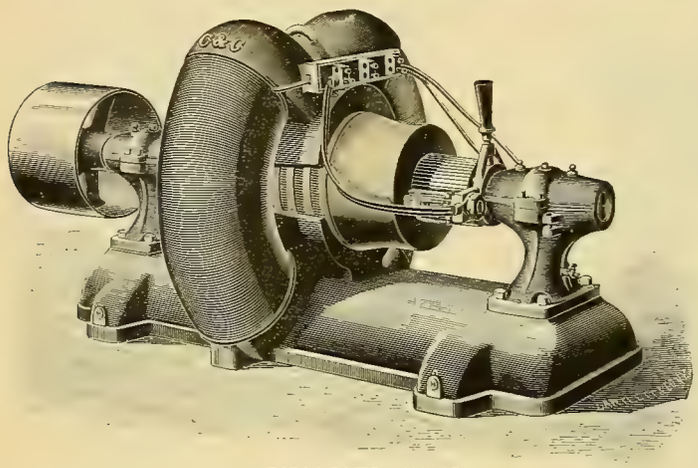


Search Light No. 13.

C. & C. Electric Motors & Dynamos.



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USED KERITE WIRE.

NOTE THE DATE OF THIS LETTER:

New York Nov 19.th 1868

To Austin G. Day. Esq

Dear Sir,

I have been much gratified in hearing your explanation of your newly discovered Compound called Kerite and in examining the various specimens of it, in its application specially to Telegraphic Conductors, as an insulator whether in the atmosphere, or beneath the earth water It appears to me you have discovered the most perfect as yet of all insulating substances for Submarine Telegraph Cables.

Its quality or rather property of resisting the deteriorating causes which tend to destroy sooner or later the insulation by gutta percha, or caoutchouc makes it an invaluable discovery in aid of Telegraphic extension. The tests to which it has been submitted and by which it has been proved to resist the deteriorating effects of the ozone of the atmosphere appear perfectly satisfactory, and I therefore, most cheerfully and cordially join with those who have tested its efficiency in congratulating you on your success in introducing so valuable an aid to the Telegraphic enterprize of the world.

In commending the Kerite specially for Telegraphic purposes I would by no means leave out of view its other various applications in the Arts not less extensive and useful than those which have had so wide an influence in the discoveries & inventions of your distinguished relative the late Charles Goodyear.

With hearty wishes for your success

Your Ob. Servt

Sam.l F. B. Morse

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W. R. BRIXEY, Supt.

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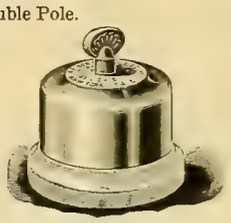
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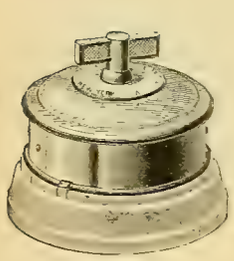
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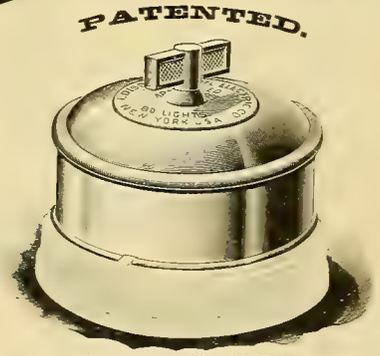
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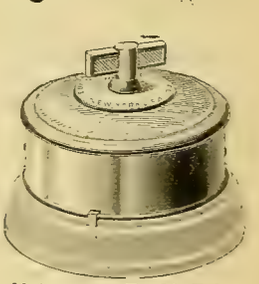
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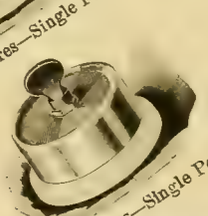
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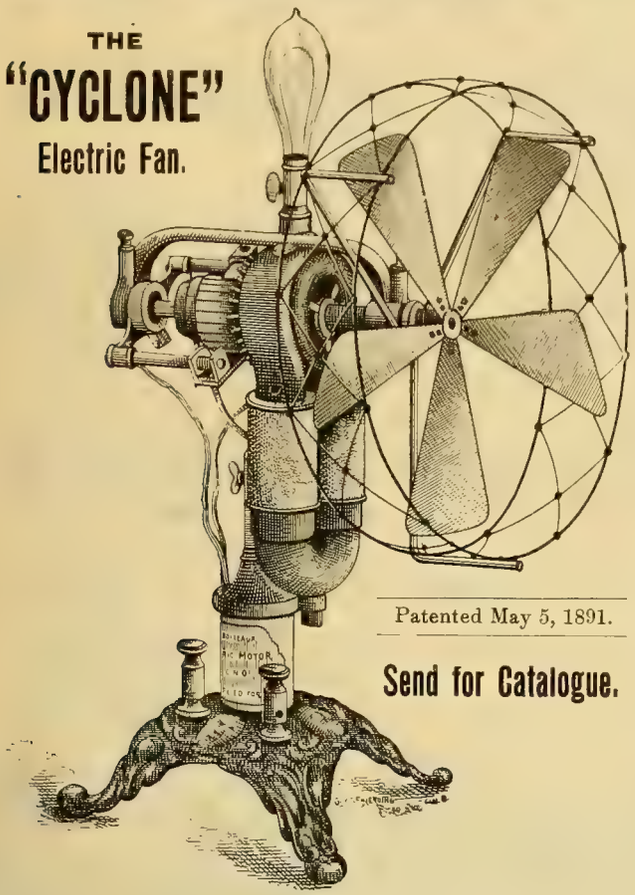

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The La Boiteaux Electric Motor and Fan.

Patented May 5, 1891.

The superiority of these Electric Fans, compared with any heretofore invented, is in our Patent Oscillating and Rotary motions, which, while creating a current of air, distributes same so equally, that the temperature is the same in all parts of the room, at the same time overcoming the objections and unhealthy effects of being under a continuous current of cool air, as produced by the ordinary Revolving Fans.

They are also entirely noiseless, and do not create the unpleasant grinding sound usually accompanying the motion of the ordinary Centrifugal Fan.

The accompanying cut illustrates our Patent Electric Fan with Rotary Motion, as adapted for use in Offices, etc.

This style is constructed to rest upon an Enameled Iron Pedestal, or may be set on the top of partitions usually in offices to divide same into compartments. While the **Fan** is in motion, **the Motor as well as the Fan revolves on their base at the slow speed of Ten Revolutions per Minute** (while the speed of the Fan is 2,000 Revolutions per Minute), the double motion thereby causing a cool wave of air, the effect of which can be readily felt at a distance of ten yards from the Motor in all directions, and it is distributed in such a gradual manner, that the unpleasant effect of a continuous current in one particular spot is overcome.

The Oscillating Fan is constructed to be placed on a sideboard, shelf, or elsewhere against the wall. The speed of the Fan is the same as in the preceding style, viz., 2,000 revolutions per minute; but in place of the Motor and Fan revolving on the center of its base, it has an Oscillating motion, **from right to left in a half circle,** thereby distributing the air throughout the room equally in all directions, with the same effect as the Rotary motion style.

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All our Motors can be attached to any incandescent circuit by a flexible cord, and may be moved at pleasure to any part of the room.

All Motors carried in stock are wound 110 volts constant potential.

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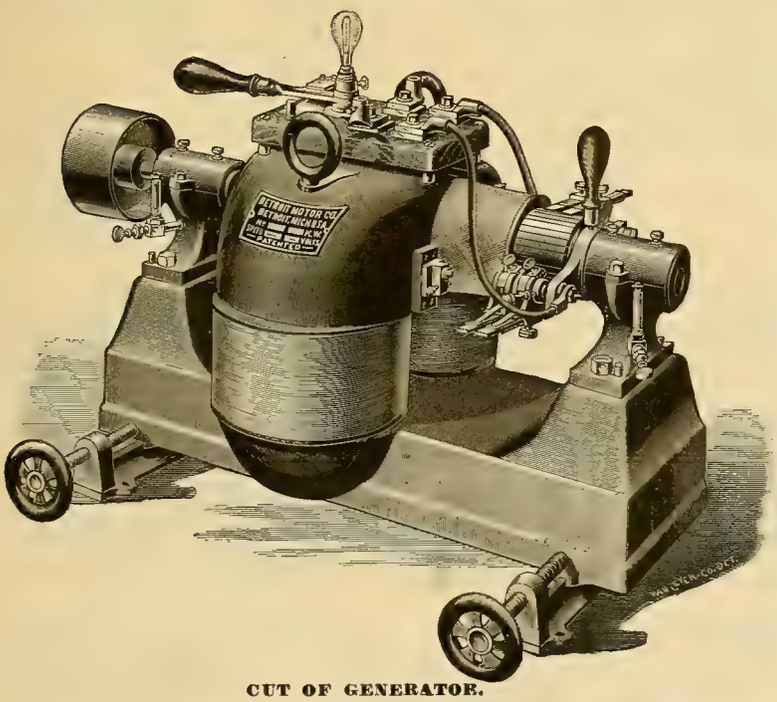

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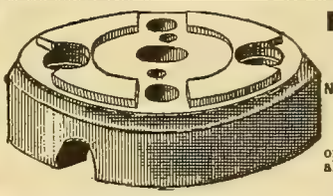

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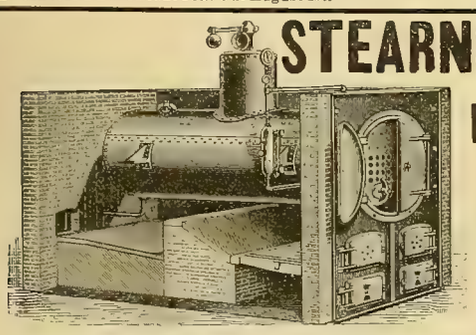

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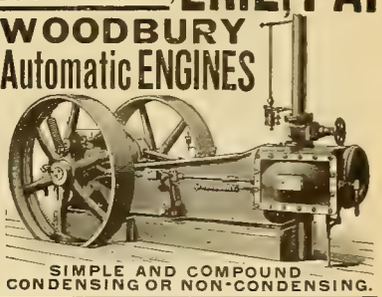

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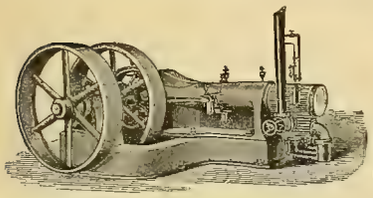

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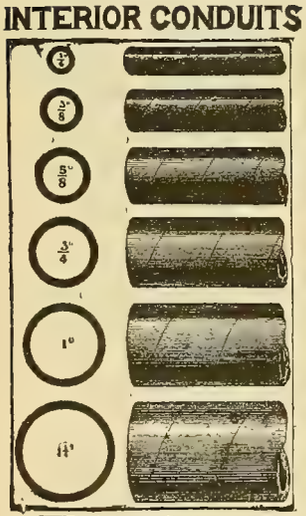

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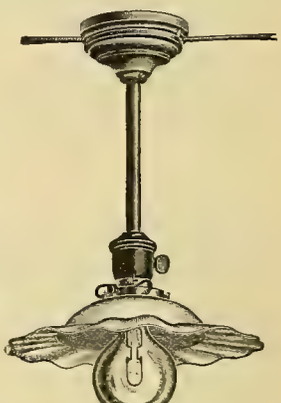

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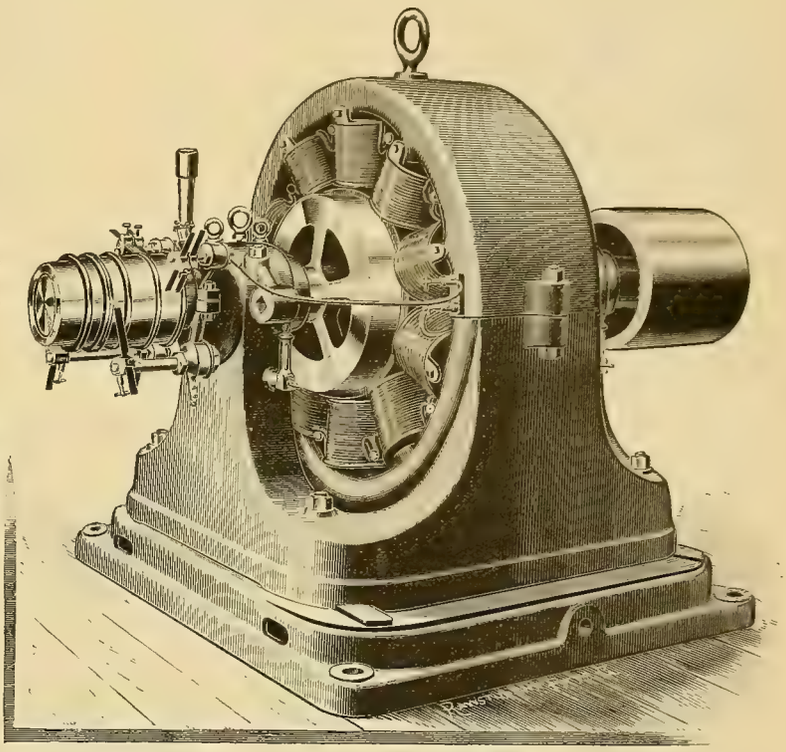

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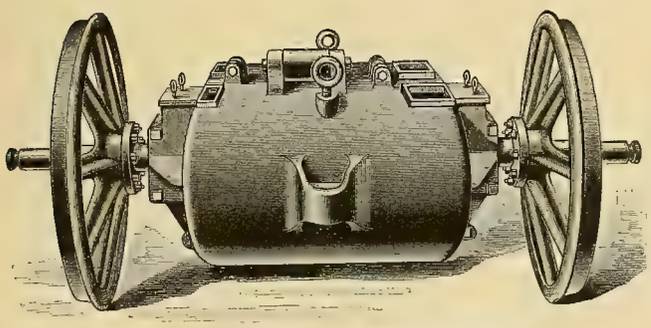

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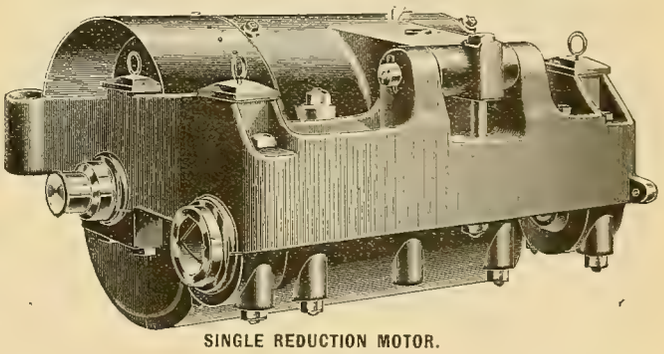
MULTIPOLAR AND 2-POLE GENERATORS,

and all Station Appliances for Street Railway Work.



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Percentage of increase in roads using our apparatus greater than that of any other company.

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OFFICES IN ALL OF THE LEADING CITIES. Correspondence Solicited.

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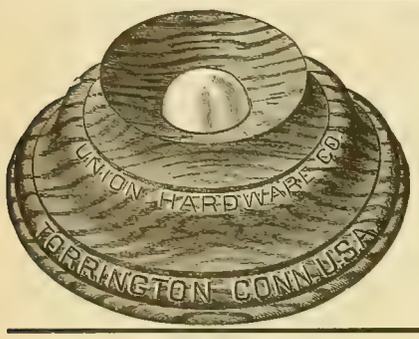

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95 CHAMBERS STREET, NEW YORK.

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911 & 913 South Washington St., PEORIA, ILL.,

MANUFACTURERS OF

Alternating and Continuous Current Dynamos and Motors,

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THE MOST COMPLETE ALTERNATING SYSTEM NOW ON THE MARKET.

Agents Wanted for Exclusive Territory.

BUY THE BEST!

The Mosher Arc Lamp.

DIRECT OR ALTERNATING INCANDESCENT CIRCUITS.

READ THE FOLLOWING TESTIMONIAL:

J. M. FISHER, Esq. WINONA, MINN., Nov. 25, 1891.

DEAR SIR:—We have been using the Mosher Arc Lamp on our Edison three wire system since last February and are now using twenty-five. They give good satisfaction to our customers, and are the most economical and profitable lamp for ourselves that we have ever used.

Yours very truly,
WINONA ELECTRIC LIGHT CO.,
J. H. JENKINS, Manager.

Noted for Simplicity and Steadiness.

500 to 5,000 candle power, making superior lamp for photo-engraving purposes. Write for price, circular, and sample lamp.

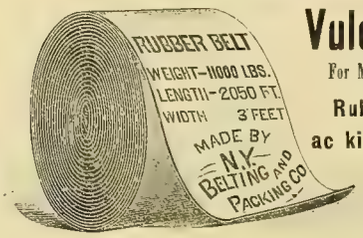
MOSHER ARC LAMP CO., 125 Ontario St., Chicago,

Or to F. P. Little & Co., Buffalo, N. Y.; Creaghead Engineering Co., Cincinnati, O.; Chas. F. Lindner, San Francisco, Cal.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, Manager, (LIMITED.) 15 Park Row, NEW YORK.

Oldest and largest Manufacturers in the United States of



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For Mechanical Purposes,

Rubber Belting,
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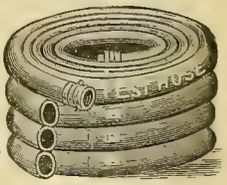

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BOSTON, 52 Summer Street.
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THE ACKNOWLEDGED SUPERIOR OF ALL

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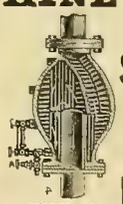

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In twelve trials in the "Cornell" Separator test, it averaged 98 7-10 per cent Dry Steam. Outstripping all competitors.

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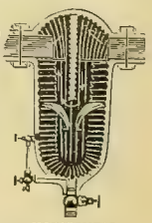

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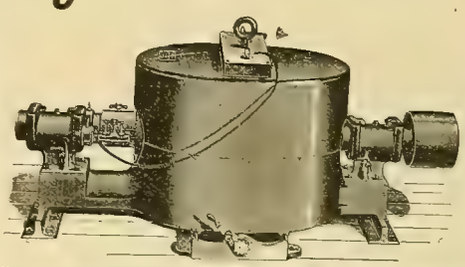

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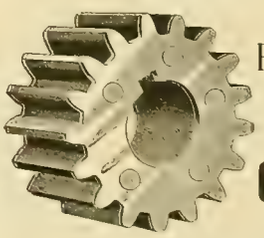
RAWHIDE DYNAMO BELTING.

CARRIES NO STATIC ELECTRICITY.

Greatest Adhesive Qualities. Causes Less Friction than any other Belt.

RAWHIDE HYDRAULIC PACKING.



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A SPECIALTY.

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Chicago Rawhide Mfg. Co.,

The only Manufacturers in the Country.

Lace Leather Rope and other Rawhide Goods of all kinds by Krueger's Patents.

This Belting and Lace Leather is not affected by steam or dampness; never becomes hard; is stronger, more durable and the most economical Belting made. The Rawhide Rope for Round Belting Transmission is superior to all others.

75 OHIO STREET, - CHICAGO, ILL.

Western Electrician.

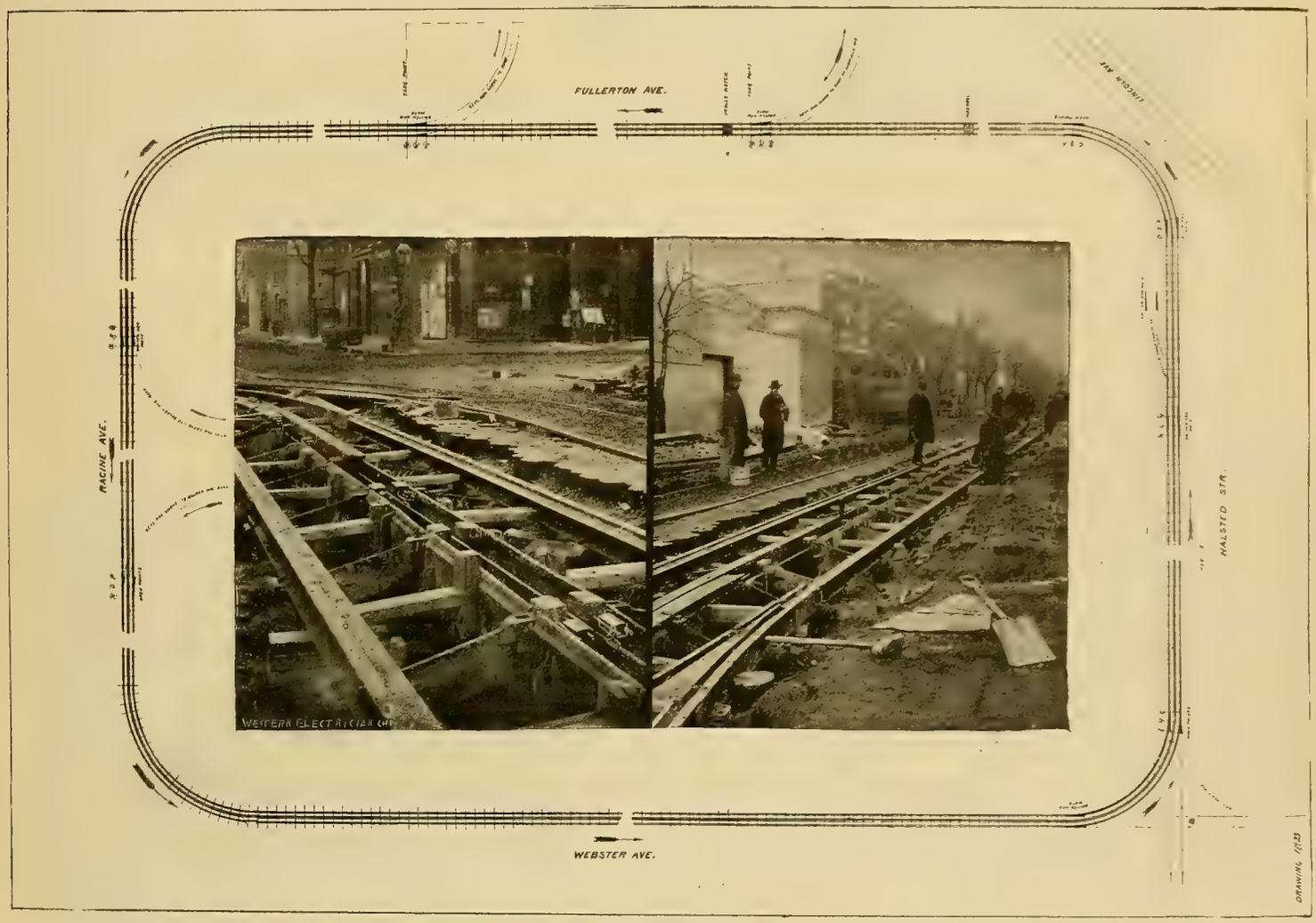
EVERY SATURDAY.

Vol. X. CHICAGO, FEBRUARY 20, 1892. No. 8

Chicago's First Electric Railway with Underground Conductors.

Any one who imagines that the underground electric railway conduit system now being exploited by the Love Traction company of Chicago is one of those projects that exist only on paper and in the mind of a visionary inventor, would be somewhat surprised if suddenly landed at the corner of Halsted street and Webster avenue. That the Love company is in earnest and is now vigorously pushing the construction on the section of road allotted it by the North Side Street Railway company is plainly to be seen from the accompanying views reproduced from photographs taken on February 3d.

The illustrations show the road as it appears from the corner of Halsted street and Webster avenue. A map of the loop which the Love company is to operate by electricity is also presented.



CHICAGO'S FIRST ELECTRIC RAILWAY WITH UNDERGROUND CONDUCTORS.

The conduit starts, as is indicated, from Lincoln and Fullerton avenues, runs west on Fullerton to Racine, thence south on Racine to Webster, east on Webster to Halsted, and finally north on Halsted to the starting point on Fullerton avenue. The electric motor cars will take the place of horses and pick up trailers from the Lincoln avenue cable trains at Fullerton and Lincoln avenues. This loop has heretofore taken eighteen cars, which were drawn to and from the center of the city by cable and pulled around the loop by horses. This section of the ine will be operated entirely by the electric system.

The Love system has already been described in the WESTERN ELECTRICIAN, but a few details of the construction of the conduit, as it is now being laid, obtained from General Manager A. G. Wheeler, will be of interest. The power equipment is to be located at the Lincoln avenue cable power station, and the current will be carried about three-eighths of a mile to the track. A 150 horse power McIntosh & Seymour high speed engine will be provided especially for the loop service, and a 500 volt constant potential Eddy generator of 125 horse power will furnish current to the metallic circuit in the conduit.

To electricians the most interesting features of the Love system are the peculiarly shaped slot rail, which forms a roof, so to speak, over each of the two conductors, and the method of insulating the trolley wire from the conduit castings. The cuts give view of the downwardly hanging lips of the two slot rails and of the trolley wire supports. The wires are hung from square blocks of moulded mica. At each insulator there are two wrought iron pins which project horizontally, are parallel with the conductors and are set into the conduit casting. The mica insulator block is grooved on both sides so that it may be slipped in between, and be supported by, these two pins. The construction, as will be seen in the illustration, is extremely simple. The insulators are set at intervals of 8 feet. The two conductors are of 0000 B. & S. hard drawn copper wire furnished by the John A. Roebling's Sons company.

It was at first intended to equip a car of special design for this loop service, but the Love company has recently decided to use Westinghouse single reduction motors of 30 horse power on standard 24 foot Pullman cars. The motor cars will be equipped with "19 B" standard McGuire trucks. In other words, it is proposed to demonstrate more particularly the practicability of transferring a double wire overhead circuit from poles above the track to a space beneath the road bed. The track construction is to be exactly similar to that employed by the North Side Street Railway company where the cable is run in the conduit. Each one of the yoke castings, which were furnished by the Bouton Foundry company, Chicago, is twenty inches, and the conduit fifteen inches deep, with a width of nine inches. The Johnstown six inch girder rail, 78 to 80 pounds, and the Johnstown curve rail, 100 pounds to the yard, are employed. The slot rail is of rolled steel.

The entire length of the loop track is about 1¾ miles. There are four curves of different radii and two double track crossings at angles of 45 and 50 degrees, and in addition to these there are eleven switches. According to General Manager Wheeler the work is being rushed with the idea of making the first practical trial with the loop fully equipped for business on March 1st.

The superintendent of the Stow quartz mine near Forbestown, Cal., is about to equip the property with an electric plant. He has about completed arrangements to have the mine and mill lighted by electricity. The dynamo will be run by the same water power that propels the machinery in the mill, and incandescent lights will take the place of the candles heretofore used by the miners in the drifts and tunnels. The work above ground will be illuminated with large arc lights. This improvement marks an important epoch in quartz mining in Butte, as it is the first of the kind to be made.

National Electric Light Association.

The National Electric Light association will hold its fifteenth convention at Buffalo, N. Y., February 23d, 24th and 25th. The headquarters of the association will be at the Iroquois Hotel, and the sessions will be held in the Buffalo Library building, which is conveniently located near the headquarters.

It is expected that there will be an unusually large attendance at this meeting, as it is understood that it will be the last convention before the holding of the World's Fair, and that the question of holding only one convention each year thereafter will be passed upon. This proposition, as has already been shown, is advocated by the more conservative members of the association, and it is believed, there will be little opposition to the measure. Thus far, at least, there has been no objection, whatever, to the proposed discontinuance of the midsummer meeting, most of the members believing that in the present condition of affairs one convention each year is enough. President Huntley advocated this measure in his annual address at the Montreal meeting, when he said:

In conclusion, I would urge that the association determine upon meeting only once a year. Even if it were not impossible to recover in six months from such overwhelming hospitality as we are now the recipients of, I believe that the time has gone by when half-yearly meetings were necessary. Once in twelve months is often enough for us to come together for the comparison of our experiences and the report of further refinements in the detail of the industry. The mere fact that frequent reunions are no longer necessary is in itself a hopeful sign, for it tells of stable and settled conditions, and of activities that now require our presence at home pretty much the year around.

That he has not changed his mind on this subject is evident to all who have discussed the topic with him during the last month. No doubt he will have something further to say on this topic to delegates in his Buffalo address.

Another noticeable feature which will distinguish the Buffalo convention from former meetings, especially in view of the fact that it is directly opposed to the policy that prevailed at the Montreal gathering, will be the absence of a general exhibition of electrical apparatus. The fact that the last convention was the first occasion on which the association had ever met on other than its native soil, and that it was made the object of a general public demonstration, had much to do, no doubt, with the elaborate display that was made. It was this exhibition that marked the turning point, and led many manufacturers to advocate discontinuance of general displays until after the World's Fair at least. Of course there will be many private exhibitions in hotel parlors, but nothing on such an extensive scale as that which has marked the displays at former conventions.

It is not to be inferred from this, however, that interest in these gatherings is declining; on the contrary, their importance is becoming more manifest each year, and it is believed the Buffalo meeting will call out the largest attendance and be of greater benefit to the members of the association than any former convention in the history of the organization. The true significance of these proposed changes of policy is to be found in the fact that the central station managers are beginning to realize their own strength, and that they feel there is no further necessity for glittering side shows to attract the general public. Not only are these displays considered no longer a necessity, but their desirability is questioned by many. In a word, the National Electric Light association is developing into an organization of business men, conducted on business principles, and as such deserves the support of every person interested in electrical development in the United States. The Buffalo meeting, planned and directed by the advocates of the new policy, should be successful not only in point of attendance and entertainment, but it should also prove of great benefit to central station managers. The present officers of the association are:

President, Charles A. Huntley, Buffalo.
First Vice-President, James I. Ayer, St. Louis.
Second Vice-President, M. J. Francisco, Rutland, Vt.
Secretary and Treasurer, George F. Porter, New York.
Executive Committee: Class 1, E. H. Peck, Brooklyn; John Seely, New York city; R. Fabin, Jr., Toledo. Class 2, Albert J. Corriveau, Montreal; H. H. Fairbanks, Worcester; A. J. DeCamp, Philadelphia. Class 3, Frederick Nichols, Toronto; M. D. Law, Schenectady; A. M. Young, Waterbury.

CONVENTION HEADQUARTERS.—IROQUOIS HOTEL, BUFFALO.

Following is the official programme for the convention, as announced by Secretary Porter:

TUESDAY, FEBRUARY 23, 1892.

Meeting of the executive committee at 9 A. M., Iroquois hotel parlors.

Morning meeting of association at 10:30 *o'clock.*

Address of welcome by Hon. Charles F. Bishop, mayor of Buffalo.
Address of President Huntley.
Report of committee on underground conduits and conductors. M. J. Francisco, chairman.

Afternoon session at 2 *o'clock.*

Report of committee on safe wiring. M. D. Law, chairman.
Report of committee on World's Columbian Exposition. B E Sunny, chairman.
"How to Fire a Steam Boiler." Richard Hammond.

Evening session at 8 *o'clock.*

"Transmission of Power." Carl Hering. Discussion by William Stanley, Jr., H. Ward Leonard, Elihu Thomson, L. B. Stillwell and others.

WEDNESDAY, FEBRUARY 24TH.

Morning session at 10 *o'clock.*

"The Allied Powers." D. Ashworth.
"The Alternating Current Motor." William Stanley.
"Electric Lighting from a Financial Standpoint." Erastus Wiman.

Afternoon session at 2:30 *o'clock.*

"Switch-boards: Their Safety and Operation." M. C. Sullivan.
"From the Tannery to the Dynamo." Chas. A. Schieren.
"Municipal Franchises for Quasi-public Corporations." Allen R. Foote.

THURSDAY, FEBRUARY 25TH.

Morning session at 10 *o'clock.*

"Overhead Construction." E. F. Peck.
"Operation of High-tension Currents Underground." E A. Leslie.
"Underground Construction of Buffalo Railway Company," J. R. Craven.

Afternoon session at 2:30 *o'clock.*

Report of secretary and treasurer; report from executive committee; election of officers.

A novel use was found for electric light in a Michigan town a few days ago. A showman's elephant was suffering from toothache, according to the story, and it was decided to fill the cavity. A dentist was summoned from New York, and, after one unsuccessful attempt, the animal was chloroformed. The brute's mouth was braced open with two crossed hickory sticks and an incandescent electric light was suspended at the opening. By this light the dentist was enabled to perform his task satisfactorily.

Convention Headquarters.

The Buffalo Library building has been secured for holding the meetings of the association, and a more appropriate selection could not be made. As will be seen from the accompanying illustration the building is a substantial structure, imposing in appearance, and advantageously situated. It occupies the triangle formed by Broadway, Washington and Clinton streets. It is a substantial fire proof structure, built of brick, and was finished in 1887 at a cost of $378,000. The library ranks among the foremost in America, and contains 60,000 volumes, most of which are in circulation, while a number are used only for reference. The reading rooms are equipped with the latest and best periodicals. They are well lighted, well ventilated, and furnished with a degree of comfort. In them the visitors will find much to interest and instruct them—rare old manuscripts, autograph letters and original works of great historical value. Most of the noted authors, statesmen and generals of this age are represented there, and a study of their chirography will no doubt be found very interesting. Buffalo is certainly to be congratulated upon the possession of such an institution, and no further evidence is needed to establish the reputation of her citizens for public spirit, liberality and culture than this eloquent monument.

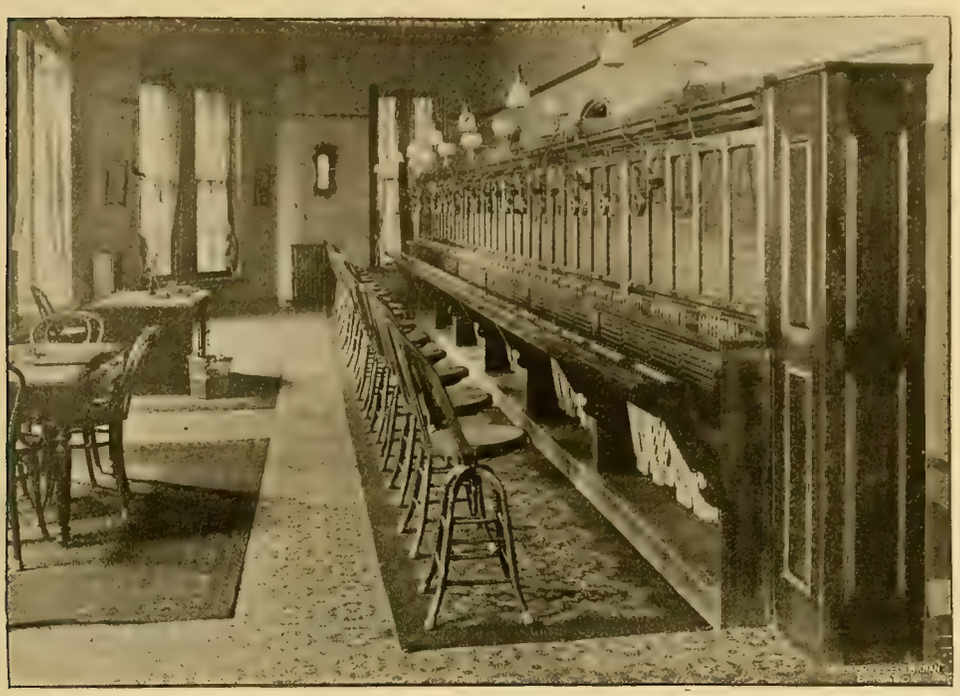
The site formerly occupied by the library is now devoted to an hotel, the Iroquois, which will be the headquarters of the association during the convention. This hotel is on the corner of Main and Eagle streets and is the largest in the city. It was erected at a cost of $1,000,000, is absolutely fireproof and can accommodate a large number of guests. An excellent cut of the hotel is presented herewith. The building is owned by the Buffalo Library association and is one of the finest structures in the city. It is a noteworthy fact that this building contains the largest isolated electric light plant in Buffalo; in fact the installation might be classified under the head of a central station, as it furnishes current for the Library building as well as the hotel. In the basement there are four 550 light United States machines driven by two Rice engines of 120 horse power each. Natural gas is used for fuel, and although the managers of the hotel say there is no difference in the operating expense since the use of coal was discontinued, the cleanliness of the present method makes it far more desirable even at greater cost. A view of the dynamo room, reproduced from a photograph, is herewith presented, showing the arrangement of the machines. A glance will suffice to show that every available foot of space is utilized and that further increase in the plant will require more extensive quarters. There are 1,900 lights in the hotel and 100 in a billiard room near by. The Buffalo Library building, which is less than 1,000 feet away, has 350 lights. There are several motors in the hotel, utilized principally in the kitchen and laundry for ventilation and other purposes. The plant is giving satisfaction, and it is believed more motors will be introduced shortly. The wiring throughout the building is of okonite and the fixtures are in many cases quite elaborate. The dining room and parlors especially are notable in this respect, the electroliers being very elaborate and costly.

CONVENTION HEADQUARTERS.—BUFFALO LIBRARY BUILDING.

The *Practical Engineer* of London says that Parliament will be asked to sanction no less than five projects for electric railways in that city, to be built, or at least commenced, this year.

Buffalo Telephone System.

The city of Buffalo is noteworthy in that it is one of two or three cities in which the toll system for telephone service prevails exclusively, and, strange though it may appear to outsiders, the public seems to like it. The Bell Telephone company of Buffalo is one of the largest corporations of the kind in the country. Not only does it control the service in Buffalo, but also in Rochester, Batavia and many intermediate places. The company was formed in 1879 and at once secured valuable franchises. To-day there are in Buffalo alone 2,018 subscribers and in Rochester 1,095. There are in Buffalo 1,115 subscribers on metallic circuits and 903 on grounded circuits. The exchange operates 3,000 miles of underground circuits and about 3,200 miles of aerial wire. The work of burying the wires is being pushed ahead with commendable rapidity. There are employed seventeen operators on the regular city service and two for the long distance company, which also has its Buffalo headquarters at this exchange. An excellent view of the switch-board in the operating room is presented in the accompanying cut. The ticket system which is in vogue requires more clerical help than in ordinary exchanges, but the company believes it is the only method on which the business should be conducted.



BUFFALO TELEPHONE SYSTEM.

John N. Culbertson, general superintendent of the company, is an earnest advocate of the Buffalo system, and he points with considerable pride to the admirable working of the Buffalo exchange, the method employed in handling the business and the details which have been so carefully worked out under his management. According to Mr. Culbertson, the Buffalo system is the only just and rational system employed—providing, as it does, that each subscriber shall bear his proportional share of expense, or in fact pay for exactly what he gets and no more. "Some of our heavy subscribers," says Mr. Culbertson, "would, no doubt, gladly avail themselves of any opportunity to return to the old system—paying so much per year for the service—but the majority of the subscribers want the present method continued. Of course when we first introduced the system there was some objection raised, but it was instigated by the big merchants, who wanted their less fortunate competitors to pay part of their expenses. This was soon realized, however, by small merchants, and there was a general revolution. To-day the present method suits the people, and they would not go back to the old-fashioned way of doing business."

It will be remembered that the company tried to introduce the new system into the Rochester branch of the business in October, 1886. The people of that city had just had a controversy with the company, and were not favorably disposed toward it, especially as there was always considerable local resentment at the idea of being considered a branch of the Buffalo exchange. As was to be expected there was opposition to the measure, but it was believed by the company that no serious results would follow. It proved, however, the beginning of a most remarkable struggle between the Bell telephone interests and the people of Rochester. After several unavailing protests had been made, it was announced that the subscribers would discontinue the use of the telephones unless the new order was rescinded. This was considered an idle threat, and for a time the indignation displayed by the people of Rochester formed the subject of many amusing newspaper paragraphs throughout the country. But the people showed their determination to fight, and soon the company realized it had a troublesome customer on its hands. The People's Telephone association, an organization of subscribers, was formed, and the war was carried on unceasingly. On Nov. 20, 1886, the Rochester subscribers hung up their telephones at the hour appointed by the People's association, and from that time until June 1, 1888, there was no telephone service in the Flower City. On the latter date the company resumed business, but the new system was not introduced, and according to the terms of the agreement, cannot be until June 1, 1893. Inasmuch as the people continue to approve the flat rate system it is hardly possible that the telephone company will risk another protracted controversy—especially in view of the fact that there is a prevailing idea, however erroneous it may prove to be, that the Bell company's exclusive rights in the telephone cease at that time. In reference to the Rochester controversy the officers of the company have always maintained that the subscribers stood in their own light that the entire trouble was caused by a few avaricious business men, who would be compelled to pay heavy tolls for their service, while under the present arrangement or flat rate the poor man is obliged to pay, in part at least, the expense which the more extensive dealer should bear.

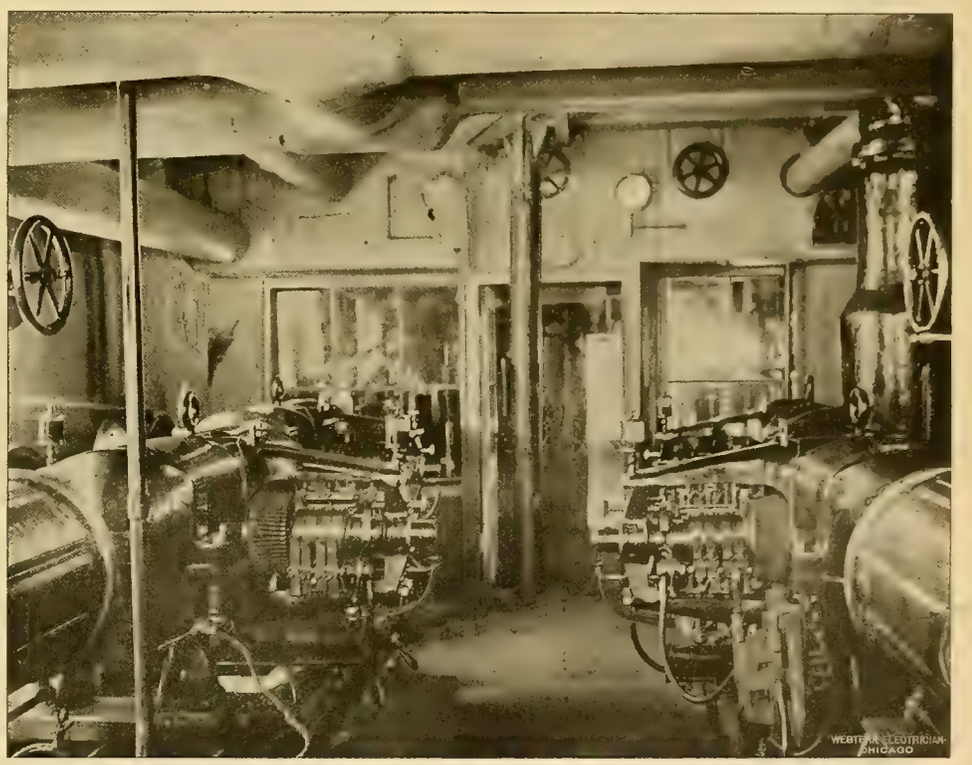
At any rate service is good and the patrons on both lines are satisfied.

Buffalo as a Convention City.

Representatives of electrical interests have on former occasions enjoyed the hospitality of the people of Buffalo, and further assurance at this time is wholly unnecessary. Delegates will find that ample arrangements have been made for their comfort and entertainment during their sojourn in the City of Breezes. There will be plenty of room at good hotels conveniently situated near the convention hall.

Buffalo has many places of historical interest, which will no doubt prove attractive to many of the visitors attending the convention. It has also numerous handsome residences, imposing public buildings and substantial commercial houses. There are fine drives through the city parks and cemeteries in the outlying districts, and in summer resorts within easy access it is particularly well supplied. The principal drive is Delaware avenue, which is rightly considered one of the finest thoroughfares in the country. It runs parallel with Main street, in a central portion of the city, along an elevated plateau with a gradual slope from either side of the avenue. It extends from the Terrace on the south to the city line on the north, a distance of about four miles, bisecting the park and Forest Lawn cemetery, and passing under one of the park driveways through an immense stone arch. On this avenue is a handsome Gothic residence that attracts much attention. It was formerly occupied by President Millard Fillmore, but is now known as the Fillmore boarding house. Opposite is the Women's Industrial Union building and the Women's Christian Association temple. Near by is St. Joseph's college, the city and county buildings, the jail and the old Buffalo club house. Handsome residences, occupied by Buffalo's most prominent families, line this thoroughfare, making it the center of fashion and culture of the city.

One of the features of the Queen City of which her people are justly proud is the park system, established in 1869, and comprising 8.6 acres. A beautiful lake, dotted with miniature islands, takes up forty-six acres. This is a favorite resort. All the parkways and avenues leading to the branches of the park system are 200 feet wide. More than $2,000,000 has been expended on the parks thus far. The annual cost for maintenance is about $90,000. There are also many smaller "squares" in the heart of the city which are used for recreation grounds. In many of these there are handsome monuments; notable among them is



ELECTRIC LIGHT PLANT AT THE IROQUOIS HOTEL, BUFFALO.

that of the soldiers and sailors, which stands in Lafayette square, on Main street, between Clinton and Lafayette streets, in front of the Buffalo Library building, where the sessions of the convention will be held. To the ladies of Buffalo belongs the entire credit of this work. The monument is eighty five feet high, and its cost was $50,000. The corner-stone was laid July 4, 1882, and the monument was unveiled July 4, 1884. The statues on the base are eight feet high, of bronze, while the one on top is ten and a half feet high. and granite.

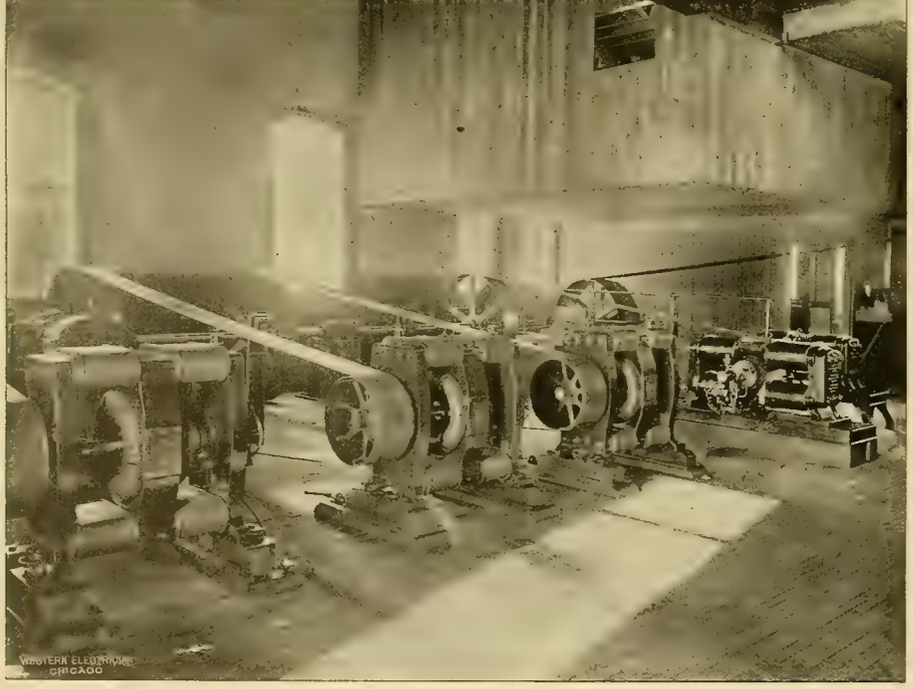
For the convenience of visitors the following list, giving the location of public buildings and hotels has been prepared:

Buffalo Library, Washington street and Broadway.
Iroquois Hotel, corner of Main and Eagle streets.
The Tifft, Main street.
The Genesee, Main and Genesee streets.
Broezel, Seneca and Wells streets.
Mansion House, Main and Exchange streets.
City and County Building, Church and Franklin streets.
Postoffice, Seneca corner Washington street.
Board of Trade, Seneca street near Main.
Music Hall. Main, Edward and Pearl streets.
Western Union Telegraph company, Main, corner Seneca streets.
Street Railway company's headquarters (starting point for all lines of street cars in the city), Main and Niagara streets.

Railroad Depots. The New York Central's depot is located on Exchange street, a short distance from Main street; the Erie depot is a few minutes' walk to the east, at the corner of Exchange and Michigan streets; the Western New York & Pennsylvania's depot is still farther east, at the corner of Exchange and Louisiana streets; the Delaware & Lackawanna's depot is at the foot of Main street; and the old Erie-street depot, on Erie street, is still entered by a few trains. Michigan Central trains arrive and depart from New York Central depot, also the Lake Shore & Michigan Southern, the West Shore, and Buffalo, Rochester & Pittsburgh.

United States Plant at Black Rock.

One of the largest central stations in Buffalo is illustrated in the accompanying views. It was installed by the United States Electric Light & Power company, the second electric company formed in the City of Breezes, and has been operated since 1885. The station is at Black Rock. The plant consists of six United States arc dynamos of 50 lights each, three new Wood machines of 60 light and two 20 light United States generators, the latter held in reserve. The station supplies current for 338 arc lamps on the streets in the district north of Ferry street. The company does no commercial lighting whatever. The dynamos are driven by a pair of compound condensing engines of 400 horse power capacity, built by the J. T. Noye Manufacturing company, Buffalo. Four 80 horse



UNITED STATES PLANT AT BLACK ROCK.

power boilers are employed. The company has adopted natural gas for fuel. Before this innovation, however, it is claimed that the company only used two pounds of soft slack per horse power per hour. This coal cost but $1.60 per ton. The company is securing its natural gas at a rate on the same basis. It is scarcely necessary to say that it is much pleased with the changes. The officers of the company are: President, S. F. Eagan; treasurer, secretary and manager, P. P. Miller; superintendent, F. P. Little.

It should be stated in this connection that the city has been divided by the council into four parts, and the street lighting for each of them is assigned to one station. The present arrangement, of course, is only maintained by the excellent service given by the companies. That such an arrangement does exist is the highest compliment that the city can pay the local electric light companies.

On February 1st this company passed under the direction of the Thomson-Houston company of Buffalo, and will hereafter be conducted in connection with that corporation.

World's Electrical Congress.

A circular has been issued by the World's Congress Auxiliary of the World's Columbian Exposition inclosing the preliminary address of the general committee on engineering congresses. This department is to be divided into seven general divisions, which will respectively treat of civil, mechanical, mining, metallurgical, electrical, military and marine engineering. The engineering congress will probably be held in July or August, 1893, and will last six days. The congress is to be opened by a joint meeting of all the divisions, after which the members of each division will meet by themselves. These divisions may be divided into as many chapters or sections as may be found desirable. The congress may terminate with another joint session. The work of every division will consist in the discussion of subjects chosen by the officers of the division and the reading of selected voluntary papers and discussion thereon. The papers must be in

UNITED STATES PLANT AT BLACK ROCK.

English, French or German, must not exceed fifteen minutes in time of delivery and must never before have been published or communicated to any society. Copies must be furnished in advance to the secretary of the division. The proposed classification of subjects for the division of electrical engineering is as follows:

Telegraphy.—Systems: duplex, quadruplex, multiplex, etc. Rapid telegraphy. Cable telegraphy and instruments. Batteries and telegraph dynamos. Circuits. Induction telegraphy.

Telephones.—Systems, transmitters, switch-boards. Automatic apparatus. Magneto bells. Long distance telephony. Induction and retardation.

Lamps.—Arc lamps and carbons, incandescent lamps and filaments. Manufacture and durability. Sockets.

Wires.—Overhead systems, underground systems, cables. Insulation.

Distribution.—High tension, direct; low tension, direct; alternating. Simple circuits, compound circuits. Series and parallel systems.

Batteries.—Primary and secondary.

Generating Machinery.—Dynamos, alternating and direct. High and low tensions. Armature and field windings. Methods of regulation. Commutators. Mechanical details.

Motors.—Direct and alternating current motors. Armature windings. Regulating devices. Commutators and mechanical details.

Appliances.—For measuring and controlling currents of electricity. Switches, rheostats, meters, safety appliances.

Transformers.—Methods of winding, loss in conversion, heating, designs.

Mining and Metallurgy.—Boring, drilling and firing, pumping. Reduction of ore.

Welding.—Welding, brazing, soldering, tempering and forging.

Transmission of Power.—Short distances, long distances.

Signals.—Bells, annunciators, automatic calls, individual calls, etc.

Railways.—Single and double wire systems, rail transmission systems, geared and gearless motors, generators. Trolley and underground systems. Storage battery systems.

Electroplating.—Current, solutions, time, etc.

Heating.—Resistance devices. Thermostats.

Execution.—Apparatus for destruction of life.

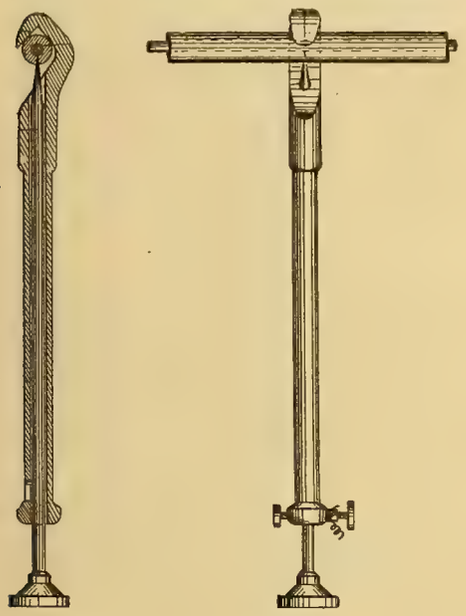
Photography.—Electrical devices for same.

The general committee states that the assignment of electricity to the department of science and philosophy, as well as to the department of engineering, is to be regarded as merely a double assignment of an important subject. In the former the scientific, and in the latter the practical aspects of the subject will have the leading place, but each of the departments will be free to consider the subject in any relation within its scope.

The circular asserts that it is proposed to assign the organization and management of the division of electrical engineering to the American Institute of Electrical Engineers.

Wire Tapper.

The cut shows a little instrument which might be employed to advantage for making a temporary connection with insulated wire. The tool has a V-shaped seat to receive and firmly hold the wire, and a pointed contact is provided which may be pressed down and made to pierce the insulation and co operate with the seat in holding the



WIRE TAPPER.

wire. Wires in a wall can be readily tested through a hole large enough to admit the tapper. A set screw works through the tubular guide for the rod. This tool was invented by G. S. Neu of New York.

Patrol Repair Wagon.

Manager A. W. Lynn of the Cream City railroad, Milwaukee, has invented a patrol wagon for electric railroaders. The accompanying illustration shows the wagon in use. It is constructed just like a police patrol wagon and

PATROL REPAIR WAGON.

is equally strong and durable. The square tower which rises out of the wagon is built of angle iron to the top of the ladder, also built of the same material. The crosspiece at the top of the ladder is very heavy and the portion of the tower above that point is made of hickory and fits inside of the iron part of the tower so that it can be lowered when not in use. The wooden part of the tower is manipulated by means of a crank and the pulley which depends from the crosspiece. When the tower is raised to its full extent it is fifteen feet high. It has been found very convenient indeed for repairing trolley wires and their appurtenances. Horses and men have no other work to do and are kept in readiness to dash off the moment a break is reported. In the wagon are all the tools and supplies that are likely to be needed. Manager Lynn will make two more wagons for the other divisions of the Villard system.

The World's Fair and Technological Education.[1]

By A. H. Revell.

I visited the Paris Exposition of 1889 and spent a month there, which I will always regard as part of the best spent time of my life. Grand, beautiful and instructive, indeed, was that exposition. It did the work of half a century toward the enlightenment of the world. But the high water mark of success to which it attained will be far surpassed by the exposition of 1893, not only in completeness, but in richness of detail and grandeur of architectural design.

Every industry will there join to make this event, not the pride of Chicago, not the pride of the West, not the pride of the East, the North or the South, but the pride of the entire continent, enriched by the work and industry of four centuries since Columbus led the way.

We have been trained to look toward the East for the technique and higher education. In 1893 there will be an engineering and industrial educator in Chicago.

While the excellence and quality of American workmanship is undeniable, yet I feel that there is something lacking. We do not apparently pay enough attention to refinement and artistic beauty in all our engineering, designing and manufacturing. There is lacking that special indescribable something which appeals so directly to the eye and to the sense.

The Columbian Exposition will educate the artistic, as well as the practical, qualities of the engineer, designer, workman and employer. Foreign expositions are of small value to the American designer and workman, as in 99 cases in 100 they cannot attend them, but they will all be able to visit the World's Fair in our own country, and see there on a grand scale what their foreign competitors are doing. Say what you may, there is something in the foreign finish and workmanship that captivates us all.

The exposition of 1851 in London, which gave the English artisan a chance to see what these of France were doing, served as a wonderful stimulus to the English. They then began to recognize the need of art education in order to achieve engineering and manufacturing supremacy. The Centennial exposition gave a great impetus to these departments in this country, and that at Chicago will do more in this direction, because it will be visited by a much larger proportion of the people of the United States.

Probably the most remarkable impulse which these nations, and others as well, received toward the development of these sciences was given at the first of the great international expositions, held in London in 1851, to which I have just referred. Expositions had been held before, but none on a scale so broad, or with a scope including all nations. So, also, there had been schools of technology, especially in France and in Germany. Those of England and America had been few and feeble.

But at the English exposition it was formally recognized in well studied reports of learned societies, and by committees made up of the world's ablest men of science, and charged with the special duty of investigation, that in that exposition the great victory lay with the nations that had most fostered the arts of technology.

The lesson was a severe one; but both England and America took it carefully into account, and the great strides which both of these nations have since taken in producing the choicest fruits of civilization inspired by science, began with that exposition, and followed the frequent establishment of schools of technology.

These lessons have been repeated with increasing emphasis at each world's fair since that already named. Can we doubt that the educative power of the coming fair will be in the same direction, and as much more emphatic as the Columbian Exposition will be greater and grander than its predecessors?

Will Chicago be prepared to recognize the instruction and to profit by it? Already other American cities have established schools of technology, while as yet Chicago has none.

A great city is the natural home of such a school. Much of the equipment must be in it and a part of it. But most of all, and here lies the reason why a first class school of technology will seek its abode in a great city, the city itself is one grand museum of technological science, a constantly growing collection of completed scientific triumphs. Railways with every phase of motive power, above, under, or on the surface, costly terminals, bridges, and bridge constructing companies, electric plants, foundries, iron mills, elevators, chemical works, manipulating gases, oils and metals, manufacturing establishments of all kinds, an infinite variety of processes that gather about the great packing industries; architecture, especially the new forms of construction recognized as the "Chicago method," with all the intricacies of actual work from the lowest embedded rail to the highest ornament, and every one here can add his own example to the growing list.

Here is a museum such as no collector ever gathered, catalogued and labeled. The school should be planted in its midst, and become itself a part thereof.

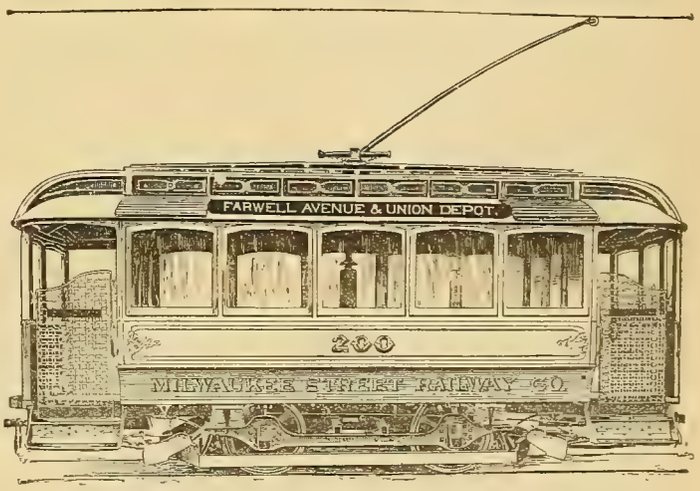
The time is ripe for such an enterprise. The coming fair should give it the grandest impetus. Thousands of the exhibits would naturally seek such a home after the exposition had closed its doors for the last time.

I am in favor of it first, last, and always.

1. Read before the Chicago Electric Club, Feb 3, 1892.

Special Vestibule Electric Car for Milwaukee.

The Villard interests which have secured control of the electric street railways of Milwaukee have just turned out a special vestibule electric car, which will undoubtedly be reserved for the use of distinguished visitors, and the officers of the road. It is considered one of the handsomest electric cars in this country has just been turned out at the South Side shops of the Milwaukee Street Railway company. It was designed by Manager Lynn and built entirely under his supervision. It is a double truck car. Its length is twenty-four feet, six inches its width, seven feet six inches and its height ten feet four inches. The exterior of the car is very handsome and the interior is magnificent. The finest, most carefully selected woods and the most elegant upholstering materials have been used. Up to the windows the woodwork is of curled birch, finely polished in oil and trimmed with mohoghany. The ceilings are of oak and mahogany, highly polished. On each side there are five large windows, all of French beveled plate glass, and at either end of each seat is a French plate mirror. The transom windows in the dome are of cathedral glass, the metal lines being heavily plated in gilt. The handstrap rods and all of the trimmings are of heavy nickel plate or oxidized silver. The straps are of russet leather, quilted with silk with a slight scarlet edge. The electric lights in the center are inside a large milk shaded globe, which is suspended in oxidized silver hangings. Heavy plush adorns the seats and back rests. The windows and doors are supplied with heavy spring roller curtains. Vestibules at each end of the car are fitted up as handsomely as the interior proper. The brake lever, hand rails and every particle of metal in sight are either nickel, silver plated or oxidized silver. It is estimated that the car cost more than double the price of any of the fine new cars which have just been put in use on the Villard system.



SPECIAL VESTIBULE ELECTRIC CAR FOR MILWAUKEE.

Recent statistics of the figures obtained with the Frankfort transmission plant show that the commercial efficiency was over 72 per cent. The cost per effective horse power was about $280, the distance of transmission being 110 miles. It was thought by some that there might be extraordinary losses not deducible from Ohm's law, but the results show that this was not the case.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE approaching convention of the National Electric Light association at Buffalo should be one of the most successful in the history of that organization. Unusual attention has been given the preparations for the meeting, and the official programme, presented elsewhere in this issue, shows that an excellent list of papers has been secured. The many important matters that will come before the association will also add greatly to the interest in the Buffalo convention.

PERHAPS there may be some who imagine that the overhead electric railway system is not progressing, and if so they will be surprised to hear that Staten Island may now be put on the list with Brooklyn. New York and Chicago are alike, so far at least as the trolley system is concerned. Chicago has permitted the encroachment of the "obnoxious" system within its limits, and perhaps New York before long, in spite of the war against the wires, will find that the enforcement of a rigid rule, regardless of reasonable exceptions, has its most decided disadvantages.

"Then came a shorter gasp, which was cut short in a gurgle by the re-application of the current flowing at 1,500 voltages and ten amperes."

THIS is the graphic manner in which the *Chicago Tribune* describes the effect of the second application of current to McElvaine recently executed at Sing Sing. Think of "1,500 voltages!" A volt is bad enough under certain circumstances, and 220 volts may even melt paving stones! But when we stop to consider what a "voltage" means and then multiply the conclusion by 1,500 there is but little wonder that the second shock completed the deadly work.

EX-MAYOR ROCHE'S contribution to the discussion of the need of a technological institution in Chicago at the Chicago Electric club is a sensible address. Mr. Roche points out the fact, which all must recognize, that Chicago, like all American cities, is still far short of engineering perfection in its municipal works. Neither its waterworks, sewerage system nor electric plant is beyond improvement. The baneful influence of politics has much to do with this, as the ex-mayor says, and one need of the city is technical men "whose only ambition is their work." Such men would naturally take a greater interest in their duties and have a more comprehensive grasp of the situation if educated amid the surroundings that were to bear witness to their professional energy in after years.

ONE of the first results of the publicity given the proceedings in the death chamber at Sing Sing prison was the introduction of a bill in the New York legislature, providing for a return to the old manner of execution. Assembly Stein, one of the witnesses of the last execution, pronounced the proceedings barbarous in the extreme. Despite the fact that the advocates of the new law had been experimenting on living men in secret, and that it was to be expected that they had become proficient in their method of putting criminals out of the way, the reports of the last execution show that the new method is still in what might be termed the experimental stage, and that the learned scientists, so called, had a disagreement as to whether their victim was dead or not after the first shock. In spite of all these horrible and revolting experiments, it has yet to be shown that the new method has, in any degree, lessened the pain endured by the condemned. It may be that the disgusting spectacle witnessed at Sing Sing may serve to bring about the complete abolition of capital punishment in the Empire State.

A COMPREHENSIVE list of subjects has been proposed for the consideration of the World's Electrical Congress, and is given on another page. One topic for discussion is presented, however, that it would have been well to have omitted, and that is "Execution—Apparatus for the destruction of life." Unless the temper of the electrical engineering profession changes very much before the summer of 1893 it will not be thought that the taking of human life by electricity has risen to the dignity of an equal place with the topics that will naturally be brought to the attention of the gathering proposed. The electrical engineer, broadly speaking, is engaged in work for the betterment of mankind; his work is constructive, not destructive. If it is necessary to discuss the subject of electrical execution in scientific bodies, the place to do it is in gatherings of medical men. We think that the gentlemen who are expected to attend the World's Electrical Congress will have no taste for the line of inquiry proposed, and that a decided improvement can be made by omitting it when the final programme is issued.

THOSE interested in the electrical features of the World's Fair will watch with some solicitude the progress of the dispute between the national commission and the local directory in relation to the question of the transportation, reception, transfer and installation of exhibits. Director-general Davis, representing the commission, and President Baker of the local board entertain different ideas on this subject, and a definite settlement is sought, so that the affairs of the exposition may be managed with less friction. Col. Davis claims that the power to install exhibits rests in the national commission by the explicit language of the act of Congress, while Mr. Baker asserts that the directors, with their knowledge of the details of the construction work and the facilities at their command, can supervise the installation more easily and to the best advantage of the exposition as a whole. Whatever may be the merits of the case, there can be no question that the contention is hurtful and deplorable, and it should be settled as speedily as possible. The Siemens & Halske case is in point as showing the trouble that this conflict in authority has caused. The gentlemen representing this important firm have spent several weeks in Chicago endeavoring to induce the exposition authorities to grant them a number of special privileges as the condition of making a large and attractive electrical exhibit. Director general Davis is disposed to grant many of the requests, while Mr. Burnham, chief of construction, and many of the directors think that it would not be proper to do so under the existing regulations. The matter stands in this unsettled state at present, and the gentlemen from Berlin have left Chicago temporarily, having obtained but poor satisfaction. For the good of the electrical display it is to be hoped that the question at issue will be settled before their return, and that some one will have unquestioned authority to grant or deny the concessions sought.

THERE is a probability that immediate attention will be given the subject of lighting by electricity the boulevards of Chicago leading to the World's Fair site. The South Park commissioners have at last taken decisive steps and have prepared plans for an elaborate system of illumination. They have received propositions from electric companies for three distinct plans, one of 310 arc lights, the second of 264, and the third of 98. The 310-light plant included all the lights required in Washington Park, Grand, Drexel and Oakwood boulevards, Garfield boulevard between South Park avenue and State street, Thirty-fifth street, Michigan avenue between Thirty-fifth street and Garfield boulevard; also the streets surrounding Washington Park. The 264-light plant would illuminate the same territory with the exception of Thirty-fifth street and Michigan avenue. The smallest plant contemplated is the illumination of Washington Park only.

It is a hopeful sign that the commissioners consider this matter seriously, but more than mere consideration of plans is required. These officials should bear in mind the fact that the electrical companies of the country have now all the work they can turn out, that with the approach of the fair business is bound to increase, and the preparation of exhibits will require much time and labor. Therefore, it behooves the commissioners to get to work and put the magnificent thoroughfares which they control, in proper shape for the great exposition. Chicago must be arrayed in holiday attire at that time, and its magnificent drives must be properly illuminated. Unless this is done it would be better that the city had not been awarded the exposition, for Chicago would be disgraced in the eyes of the world for all time.

FOR some months the WESTERN ELECTRICIAN has been advocating the desirability of applying electricity to the South side cross-town lines in Chicago, and at the present writing it looks as though the Chicago City Railway company had at last awakened to the fact that no better motive power could be found. According to one of the board of directors of the company, it has been decided to place motors on all of the cross-town lines, and the company will soon ask the city council for an ordinance which will permit the introduction of the improvement. Of course, the cable roads will continue as at present, but the company is particularly anxious to use electric motive power on Sixty-third street to connect the State street line with the World's Fair grounds.

Unfortunately, though, the decision of the street railway company is not all that is necessary before the long suffering South Sider can commence once more to patronize the conveyances that sometimes may be seen on the side streets. Of course, there will be objectors in the city council, and some may be unkind enough to hint that each one of these in turn will have to be "educated" to an appreciation of the advantages of electricity. In some cities such education is very costly, and some of the good and thoughtful city fathers waste a great deal of time before they conclude that there is really nothing in the absurd objections to the trolley system, which are being continually presented by ignorant people. A great deal of work, then, will have to be done, and the sooner the street railway company commences the better it will be for itself and its patrons. The Calumet company entered the wedge about a year ago, and this company has now a most valuable franchise for lines in the suburbs, but nevertheless within the city limits. With this company's work as a precedent and an ample supply of surplus funds—not to mention the backing it will receive from a people whose needs it has apparently so wilfully neglected—the Chicago City Railway company should succeed in making the much desired and most necessary change with as little delay as possible.

Induction by High Potential Discharges.

By Elihu Thomson.

It is well known that electric lines are strongly affected by induction during thunderstorms, and it would naturally be inferred that a line in a direction parallel to the flash would receive the strongest inductive influence, and that the induction would not necessarily be static induction, but currents would be set up by dynamic induction, complicated in many cases by static inductive actions occurring at the same time. What are known as "return strokes" in lightning flashes, according to this view, may be nothing

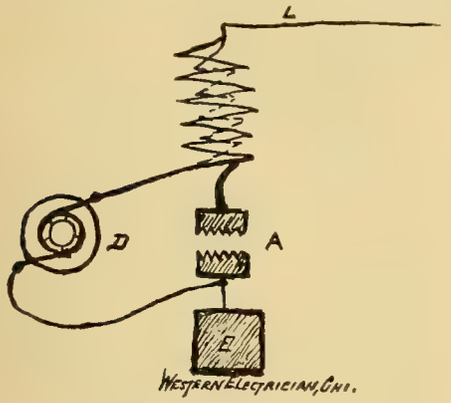


FIG. 1. INDUCTION BY HIGH POTENTIAL DISCHARGES.

more or less than parallel induced discharges along fairly good conducting paths, and it is possible that in the neighborhood of a lightning flash such induction may be of a very intense character.

These considerations led to my making the experiment of inducing, by a Leyden jar discharge, passed through a single turn of insulated wire, a discharge in a ring shaped vacuum tube placed alongside. Such a discharge was found to illuminate the vacuum. Similar experiments had been made and published by Prof. J. J. Thomson.

In working to devise a means for the protection of electrical apparatus from the effects of such induced discharges of lightning, it occurred to the writer to employ the inductive effects of the discharges to counteract, as far as possible, the effects of such discharges, or, as it were, to interpose a barrier between the discharges and the apparatus to be protected. This gave rise to a lightning discharge protector, or lightning arrester, the principle of which is shown in the accompanying cut Fig. 1. Let L be a line leading from a dynamo or other electrical apparatus and subject to induction from lightning discharges or subject to lightning discharges themselves as in a railway trolley line. Let D represeut a dynamo with one terminal grounded and the other connected to line. In such a case there were no provision for protecting the dynamo D from a lightning discharge it would be in danger of injury in case of induction occurring along the line or in case of a flash reaching the line. To avoid this I place between the dynamo and the line a sort of induction coil which consists of a double coil, each coil being made of a few turns of coarse wire highly insulated

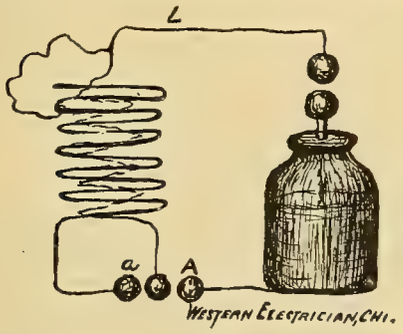


FIG. 2. INDUCTION BY HIGH POTENTIAL DISCHARGES.

from each other. One of the coils may be wound upon the outside of a glass cylinder and the other coil may be placed in the interior of it. Both are connected to line at one end, as shown, and one or both are connected to earth through the discharge plates of a lightning arrester A provided with an arc rupturing device, such as a magnet to blow out the arc in case the potential of the dynamo is high enough to maintain such an arc. The coil in the dynamo circuit has been found to need a few more turns than that in the earth circuit, and the direction of winding in the two coils is such that they are opposed in heir inductions, or such that a discharge passing from line to earth through one of the coils tends to induce a discharge in a direction toward the line in the other coil, or the coil in the dynamo circuit.

The manner of experimenting to detetmine the relation of the coils was substantially as follows: A double coil, Fig. 2, was made in which the inner turns were about 12 and the outer turns 20. These coils were kept separate from each other, and the sliding of a branch wire to the line from point to point on the other wire soon gave the effective length of the coil. The inner coil was connected through a small spark gap, as at A, to the outer coating of a Leyden jar, while the wire L was brought near the pole of the jar, which was continually being charged from a Toepler-Holtz machine. The discharge, in passing from the knob of the jar to the line wire L, passed by the inner coil. When a certain length of the outer coil was employed only a very short or almost imperceptible spark was obtainable at a. If the balance of the turns were disturbed by including more or less than the proper number of the outer turns not only did a vigorous spark occur, but the gap at a could be very considerably extended, in accordance with the amount of departure taken from the proper number of turns required to produce the balance.

This experiment indicates that it is possible to make a selective path for the Leyden jar discharge, and to have, as in Fig. 1, a structure so proportioned that the discharges reaching the line will pass to earth without tending to go through the circuit of the dynamo D. The action is apparently due to a balance of electromotive forces such that the discharge which tends to pass from the line in going to earth induces in the coil connected to the dynamo a counter electromotive force which nearly overcomes the potential of the discharge before it reaches the dynamo. This balance of inductive effects is certainly very striking, and once obtained it is disturbed, as in the experiments, by changing the relative lengths of the coils in inductive relation through so small an amount as an inch or two.

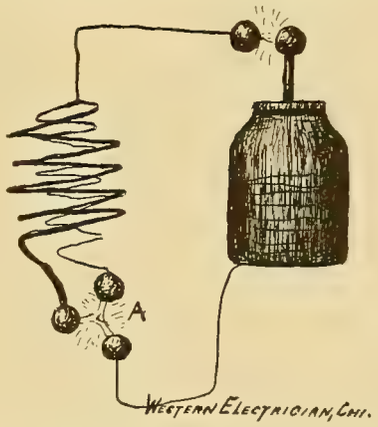


FIG. 3. INDUCTION BY HIGH POTENTIAL DISCHARGES.

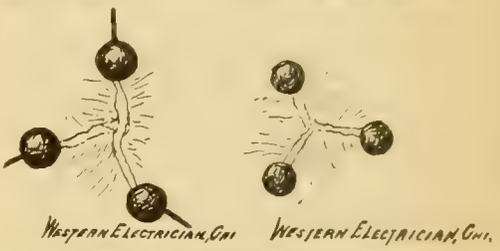
It may also be mentioned that some curious effects of spark were obtained in these experiments. When a disturbance of the balance exists, and a spark is attained at a, the character of the spark is different from that of the Leyden jar discharge. It appears to be less luminous, and the noise less sharp, and its color would indicate a greater power of volatizing metal, and perhaps a greater duration. No doubt this is in part due to a current local to the coils in series with one another.

Another curious effect was the production of T-shaped and Y-shaped sparks, or three branched sparks—such as are shown in Figs. 3, 4 and 5.

These were obtained by separating the electrodes at A about an inch and a half, and bringing the third electrode from the outer coil to the position shown in Fig. 3. With this adjustment the discharges were obtained as before from the charged jar. In this case the discharge appears to split and unite in air, producing the curious shaped sparks shown. It would seem that to obtain these effects, particularly the sparks which were three branched, from a common point in the center between the discharge electrodes, the air dielectric must break down simultaneously between the three electrodes. To assume that the straight part above forms first, and the cross or transverse spark strikes from the side of this spark to the third electrode, would explain the T shapes.

The inductive effects obtained with the apparatus described soon led the writer to reason that the passage of heavy condenser charges through a coarse wire primary coil of few turns might be made to induce in a finer coil of more turns wound parallel thereto, discharges of much higher potential and less current. In this case the Ruhmkorff coil would, so to speak, have its primary subjected to the oscillations of a condenser discharge of high potential, instead of low potential battery discharges raised in potential by the condenser and interrupter.

On trying the experiment with a coarse bare wire coil of about ten turns inclosed in a glass tube, without any iron core, and with a secondary of one layer of fine silk covered wire outside the glass it was found that the passage in the coarse coil of Leyden jar discharges of about ½ inch spark would give rise to such high inductive effects in the secondary as to spark from turn to turn in the single layer. By immersing the apparatus in a jar containing insulating oil, however, the insulation of the turns was improved, and sparks of two or three inches were obtained between the terminals of the secondary at every discharge of the jar. The glass tube used was



FIGS 4 AND 5. INDUCTION BY HIGH POTENTIAL DISCHARGES.

about two inches in diameter and five inches long. There were about 120 turns in the secondary layer. The induction must have been at least as high as from 100 to 150 volts to the inch of wire. It was soon found that glass tubes ⅛ of an inch thick were frequently punctured under the oil, and that the spark of the jar could not be unduly lengthened without producing discharges under the oil or between turns of the secondary.

The sparks from the secondary were peculiar in that they appeared to be prolonged, and quite like those of a Ruhmkorff coil worked in the ordinary way, but with small condensing surfaces on each terminal of the secondary.

Arrangements were made to obtain frequent condenser discharges at high potential, and to carry on the experiments on a much larger scale. The results have shown that it is possible to obtain torrents of long sparks, and this may be done without any very great expense for apparatus, the expense being very great in the case of the large Ruhmkorff coils hitherto employed. Sparks of two or three feet long will, I think, be readily obtainable The sparks are like those obtained from small jars, and if the terminals be connected to jars in the same way as the condensers are attached to a Holtz machine the thickness of the sparks can be increased at a sacrifice of length.

I will now describe the apparatus I use. This will give a torrent of sparks of 7 to 8 inches in length, making a loud roaring sound, and the length of spark seems limited only by the capacity of the secondary coil to maintain the insulation. Fig. 6 is a view of the apparatus used. A is a large induction coil capable of carrying in its primary ordinary alternating lighting currents of 50 to 100 volts and transforming up to 10,000 to 12,000 volts. So used, the coil will spark over ½ inch to one inch, and give the well known uprising thin arc. A blast of air blown on such an arc changes it into a beautiful pale purple flame. A con-

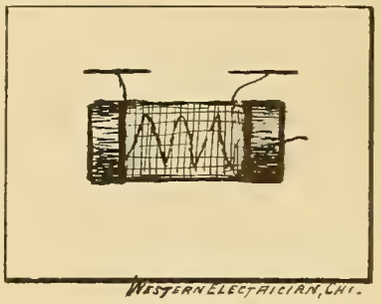


FIG. 7. INDUCTION BY HIGH POTENTIAL DISCHARGES.

denser B, the capacity of which can be changed, is connected to receive the current from the secondary of A. The spark with moderate condensing capacity is not much changed unless a blast of air be blown upon it. In the latter case it becomes a most beautiful electrical phenomenon. It appears to be a mass of flame filled with fine and thick shreds representing the condenser discharges, a gorgeous network of electric fire changing with any variation of the pressure or direction of the air blast. Sometimes, as on breaking the primary circuit, the oscillations of charge and discharge are seen as minute parallel lines or sparks on the borders of the flame joining the terminals. With greater condensing surface the discharge between

terminals becomes thicker and white even without the blast. When a very strong jet is turned on it roars loudly.

At *C* is a second and peculiar transformer, the primary of which is an open helix of but a few turns, for instance, 15 or 20 convolutions of heavily insulated line wire about four or five inches in diameter. This is surrounded by a thick glass cylinder, upon which has been wound say 150 turns of fine silk covered wire in one layer with a silk thread between the turns so as to cause them to be well insulated laterally. This simple induction coil is now immersed in a jar of heavy oil and the terminals on leaving the oil are kept as far apart as possible, and surrounded by glass tubes. The terminals of the coarse and short primary are connected in circuit with the discharge balls upon which the jet of air plays at *J*. The finer secondary terminals are connected to discharge terminals, as at *D*, for obtaining the spark. On passing the alternating current in the primary of *A* and adjusting the spark gap and jet at *J* as well as the distance between the discharge terminals at *D*, it is easy to obtain sparks of 7 to 8 inches in a perfect torrent at *D*, while sparks of ¼ inch are passing at *J*.

In fact coil *A* and condenser jars *B* constitute the source of very rapid electric oscillations and correspond to

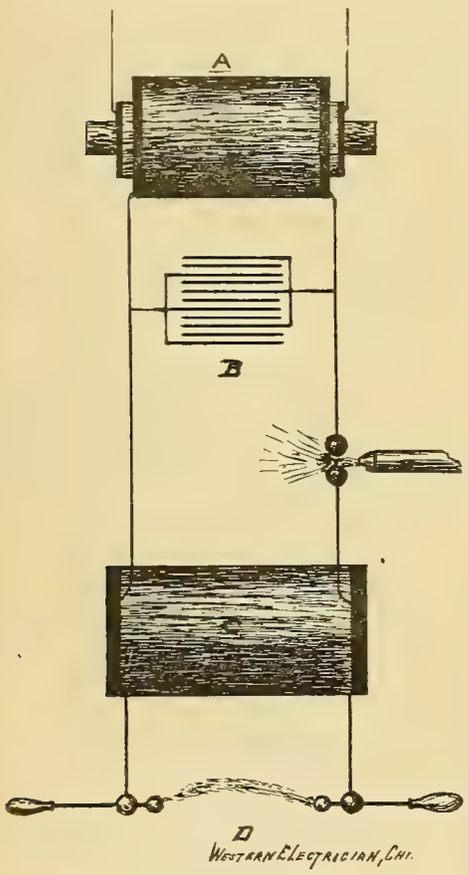


FIG. 6. INDUCTION BY HIGH POTENTIAL DISCHARGES.

the primary battery and condenser of a Ruhmkorff coil, while the air jet and spark gap at *J* bear a similar relation to the interrupter.

The discharges obtained at *D* represent, it would appear, at least 150,000 volts in potential or about a thousand volts to each turn of the secondary. The potential may be higher, for there is no data of spark length at such high pressures. It should be mentioned that the limit of spark was apparently that of the insulation of the secondary turns, for on attempting to increase it by separating the terminals at *D* to over eight inches, the sparks jumped in the jar of oil and could be seen passing under the oil from the secondary to the primary wires. Were it not for the required insulation between the turns of the fine wire secondary of *C* they could be wound in one layer so as not to cover more than two or three inches of the glass cylinder, and could be made to give out sparks of a foot or more in length. The volts per inch of wire obtained in these experiments are extraordinary, and it is quite certain that the limit will depend on the insulation. I am now possessed of the means for obtaining artificial lightning in a steady stream, and can experiment at will with extremely high voltages. The advantages of oil insulation are emphasized by these experiments, for although sparks frequently passed under the oil the insulation renewed at once.

It is necessary that the coil *C* be sunk well below the surface of the oil, as otherwise the discharges will perforate the oil layer at each end and pass over the surface.

It is curious to note the agitation of the oil over the coil when in action, and the coil is not deeply immersed yet sufficiently so to prevent discharge. A curious discharge without electrodes is obtained by providing each terminal of the secondary layer *C* with a metal plate which the oil just covers, the plates being parallel to the oil surface, Figs. 7 and 8. Great agitation of the oil over the plates ensues and sparks pass over the surface of the oil and spread over the surfaee just above the plates. If the oil layer be too thin it is perforated by discharges passing from plate to plate, and oil is scattered. Geissler tubes are lighted in the vicinity of the coil, outside the jar, or near the terminals, an action long well known in the case in the working of Ruhmkorff coils of considerable power. The frequency of the alternations used was 125 or 250 alternations per second. By raising the alternations the spark torrent will be more continuous.

These experiments demonstrate that lightning discharges, aside from electrostatic effects, may be the source of most vigorous electro dynamic inductions, and that high potential discharges may result. The bearing of this on a "return stroke" has already been mentioned.

It may also be pointed out that in the electro dynamic inductions set up we have a means for the study of the rate of oscillation, potential and current of lightning discharges, which are now but little understood. It is too much to assume that all such discharges take the oscillatory character of Leyden jar discharges; and it would be useful to distinguish between rates and characters of discharge. The writer remembers that during a storm a few years ago he noticed a ringing or humming sound accompanying a not very distant flash of lightning. The sound was remarkably clear, and almost musical. Could this sound have recorded the oscillations of a discharge in which the capacity and self induction were such as to give the oscillations defined rate within the ordinary range of pitch of musical sounds? This is an observation which the writer takes the present occasion to record, as a strong impression was made on him by the loud, clear ringing tone which followed the flash.

Electricity at the World's Fair.

The specifications for the incandescent lighting at the World's Fair are now in the hands of the printer, and will be issued within a few days.

Much thought has been devoted to a consideration of the extent of the lighting of the buildings at the World's Fair to be done by the authorities of the exposition. A number of the buildings, such as the music hall, the casinos, administration building, fisheries building, art gallery and the like will be brilliantly illuminated at night by incandescent lamps, but the extent to which the general lighting of the large buildings will be carried has not been so well determined. Thus, the general plan for the electricity building contemplates the employment of 398 arc lights—about one for every thousand feet of floor space. It is debated whether it will be better to distribute these lamps uniformly over the entire space or whether to confine them to the aisles and open spaces, relying on exhibitors to pay for the incandescent lights used for decorative purposes. The manner of lighting the great vaulted ceiling is also exciting discussion. It would appear that only arc lamps would answer the purpose, but it will be difficult to attach them to the upper portions of the lofty steel arches in such a position as to be easily accessible to the lamp trimmers. The plans are still unsettled, and their determination will be largely influenced by the bids received on the arc light specifications that have been issued, as the authorities will be governed, to a great extent, by financial considerations.

L. Stieringer, who is associated with Frederick Sargent, electrical engineer of the construction department, in planning the lighting effects, left for a short trip East on Saturday.

On Friday of last week the representatives of Siemens & Halske left Chicago for a two weeks' trip to Florida and the East. The requests of this firm and their reception by the exposition authorities have excited much comment within the last week or two. The Germans go away with their demands nearly all unsatisfied, partly because all of the World's Fair authorities agreed that some of them were unreasonable, and partly because of the unfortunate difference of opinion between the officers of the national commission and the local directors in relation to the installation of exhibits. This dispute has not yet been settled, and in the meantime no definite assurances have been extended to the Berlin firm, save a promise of space in the transportation building for its electrical railway signaling apparatus. Herrn Siemens, Vogel, von Babo and the others will return to Chicago in about two weeks, and doubtless by that time Director-general Davis can give them some positive information in relation to the concessions they seek.

Attitude of Electric Companies Toward Technological Education.[1]

By B. E. Sunny.

In and about Chicago there has never been any special difficulty in securing the services of what are known as "practical electricians," to care for and operate the several types of electrical apparatus that have, from one time to another, been developed and put into service. Any man of ordinary intelligence can, with a few months' experience, acquire a sufficient knowledge of the most intricate piece of electrical machinery made for the public service, so that he can operate it successfully, and with several additional months' experience, is competent to make any necessary repairs. So far all is well, and so long as the directions of the manufacturer are followed in the operation and maintenance of any of the standard types of machinery, no unusual difficulties are encountered, but as is too often the case, the "practical electrician," in a year or even less, has grown in confidence and courage to a point where he begins to point out wherein the design of the particular machine is wrong, and to suggest changes that will, in his opinion, improve its operation and efficiency.

If he stopped at the discovery of the supposed defects no harm would be done, but it is contrary to his progressive spirit to hesitate to make the alterations that seem to him to be so essential to the proper working of the machine. It is a foregone conclusion, of course, that the piece of machinery so carefully designed in all its details by skilled electrical engineers, and each part made to conform electrically to every other part, is not susceptible of changes and improvements by the average "practical electrician" and his efforts in that direction are rarely, if ever, successful in doing any more than pointing out to him the fact that he does not understand the theory or principle upon which the machine is designed, or the relative value of one of its parts to the other.

Indeed, if his experiments brought about this result,

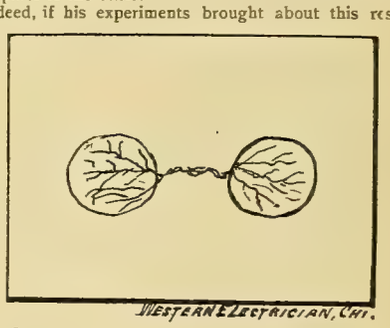


FIG. 8. INDUCTION BY HIGH POTENTIAL DISCHARGES.

somethiug would be gained, but it is more than probable that he would ascribe his failure to the lack of proper tools, material or opportunity, and still adhere to his belief that the machine is wrong in its design and construction.

The story of the efforts of the average "practical electrician" to make improvements on the standard machine is such an old story to any one familiar with the operation of electrical properties as to be unworthy of repetition at this time, except for the purpose of emphasizing the great necessity for a theoretical as well as a practical knowledge of electrical machinery by the person in whose charge it is placed. With a practical knowledge only—gathered in a few months' observation of the operation of the apparatus, assisted by a few stray suggestions from persons of larger experience—the employe, upon whom frequently devolves the responsibility of the running of expensive and delicate machinery, cannot be expected to appreciate the influence upon the apparatus of a lack of ventilation in the station, uncleanliness, irregular speed, overload or underload, and in the wires attached to the apparatus and covering a large mileage outside, poor insulation, improper size of wire, etc.

With a knowledge of the theory upon which the apparatus is designed to work, coupled with a practical experience, the employe is properly equipped to manage the standard machinery of to day, at the highest point of efficiency and minimum cost for repairs. It is, however, from the lack of this combination of a theoretical and practical knowledge of apparatus in the average employe that the electrical business has suffered, nor can any blame attach to him. On the contrary, he deserves unstinted praise for adapting himself so speedily to the requirements of a service in which he was untaught, and which has developed with a rapidity beyond the capacity of our educational institutions to instruct him. Not only in the daily operation of electrical properties has the want of this combined theoretical and practical knowledge been severely felt, but more particularly in the treatment of the problems with which, as you can well imagine, the electrical business has been beset.

I need not recall to your minds the fact that the pioneer work in the placing and operating of wires underground, especially high pressure current wires, was done in Chicago, nor need I remind those who were connected with the early efforts in this direction of the almost total lack of definite knowledge regarding the theory of the operation of electrical current transmitted through underground cir-

1. Read before the Chicago Electric Club, February 3, 1892.

cuits. The problem of underground electrical service is simple now, in the light of the experience gained at so great a cost in time and money in experimenting—that is, so far as Chicago is concerned—but the great territory all about us containing cities that are rapidly outgrowing overhead wires is almost as poorly equipped in electrical engineers, trained in theory and practice, as were we, when the problem was presented to us.

It is the universal opinion that electricity still has in store for us some of its greatest wonders. That much is expected of it that can scarcely be realized by the most sanguine champions, is perfectly apparent, but it is entirely within the range of possibility that the next few years will see it more broadly applied for the transportation of passengers and freight as a substitute for steam; a more general applica-

PENNSYLVANIA LAMP.

tion for the transmission and furnishing of power at long distances and by the use of high pressure currents, particularly in connection with the water power scattered throughout the western country; for the work of drilling, cutting, pumping and hoisting in mines, as well as for the minor applications that are developed from day to day.

These new and broadened applications will call for the services of skilled employes, men of special training, equipped theoretically and practically for the work, and, as Chicago is the great center of the territory in which all this work is to be done, and will be looked to for support and assistance, is there a more appropriate place for an educational institution that will enable it to answer the demand?

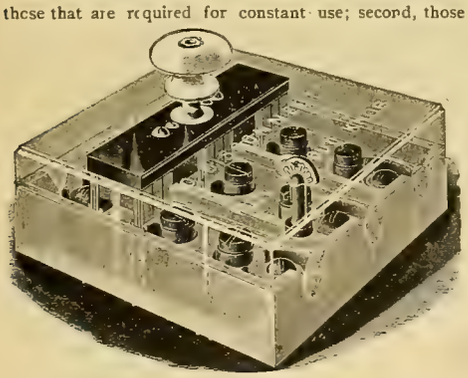
At no point in the western country is there what can be regarded as a well equipped school for the development of electrical engineers and in the East, there are but five: the Stevens, the Johns-Hopkins, Cornell, the Sheffield Scientific School and the Massachusetts Institute of Technology. In all of these institutions, the electrical course receives the prominence that it merits. In fact, 25 per cent. of the entire attendance at one of them is in the electrical branch. It is estimated that in the five institutions named there are in all 1,100 students taking the electrical course, a number ridiculously inadequate to the requirements of the important work to be done. Of this number, it can be safely estimated that at least half are from this western country, and are compelled to go East, remote from their homes and home influences, and at additional cost for tuition.

With proper educational facilities in Chicago, the ambition of the young graduate from the High School, for an electrical training that would serve him well in a service that is sure to need him, would be readily and more cheaply attainable than it is now, and would lead, in the course of a few years, to the manning of the great electrical properties that are growing all through the West with skilled help.

I have no hesitation whatever in stating that the attitude of the electrical manufacturing companies can not and will not be other than exceedingly cordial toward this most excellent and much needed enterprise. There is no possible doubt but that they will co-operate generously and heartily in promoting the success of the undertaking, and will regard the advent of an educational institution in the West as a forerunner of a greater freedom from the annoyances and vexations growing out of well meaning, but unskilled help, and a more speedy broadening of the application of electricity, because of the increased intelligence of those in whose hands it must be intrusted.

New Switch.

Electrical switches for breaking currents of both large and small capacities may be divided into two classes: First, those that are required for constant use; second, those



NEW SWITCH.

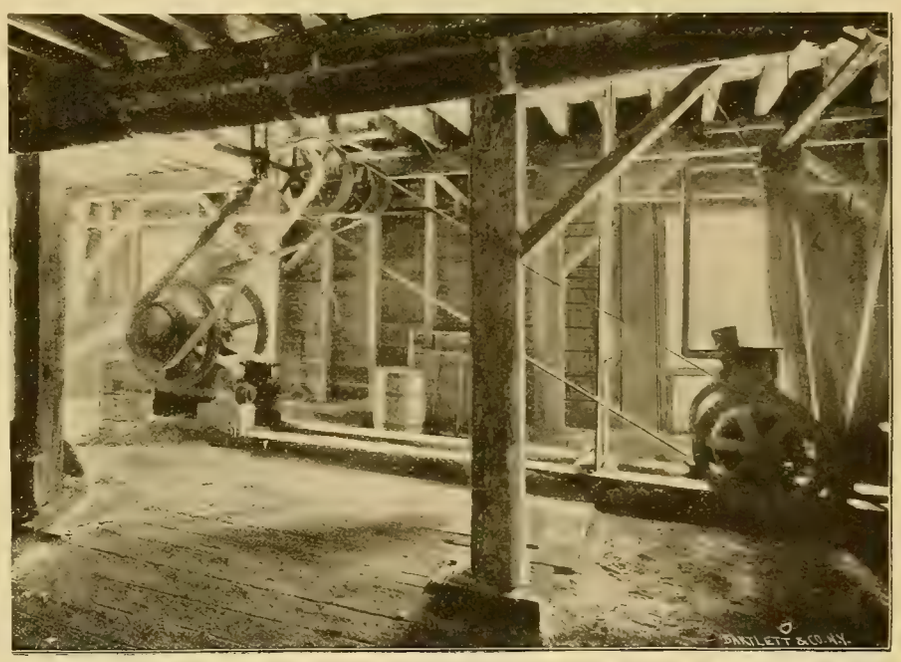
that are but seldom called upon to perform the service for which they are designed. The key socket is a ready illustration of the former and the huge feeder switch of the latter class. To the first class many new designs are contributed from time to time, but to the latter, the use being to a certain degree limited, but few are well known enough to demand recognition. The device illustrated herewith is a switch of the second class, and is known as the V. V. service cut-out, the invention of J. H. Van Vleck, electrician and chief engineer of the Edison Electric Illuminating company of New York. It is claimed for this device that it combines in a compact form within itself a switch and cut-out. The switch is constructed wholly of fireproof material, its base and cover being of the best quality of porcelain. It is made for the two and three wire systems, on the plan illustrated, from which it will be seen that one half of the device embodies the ordinary safety cut-out, while in the other half there is a novel form of quick acting snap switch. The connections are of bronze, with strong screws for the binding posts. The contacts of the plugs are so arranged that when the plug is withdrawn to open the circuit the movement is accelerated by means of a strong spring, which is contained in the plug itself, thus insuring a rapid and complete break with a sharp snap action. The only exposed portion of the plug is finished hard rubber.

This appliance is offered to the trade by the Interior Conduit & Insulation company of New York.

Self-Contained Machine.

In the accompanying cut is shown a temporary installation of a Westinghouse machine at the works of the Laurel Hill Chemical company, Laurel Hill, L. I.

Two timbers laid upon the ground and braces by strut pieces from the ceiling form the bed of the outfit, which consists of a 25 horse power Westinghouse engine driving



SELF-CONTAINED MACHINE.

a salt cake crusher and grinder. Each machine is complete in itself and independent of its surroundings, and the engine easily runs with perfect safety at a speed of 400 revolutions per minute on its slender foundation.

While the plant is not intended as a permanent one, the character of the production is no different from what could be obtained under more favorable conditions. Each machine yields as a whole to the inequalities of the foundation with no undue tendency to strain or warp the working parts.

However well designed a manufacturing establishment may be, changes are almost constantly going on as more recent improvements are incorporated with the original plant. Considering this certainty, much more valuable and satisfactory is the self-contained machine which may be readily shifted from place to place and do its work as well when located but temporarily as when all the precautions are observed for an indefinite operation.

Pennsylvania Lamp.

The public is now sufficiently educated in electrical matters to distinguish between a good and an indifferent lamp. The demand is for efficiency and a reasonable length of life, which should be at least 600 hours, the lamp to consume a tenth of a horse power. It has been claimed that lamp manufacturers of late have had so much competition that they were compelled to slight the work, giving inferior glass, filaments and poor workmanship in order to successfully compete in price. The Pennsylvania Electric Engineering company of Philadelphia, however, has lately put upon the market a new lamp, in which, it states, the loss in efficiency considered to be due to the vapor of mercury is overcome. The "Pennsylvania" lamp is exhausted with mechanical pumps, which, it is claimed, produce not only a higher vacuum, but secure far more uniform results than it is possible to obtain by the old method. The company states that with its process of mechanical pumping it can produce a lamp which shall have an average life of 1,000 hours, and one that can be successfully operated at the rate of 11.2 candle power lamps per horse power.

Benefit of a Technological Institute to Public Works and Municipal Corporations.[1]

By John A. Roche.

I regret exceedingly not to be able to share the same hopeful views as to the future of our municipality as my friend Parker does. The future welfare of Chicago is the motive which prompts me to speak in a strain quite different from that in which Mr. Parker expresses his hopes for the future of our city. Rather will I speak facts as I know them in order that we may thereby get a clearer and better understanding of the situation. Now, I think I am qualified to speak on the subject of our city and its government, knowing, as I do, some of its weaknesses.

Our system of lighting has been praised throughout the land. Our underground wire system is pointed to as a model, and as indisputable evidence of the value of placing the electric conductors in the earth. All that has been said is true, but much has not been said that might have been. To be sure we have our subways, but they are far from complete. While it is a cheering sight to see men busy burying old wires and laying new ones, it is not especially desirable to have our streets ripped up day after day to accommodate each new comer. What should have been done in the first place was to provide a conduit large enough to hold all the wires that then were or have since been in existence. Had the city government at the time of building the first subway insisted upon making it large enough, the electric companies would have saved considerable money, and the public much annoyance. This is but a single example of the value of good engineering; yet I could go on and detail many similar instances in every branch of the public service—sewers, gas mains, water pipes and the like.

To realize the most perfect condition of public works each of these departments should be under the control of a competent engineer of acknowledged ability in his line, who should hold office absolutely independent of political considerations. They should be free from the turmoil of political life, free from the dictates of parties or leaders, and continue in office as long as they were competent and honest. It is only when we have made such arrangements that we can hope for a realization of the vision my friend Parker has presented of the future Chicago. To get such engineers there can be no better plan adopted for educating them than the one outlined here to night.

To illustrate the necessity of freeing our public engineers from the fortunes of political life, I may be permitted to depart for a moment from the main subject. I would speak to you of a man the memory of whose work lives after him. The work he accomplished for our city will keep the dust of time from dimming for a single instant the luster of his name. I refer now to our lamented friend Mr. Cheesborough. He came to Chicago from New York in 1855. Recognizing in him wonderful engineering abilities, our city sent him to Europe, and as the result of his trip he made a report on our sewerage and water systems that was adopted not only by the city but by almost every other city on the continent—a report that has

1. Abstract of address before the Chicago Electric club, Feb. 3, 1892.

become law as regards city works. He planned our systems of drainage. He built the two-mile crib to supply the city with water—a piece of engineering that has challenged the admiration of the world. He created the Fullerton aqueduct, another masterpiece of engineering. To crown it, he gave the city swinging bridges, the value of which is too well-known to need description. He even foresaw the value of our Chicago river as an outlet for refuse by equpping a pumping station, and in time his ideas for the completion of that plan will be fully carried out. He was earnest and honest. His work stands to-day unparalleled, and yet in 1881, after all these years of service, he was rudely turned out of office in the juggle of political affairs and lost to sight as a public officer for all time. What he did we all knew and admired; what he might have done we can pretty nearly calculate. Yet his life work was shattered in a single day by a turn of the political wheel. So that I insist that if Chicago will take her rank among the cities of the earth she will have to divorce her engineering problems from her politics.

When I hear able arguments in favor of increasing our facilities for technical education, I cannot but indorse without question the conclusion of Mr. Parker—our city needs competent technical men, men whose only ambition is their work, like the simple laborer who goes out at morn to earn his daily bread, and returns at night to enjoy the fruits of his work with his family.

Chicago has many things to be proud of, many claims of supremacy that have been recognized even by her most bitter critics. In civil engineering, however, there are many things she has yet to learn from other cities. For instance in London they have a high pressure water system by which they obtain thousands of horse power for all kinds of work. Chicago might revel in that privilege. If she did, I will venture there would be many less tons of coal burned than there is to-day, with all its attendant smoke nuisance. We talk of ordinances and regulations. We place restrictions upon the owners of boilers; but can any inspector, or even army of inspectors, always watch the engineer? True, the law may demand that a man shall squirt a jet of steam into his furnace; but what assurance have we that this will be done at all hours? When the inspector is around, there will be no trouble. Let him turn his back, and it is a very public-spirited engineer who misses the opportunity of saving for his employer twenty per cent. in his coal bill. The way to remedy the evil is to strike at the root, and you will never affect the root by fingering with the branches. There is no reason why good engineering cannot easily remedy what now seems such a blemish on our city.

It has been said by a competent authority that in ten years we will obtain twice as much energy from a ton of coal as we do at the present time. That means that though we may then have twice the amount of power, we will not have any more smoke than at present. And so all along the line.

Mr. Parker has furnished statistics to show the great commercial interests of Chicago. He tells us that one-third of the total railroad mileage of the world finds a terminus within our borders; but he did not deface the picture with the reality of the situation. We all know that the railroad lines entering the city are at present in a, we will not say the most dangerous condition, but almost discouraging condition. Would we see the tracks elevated or buried, two things that we hope and pray for? It is simply a question of engineering, and who is better able to solve the problem than able engineers reared and educated among us, knowing our wants, and applying our own remedies?

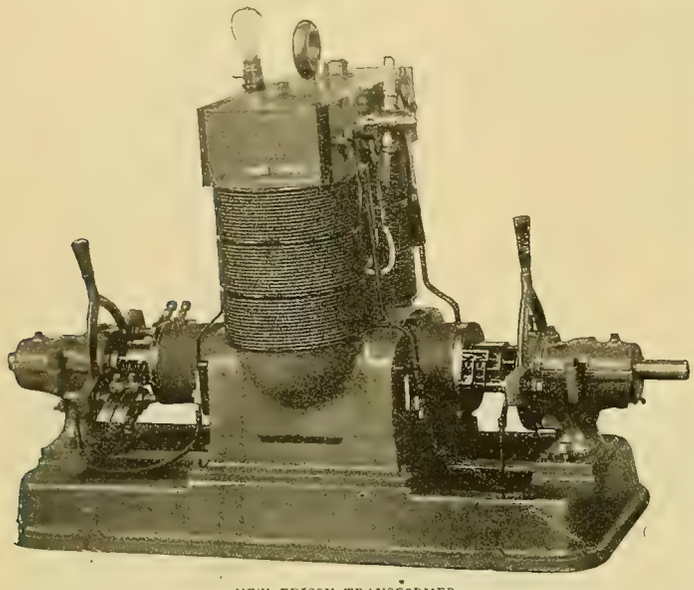
The establishment of such an institution for technical training ceases to be a desirablility; it is a necessity. Chicago is pre-eminently a city built on engineering principles. Now let us have the good sense to recognize that fact before the world by erecting and maintaining what will be another jewel in our city's diadem—a technological institution.

The Genesee-Vanderbilt Mining company of Red Mountain, Colo., is erecting an electric plant for the purpose of lighting its mines and buildings.

New Edison Transformer.

The cut shows a new Edison continuous current transformer, or motor generator, of special interest to practical electrical men on account of the novel features which it presents. This machine has been designed for special use on street railway circuits, and is employed to convert the current from 500 volts on the motor to 125 volts on the dynamo, thus furnishing a current of low tension for either lighting or power.

The motor generator is, in reality, as the name implies, a combination of two machines in one. The armature has two distinct windings, and each end is furnished with its commutator, rocker arm and brush holders. The transformer, represented in the illustration, is of six kilowatts capacity, the dimensions being those of the standard Edison 12 kilowatt generator, with the exception of the length of the bed plate and pole pieces. The head board at the motor end of the machine is provided with a double pole switch, while the board at the generator end is furnished with a single pole switch.



NEW EDISON TRANSFORMER.

The advantages which such a machine as this presents will be readily understood. Take, for instance, a case where lighting is to be accomplished at a distance from a source of water power. A turbine and generator evolving current of high potentiality can be placed near the waterfall, to supply electricity to lamps in premises some miles away. In the place of a receiving motor for the high potential current belted to a separate generator, one of these transformers can be employed to take the place of the two machines. Another instance may be given. A street railway station, in which the machines are generating current at 500 volts, finds it possible to utilize a portion of this current for incandescent lighting. Instead of a subsidiary motor belted to a dynamo wound for 125 volts, or a separate engine and generator, wires are led from the 500 volt machine to the motor generator, and current of the necessary tension for incandescent lamps is produced. These machines are manufactured at the Schenectady works of the Edison General Electric company in various sizes and for different voltages. The highest pressure for which they are designed is 1,200 volts in primary circuit.

Electric fan builders will have to keep up a high standard of construction, for a saloonkeeper of Long Island City recently lost his eye while watching the experiments of a dealer in electrical fans. The fan was revolving at high speed when one of the blades broke and flew out, striking the man and cutting the eye out of the socket.

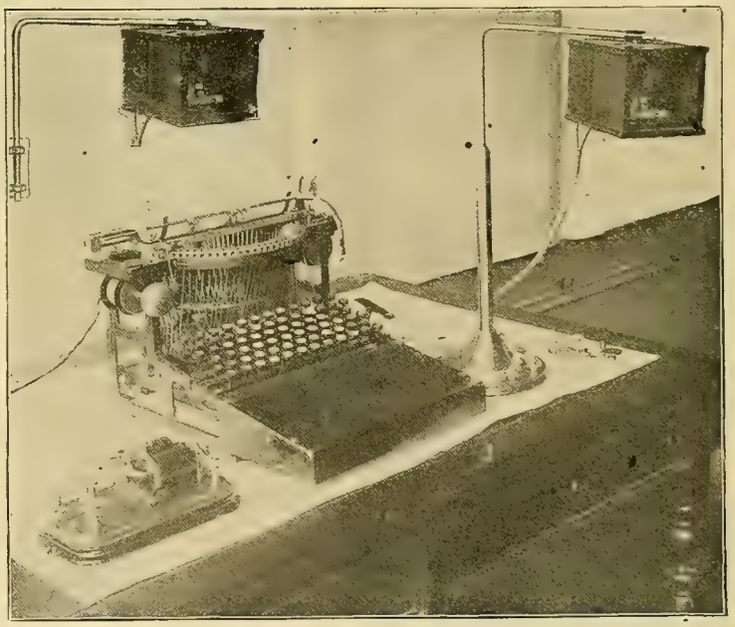
Bunnell's Adjustable Extension Sounder Support and Resonator.

Presented herewith is an illustration of a device for increasing the sound of a telegraph instrument, and for adjusting its position so as to bring it as near as desired to the operator.

The typewriter, instead of the pen and pencil, has been extensively adopted for receiving during the last two or three years, but its use has been attended with some difficulty owing to a tendency to confuse the receiver, caused by the clicking of the machine being sometimes as loud as that of the sounder. This interference, it is stated, is entirely eliminated by the employment of the Bunnell arrangement.

Through the use of the support the sounder may be brought to any position required close to the receiving operator, and the entire volume of sound so greatly increased that it can be easily and distinctly heard over outside noise. A movement of the resonator makes it possible also to receive easily from an instrument which may be so closely adjusted that it cannot be heard by any one except the operator who is receiving.

The sounder proper is the Bunnell pattern, known as the Giant sounder. It is clamped within the resonant box, which is open at both ends, and is sustained in mid-air by the swivel pendant on a swinging arm. This arm is also adjustable, and may be raised to or lowered from any height within the necessary range. As the arm also swings laterally on its support, the operator can have the sounder wherever it is wanted. The effect of clamping the sounder within this peculiar resonating box is to increase greatly its loudness and distinctness, leaving nothing more to be desired in that direction, unless the operator is nearly stone deaf, for the instrument, with its increased sound, can be brought so close as to almost touch the ear if desired.



BUNNELL'S ADJUSTABLE EXTENSION SOUNDER SUPPORT AND RESONATER.

The Attitude of the University of Chicago toward Technological Education.[1]

By Dr. Wm. R. Harper.

Great has been the pleasure and great the profit which we have received from the papers read this evening in our presence. Topics of world wide interest have been discussed by men whose ability to discuss them no one will question. Every one of us here present sees and appreciates the situation now as we have never appreciated it before. As men who believe in the future of Chicago, and as men who have possessed a certain familiarity with the progress of educational work, we have always believed in a general way in the truth of the positions taken here to-night. But I am sure that I speak the truth when I say that now the case is a more definite one, the necessity of action more clear, and the possibility of results more certain in our minds than ever before. There rests upon me the grave responsibility of closing the discussion, and of indicating to you briefly the attitude of the University of Chicago toward technological education. You will pardon me, I am sure, if briefly I speak first of the university itself. The institution is to be a university with all that is implied in that word. As you know, the great majority of institutions called universities are in no proper sense entitled to that distinction. Our institution would have no right to exist if it came among you as a college. There are to-day as many colleges as are needed, but here in the West, excepting perhaps the university at Ann Arbor, it is

1. Read before the Chicago Electric Club, February 3, 1892.

fair to say, that the real number is less than the number alleged.

As is known to you, the greater part by far of the funds which make up our endowment is set apart for strictly university work as distinguished from college work. The university, therefore, has come to the city of Chicago in no sense as a rival of the many institutions in Illinois and in surrounding states, but rather to supplement the work which they are doing, and doing so well. The time has come when the ordinary college course is not enough. Special provision must be made for advanced work in all the great departments of learning, and it is this advanced work which we have undertaken to do.

Further, our institution, in name and in fact, is the University of Chicago. It is not merely a university near or in Chicago. Evidence of most satisfactory character has been furnished that the citizens of Chicago have taken the university into their hearts. The press of the city speaks of it as "our university." Men of every creed say "our university," and in every sense of the word it is your university—the University of Chicago.

The question is, then, what is to be the attitude toward technical work of the proposed institution endowed to do, not college work, but advanced work, located as it is in the heart of this energetic, ever-growing, never-resting city of Chicago. I need not take time to assure you of what, I am certain, not only you, but every friend of the University will be glad to be assured, namely, that for those departments, which, for the sake of convenience may be called the humanities, the amplest provision is to be made. The most ardent friend of technological study will agree with me that in this busy atmosphere, in the midst of the activity which surrounds us on every side, it is well to cultivate the humanizing studies. The busier we are, the more intense is our activity, the greater the need of emphasizing either for ourselves or for others, the development among us of those particular studies which cultivate and elevate. The great reproach with which our friends in the East charge us is that in this respect we have not developed as rapidly as in more material things.

I say, therefore, and every man of you will agree with me, that the university must lay great emphasis upon these departments of learning, and must offer the students of our city and of the West and South, privileges in no particular inferior to those furnished by Yale and Harvard.

But is this all? If in many eastern institutions this is all that is attempted, shall we undertake no more? Shall we say to ourselves: This is our work to do and anything more, if done, shall be done by separate and distinct institutions? Shall we take the position that technological work in all its departments is not work properly coming within the scope of the university?

It seems to me that the University of Chicago, should it limit itself to the humanities, or even to the humanities and pure science, will accomplish only half the work it ought to do. As I have said from the beginning, it has been the purpose of the institution to be a university. This idea has been at the basis of all its plans. This idea has commended itself to the friends of the institution more strongly with each passing month, and in accordance with this idea, it stands ready to take up, either directly or indirectly, the great work which has been outlined here to-night. There is no work the doing of which will more clearly show to the citizens of Chicago the interest which those who are connected with the institution feel in the city itself. There is no work the doing of which will advance more speedily the interests of the city. There is no work the doing of which will enable us to be of more assistance to our fellow men, or to the cause of highest usefulness. Such work must be done, and may I say just a word or two about the doing of it?

First. The work should be done under the direction of and in connection with a university. This has been taken for granted; but why is it so?

(a) Because it deserves, and should be given the character and the dignity of university work. Its professors should have the rank of university professors; its students, the degrees of university men.

(b) Because contact with the more scholastic life and work will help such work and the students who engage in it. Let us not lose any opportunity to place our boys, while young, under the best of humanizing influences. Every such influence will leave its mark, and sooner or later in the life of every individual count for much. Shall the student of divinity or of philosophy, or of ancient history, or philology, continue to, as for centuries past, separate himself altogether from the stir and stimulus of active life? By no means. Nor on the other hand should the engineer cut loose from that which wears off the rough, which broadens and enlightens and exalts.

Such work should be done in a University, still farther:

(c) Because of economic reasons. In connection with technological work, and as a part of it, pure mathematics and pure science must be provided. To accomplish the best results, a knowledge of at least two modern languages should be acquired. To secure a breadth and discipline of mind, which every one will acknowledge to be desirable, history and political science must be studied. All technological schools, as you know, include these things. If, now, the technological work is organized in connection with a university in which these subjects are being presented in the best possible manner, surely there is great advantage; and if thus the duplicality of work is avoided there is, as well, economy. The work, therefore should be done in a university.

The University of Chicago stands ready, as I have said, to do anything and everything within its power to further these ends.

Second. The work should be done in a manner worthy of Chicago. This means two things.

(a) Promptly, in fact immediately.

(b) Upon a large and ever-growing scale.

Here again, I am pleased to say to you, the university stands ready. It will act just so soon as you may direct; and upon a scale as large as you may indicate. The magnitude of the operation will only be limited by the amount of means placed at its disposal

Gentlemen, the fact that the Electric club should take up for consideration so great and serious a question is a most significant event in the history of this city, and in the history of education. It is not strange that you should do this, for you, of all men, know the need of such work as has been discussed. Should we not hope that with our forces joined together, something of great moment shall result? If you will help us, we will undertake it; if you will undertake it, we will help. It ought to be done; it can be done. May I say it, it shall be done!

Electrical Engineering at the University of Nebraska.

The electrical engineering laboratory at the University of Nebraska is nearly completed. Its dimensions are fifty by sixty feet, with high roof, for good ventilation, and it is designed especially with a view of securing plenty of light.

In this building are being placed two engines, one 100 horse power Giddings automatic tandem compound condensing, made by the Sioux City Engine Works and one 25 horse power single cylinder Atlas engine, made by the Atlas Engine company, Indianapolis. Each engine may be coupled to either end of a line of countershafting through the center of the building, or belted direct to the dynamos. The line of countershafting was made by the Falls Rivet & Machine company, Cuyahoga Falls, O., and is a model of workmanship. The driven pulley from the 100 horse power engine is attached to the shaft through a Van Winkle 100 horse power spring dynamometer and this allows accurate power measurements to be made at all times. Clutches are used so that any dynamo may be started or stopped at pleasure without stopping engines or throwing off belts. By a system of friction clutch couplings the whole line of shafting may be driven from either engine independently or from both engines working together, as occasion may require. To this line of countershafting are connected one 500 light 1,000 volt Westinghouse alternator, one 25 light Thomson Houston arc dynamo, one 25 light Wood arc dynamo, two 15 kilowatt Edison 100 volt dynamos, arranged for the three wire system and one Weston 100 volt 100 light direct current dynamo. The engines are arranged so that they may be run at high pressure, exhausting through improved exhaust heads into the atmosphere, or they may be connected with a 100 horse power Worthington independent jet condenser and run as condensing engines. Steam is furnished by a 125 horse power Sterling boiler placed in a separate building in the rear. Beside the Van Winkle dynamometer pony friction brake, a bracket cradle dynamometer and two dynamometers of special design—one an oil and the other a magnetic dynamometer—are provided for power measurements. Each system represented is complete in every detail. Four handsome fire proof switch-boards are provided on which to place the measuring instruments and regulating devices of each system. About $5,000 has been expended in importing standard electrical instruments alone, and a large amount of apparatus such as current and voltmeters, lamps, transformers, etc, possessing special features, has been procured firms other than those named. Sixty-five storage cells of for three distinct types are used to light the building and from experimental work. The total addition to the equipment in this department this year will amount to over $30,000. The department, it will be seen, is fully equipped for its work. It is in charge of Prof. R. B. Owens.

Death of George Worthington

The announcement of the death of George Worthington, which occurred at Buffalo about two weeks ago, was received with genuine regret by the entire electrical fraternity. Mr. Worthington was born in East Bethany, Genesee county, N. Y., in 1844. He was a veteran of the late war, and was later engaged in various electrical pursuits, until, in 1882, he founded the *Electrical Review* of New York, when there was no other weekly electrical paper in America. Mr. Worthington developed into a good newspaper man, and he had an exceptionally wide acquaintance among men engaged in electrical pursuits. He was universally liked, and his presence was always a welcome addition to any gathering of electrical men. The deceased was largely instrumental in founding the National Electric Light association and the New York Electric club. He was also a charter member of the American Institute of Electrical Engineers. The New York Electric club has adopted resolutions eulogizing his memory.

Chicago Electric Club.

The paper read by Carl Kammeyer at the meeting of the Chicago Electric club on Monday evening last was one of the most interesting productions that have been presented this season. Mr. Kammeyer's lecture was on "Photography as Applied to the Investigation of Electrical Phenomena." The paper gave some of the results obtained by photographing various fuse wires and fuse metals while in the act of fusing or exploding under an excess of current and was illustrated by means of lantern slides which showed the results obtained under various conditions.

The lecture was discussed by Messrs. Sperry, Dow and Wirt.

CORRESPONDENCE.

New York Notes.

New York, February [illegible]. Of course, at the present time the all absorbing topic for electrical people is the consolidation of the Thomson-Houston and Edison interests. At the Edison stockholders' meeting on Wednesday [illegible], 505 shares were represented out of 150,000. The following named trustees were elected without opposition: C. H. Coster, Thomas A. Edison, J. H. Herrick, Samuel Insull, Edward H. Johnson, A. Marcus, Carl Schurz, Francis S. Smithers, Henry Villard, Samuel Spencer and J. Hood Wright. These are all re-elections, except in the case of Mr. Spencer, who is a Drexel Morgan man and takes the place of James N. Williams, a Villard man. Mr. Coster and Mr. Wright are also Drexel-Morgan men, being members of the banking firm.

On Friday at the meeting of the newly elected trustees of the Edison General company Henry Villard was re-elected president of the company. Other old officers re-elected with President Villard were as follows: Vice-president, J. H. Herrick; second vice-president, Samuel Insull; secretary, A. Marcus; treasurer and assistant secretary, F. S. Hastings; assistant treasurer, A. S. Beeves; controller, Joseph P. Ord. As was expected, Mr. Villard presented his resignation. J. Hood Wright of Drexel, Morgan & Co. offered resolutions expressingregret that Mr Villard was determined to retire from the presidency. They were adopted. It is thought that H. McK. Twombly will be elected to succeed Mr. Villard. Mr. Twombly is a brother-in-law of the Vanderbilts.

Plainfield, N. J., people are to be pitied. They do not know why, but they object to the trolley, and now a number of progressive gentlemen have introduced a bill into the legislature which, if it goes through, may force them to ride faster than heretofore has been their custom.

Commissioner Walton Storm has stated that he believed that the Board of Electrical Control would have to be continued another year at least, so that its business might be properly attended to. He said that the commissioners were kept very busy every day with applications for electric lights and subway privileges, and that this business would have to be attended to by some one.

The Suburban Electric Light company of Elizabeth, N. J., has begun the building of a line to Roselle, Crawford and Westfield, to light them by electricity. A sub-station will be established at Westfield. Ground will be broken in a couple of weeks at Elizabeth for the company's new plant on Murray street. The works will be much larger than the present plant. The company intends eventually to light up the whole of Union county when it gets the new station in operation.

A rumor comes from Asbury Park, N. J., to the effect that the Seashore Electric Railway company intends to pull up its tracks and get out of the town. The company has for the last three months been trying to get from the borough commissioners an extension of its franchise for fifty years, in order that it might float bonds and secure thereon enough money to complete a double track over the entire route. The matter, though, has not yet been definitely settled, and there is still a chance that the company will continue its service. W. F. O.

San Francisco, Cal.

San Francisco, February 11.—Two interesting stories recalled by the prominence recently given to the Edison patent for communicating between distant places without the aid of wires come from San Bernardino, one of the counties of Southern California. In the first it is claimed that the idea was not original with Edison but that it was due to a William Stout, who sixteen years ago was considered the craziest loon in San Bernardino for maintaining the possibility of telegraphing and telephoning without wires. 'Professor" Stout is said to have been a well-read, intelligent man. He made electricity and magnetism a special study and developed a number of ideas that stamped him as being almost half a century ahead of his time. The poor old enthusiast now lies in an almost forgotten grave, but his acquaintances aver that they would not be surprised to learn that many another of his advanced and apparently chimerical ideas had a solid foundation. Be this as it may hereafter, if the phenomenon related in the second story were general, Edison's patent or even the telephone would be of no service for distances of ten miles or so. Close by the town of Colton, in San Bernardino county, is a peculiar hill of solid marble known as Slover mountain. Eight or ten miles distant is the range called the Box Spring mountains. One day a hunter was

climbing these hills, and stopping to rest for a few minutes, he was startled at hearing the sound of human voices apparently coming from the clear atmosphere. No human being was within sight, and after recovering from his astonishment he broke into the conversation. An exclamation of surprise answered him, and after the interchange of a few questions and answers the Box Springs hunter learned that he was actually conversing in an ordinary tone of voice with persons on Slover mountain, at least eight miles distant. The surprised conversationalists experimented by going up and down the mountain and trying their voices at different levels, but found that only at one particular point was it possible to make each other heard. This remarkable fact was tested subsequently a number of times with success, but finally after a severe earthquake it was found that the natural telephone no longer existed.

Veteran electric light men will all remember the interest with which they watched the experiment attending the erection of the San Jose, Cal., electric light tower. It was the first structure of the kind ever built, and naturally the eyes of the electrical world were upon it. "The Pride of San Jose," as the tower is yet styled, is now the subject of fierce contention, in fact it has been such for more than two years, and to tell the story of the trouble is to relate the history of electric lighting in San Jose. In 1881 John J. Owen, then editor and proprietor of the San Jose *Mercury*, who had become interested in electricity, conceived the idea that a tower surrounded by arc lamps would afford a far more satisfactory means of illuminating the town than the gas, coal oil, tallow candles or the burning stubble fields which constituted the means then in use. The project was discussed through the columns of the *Mercury* and finally the common council gave Owen permission to erect the tower at the intersection of Santa Clara and Market streets with the understanding that the city should not be chargeable with any of the expense of its maintenance or construction. Subscriptions were then called for, and in return for money paid in Owen issued certificates of ownership in the tower, which provided that every subscriber should have a pro rata ownership in the structure. The heaviest subscriber was the California Electric Light company of this city, which, through Geo. H. Roe, its secretary and manager, subscribed $1,500 worth of iron and $1,250 in cash. As a result of the subscriptions the tower was completed early in December, 1881, and on the 13th of same month it was lighted for the first time by six 4,000 candle power Brush lamps operated from a temporary plant loaned by Mr. Roe's company, and placed in a planing mill. The experiment was eminently successful and from the 200-foot elevation the light was about half the intensity of moonlight at a distance of half a mile. San Jose took a holiday and its citizens, with appropriate ceremonies, celebrated the event that gave their city the distinction of being the finest electrically lighted one in America.

In April, 1882, the San Jose Brush Electric Light company was organized, and Owen gave a bill of sale of the tower to the company for $2 000 in cash and $3,000 in stock of the company, the cash, Owen alleges, being used in paying bills outstanding against the construction of the tower. Then followed a long and bitter rivalry between the Brush company and the San Jose Gas company, which terminated in 1889 by the consolidation of the two corporations. This combination was not satisfactory to all the stockholders, some of whom withdrew and joined forces with others, forming the Electric Improvement company of San Jose. The warfare which followed between the two electric companies was perhaps the most bitter that ever existed on the Pacific coast and includes tales of boodle and municipal corruption. When the first bids for city lighting were opened it was found that the Electric Improvement company's figure for lighting the city were $960 a year more than that of the old company, while its bid for street lighting was $11,880 higher, nevertheless the Improvement company was awarded the contract. Thereupon the president of the Brush company instituted suit to annul the contract on the ground that it had been obtained by "connivance, conspiracy, fraud and boodle." The public feeling in the matter ran so high that the hearing of the case was transferred to San Mateo county, where a judgment was rendered sustaining the contract. The old company, upon the expiration of its contract, discontinued lighting the tower whereupon the new company asked the common council for permission to take possession of the tower and light. This was promptly granted, but the Brush company with equal promptness secured a temporary writ of mandate restraining the new company from using the structure. The writ was not served, however, and on the night of February 28th last four employes of the Improvement company climbed the tower and were hard at work at their lofty elevation connecting up lamps when they were startled by the appearance of a force of men coming up the tower headed by an officer of the Brush company, who ordered the four men down, emphasizing the order by presenting a revolver in an attitude and with a look of determination that meant business. The Improvement company's men lost no time in getting down while the victors cut the wires and carried the lamps away. After midnight, however, the four men reappeared on the tower, replaced the lamps, lighted them and kept them burning until morning. Soon after the injunction was dissolved, others were issued and during their hearing the officers of both companies were fined for contempt. As the matter now stands the Brush company—now the San Jose Light & Power company—holds that it owns the tower, basing its title on the bill of sale given by Owen, upon its subsequent peaceable possession and the fact that the tower has been assessed to it and that it has paid the taxes therefor. The Electric Improvement company which figures as the defendant in the latest suit, alleges that the title to the tower is in the city; that it was built by public subscriptions as a public enterprise; that it is a part of the realty and that when the contract between the old company and the city expired the tower reverted to the city. Meanwhile the tower remains in darkness, each side is saying harsh things about the other, and each side has determined to carry the case to the Supreme Court.

The Electric Improvement company of San Francisco has obtained a temporary injunction restraining Chief Scannell of the San Francisco fire department from cutting the housetop wires maintained in violation of Ordinance 2,301. The plaintiff alleges that the wires used by them are thoroughly insulated and strongly supported and suspended at least seven feet above the roofs of buildings, with the consent of their owners. It further contend that no actual or probable danger exists to any of the buildings, or to firemen, or to any other persons by reason of such electric wires. Neither is the cost of insurance for loss by fire increased on such buildings, nor is the risk of fire increased. The corporation also alleges that there is no other practicable method of running said connecting wires which will afford equal security to persons and property. It claims that wires maintained upon poles erected upon and along sidewalks in the streets are more liable to cause danger to life and property. Notwithstanding these last mentioned facts the plaintiff avers that the Board of Supervisors has allowed the California Electric Light company to suspend its wires along the sidewalks at a much lower elevation than those maintained by the plaintiffs and has frequently refused to grant the plaintiff and other corporations the privileges granted to the California Electric Light company. S

Milwaukee, Wis

MILWAUKEE, February 13.—At the last meeting of the Common Council electric street lighting was the cause of one of the worst squabbles that that body has indulged in for some time. Ald. Lorenz introduced a resolution alleging that the public money was being squandered for the benefit of a private corporation (meaning the Badger Illuminating company) especially in the remote districts, where cheaper lights could be used. The resolution called for the appointment of a standing committee of five members, to be known as the committee on lighting streets, to which should be referred all resolutions ordering the erection or discontinance of street lights. In explaining his resolution Ald. Lorenz said that the price of electric lights ($110 per lamp per year) was too high, but nevertheless resolutions had been introduced lately ordering them by the dozen. A third of several of the ward funds, he asserted, was being spent for electric lights. His resolution and remarks aroused a storm. Aldermen jumped up on all sides and declared that nobody had a right to interfere with the ward funds. Ald. Ziegler said the resolution was an insult. He said that the city was poorly lighted and that if the alderman had his way he would order electric lamps on every street corner. Ald. Hanke moved the indefinite postponement of the resolution. Ald. Lorenz wanted the resolution referred to the committee on rules so that taxpayers could be heard concerning it. Many of the aldermen, he asserted, were incapable of taking care of their ward funds. The city needed other improvements, such as more schoolhouses, more than it did electric lights. After a heated debate the motion to indefinitely postpone the resolution was carried by a vote of 28 to 3.

Power for the Chestnut street line of the Milwaukee Street Railway company is to be drawn from the power house of the Hinsey (Milwaukee) electric railway. The work of putting in place the machinery in the immense Edison power house on River street is by no means completed yet and the plant will not be in perfect shape for more than two months. C.

Notice to Delegates.

Delegates to the annual meeting of the National Electric Light association at Buffalo will leave Chicago Monday afternoon, February 22d, and arrangements are being made for conveying them in special vestibule sleeping cars attached to the 3:10 P. M. train of the Lake Shore & Michigan Southern Railway, arriving in Buffalo at 7:20 o'clock (eastern time) the next morning. Any who find it more convenient to leave later can take the Limited at 5:30 P. M., arriving at 8:40 A. M., eastern time. Of the trains returning, the most convenient leave Buffalo at 11:50 A. M., 7:20 P. M. and 11:08 P M., all central time, arriving in Chicago respectively at 7:35 A. M., 9:30 A. M., and 3 P. M. the next day. It will thus be seen that the trip in either direction may be made in a single night's travel, an advantage that this line offers over any other of half a day's time saved on the return journey. Tickets for the round trip $18, on the certificate plan; berths $3 each way, $1 extra going on the Limited. For reservations, certificates, or any information, address John L. Martin of committee on transportation, care of Chicago Electric club, Chicago, or C. K. Wilber, western passenger agent, Chicago.

PERSONAL.

J. E. Talbot of the Fort Wayne Electric company was in Chicago last Saturday.

C. T. Gage has recently been appointed manager of the Chicago office of the Detroit Motor company.

Fred Degenhardt, Chicago, has recovered from his recent illness. His numerous friends are congratulating him.

J. W. Marsh, general manager of the Standard Underground Cable company, Pittsburg, was in Chicago last week.

President Ralph L. Shainwald of the Standard Paint company, New York, dined at the Chicago Electric club last week.

Herbert H. Brooks, general manager of the American Circular Loom company, Boston, manufacturers of wires and cables, is in Chicago.

Victor H. Peterson, who was connected with Fairbanks, Morse & Co., Chicago, for ten years, died on Thursday, February 11th. Mr. Peterson had been confined to his bed since February 6th with a severe attack of erysipelas.

Charles G Armstrong, consulting electrician for the architectural firm of Adler & Sullivan, Chicago, delivered an address on electricity, illustrated by experiments, before the Chicago Architectural Sketch club on February 8th. Mr. Armstrong gave some valuable hints on points of construction, the capacity of wires, and the use of fuses.

NEW INCORPORATIONS.

Constantine Electric company, Constantine, Mich.; capital stock, $6,000; to make and supply electric light and power; Levi T. Hull, Constantine, Mich.

Eldora Electric Light company, Eldora, Ia.; capital stock, $15,000; to erect, maintain, own and operate an electric light plant at Eldora, Ia; C. E. Albrook, Eldora, Ia.

Universal Printing Telegraph & Signal company, New York, N. Y.; capital stock, $100,000; to acquire and deal in electrical signals, printing telegraphs and railroad signals.

Negaunee & Ishpeming Electric Light company, Negaunee, Mich.; capital stock, $20,000; supplying Negaunee & Ishpeming with electric light; John B. Maas, Negaunee, Mich.

Everett Gold Mining & Milling company, Tacoma, Wash.; capital stock, $1,000,000; general mining business, electric light and gas works; A. S. Dunham, Box 936, Seattle, Wash.

Milton Electric Light & Power company, Milton, Pa.; capital stock, $40,000; manufacturing and supplying light and power by electricity in Milton; L. E. Snow, 509 Arch street, Philadelphia, Pa.

Lower Chichester Electric Light, Heat & Power company, Lower Chichester, Pa; capital stock, $1,000; supplying light, heat and power by electricity to the public in Chichester; E. H. Hall, Media, Pa.

Washington Street Railway company, Washington, Ind.; capital stock, $50,000; building, erecting, maintaining and owning an electric railway and electric power and lighting system; S. H. Taylor, Washington, Ind.

Alessandro Valley Land company, Alessandro, Cal.; capital, stock $1,000,000; to deal in real estate, improvements, product, water rights and works, gas and electric works, etc.; Walter A. Main, Redlands, Cal.

Alessandro Town company, Alessandro, Cal; capital stock, $1,500,000; to deal in real estate, improvements, water rights and works, factories, pipe lines, gas and electric works; Walter A. Main, Redlands, Cal.

Dayton Auxiliary Fire Alarm company, Dayton, O.; capital stock, $30,000; installing and operating auxiliary fire alarms, devices, and operating and dealing in other electrical supplies and appliances; Harry F. Molan, Dayton, O.

Mitchell Electric company, St. Paul, Minn.; capital stock, $15,000; to construct and operate an electric plant, deal in electricity for light, heat and power, manufacture and repair all necessary appliances used in connection with utilization of electricity, lease, purchase and sell and mort-

gage real and personal estate; H. C. Levis, 401 Sibley street, St. Paul, Minn.

Robinson Motor & Battery company, Portland, Me.; capital stock, $500,000; to manufacture and deal in all kinds of electrical machinery, rails, posts, trusses, batteries, cars, motors, dynamos, etc ; Clarence Hale, Portland, Me.

Ogden Electric Power company (incorporated in W. Va.) New York City, N. Y.; capital stock, $500,000; general mining and smelting business, erecting electric light plants, etc.; George Sullivan, 45 Wall street, New York, N. Y.

Dalles Electric Telephone & Power company, Dalles, Ore.; capital stock, $40,000; to purchase, build, equip, operate and maintain an electric light plant in and for Dalles City in Wasco county, Ore.; W. H. Wilson, Dalles, Ore.

Electro Automatic Appliance company, Hartford, Conn.; capital stock, $30,000; to manufacture, buy, sell and deal in all kinds of mechanical and electrical appliances adapted to steam engines, steamboilers, water wheels, etc.

Lincoln Street Railway company, Consolidated Lincoln Street Railway company and Lincoln Rapid Transit company, Lincoln, Neb.; capital stock, $2,300,000; to construct and maintain electric street railways in Lincoln, Neb.

Ryan & McDonald Construction company (incorporated in W. Va.), Baltimore, Md.; capital stock, $600,000; constructing railroads to be operated by steam, electricity, traction or other power; also constructing wharves, telegraph, etc ; E. J. D. Cross, B. & O. Central building, Baltimore, Md.

Central Gas, Light & Water company, San Francisco, Cal.; capital stock, $300,000; to deal in and operate waterworks in the county of San Joaquin; also gas and electric light plants, mill, timber lands. grain, warehouses, wells, personal property, franchises, stock, patents, real estate, etc.; J. M. Whitworth, San Francisco, Cal.

Madera Electric Light, Transportation & Power company, Madera, Cal.; capital stock, $100,000; to build and operate street railways for freight and passengers, electric plants, deal in real estate and personal property, merchandise, water and waterworks, packing houses, warehouses, mills, factories, etc.; Robt. L. Hargrove, Madera, Cal.

Central Electric Light & Power company, Chicago, Ill.; capital stock, $500,000; to manufacture, sell and rent light, heat and power produced by electricity or otherwise, purchase, manufacture and rent inventions, machinery, appliances, apparatus, etc., incident to the production and use thereof; George Driggs, 227 Court House, Chicago, Ill.

ELECTRIC LIGHTING.

There is talk of the erection of an electric light plant at Highland, Ala.

The city of Waynesboro, Va., is considering the erection of its own electric light plant.

The city of Salisbury, N. C., is contemplating the erection of an electric light plant.

The Moundsville, W. Va., Electric company at its last annual meeting authorized a $10,000 increase of its capital stock in order to put in a duplicate plant.

It is reported that the city of Denton, Tex , has contracted with the Denton Water, Light and Power company for the erection of an electric light plant.

A company has been organized to furnish illumination, both by gas and electricity, for the town of Calumet, near Chicago. It has a capital stock of $500,000.

A bill will be introduced in the legislature of Virginia authorizing the issuance of $100,000 of bonds by the city of Berkley for local improvements, including the establishment of an electric light plant.

A central lighting station is to be established at Sidney, Wash. The location of the plant will be near the center of the town on the water front and arrangements for the site have been concluded. The plant will cost about $12,000.

A recent fire in the electric light station at Eugene, Ore , destroyed two dynamos used in lighting the town. The damage sustained will amount to $5,000 beside depriving the town of light until new dynamos can be secured from the East.

It is reported that the Detroit Electric Light & Power company has come under the control of the Thomson Houston company. The present indebtedness of the company is said to be about $400,000, and the last inventory, it is asserted, showed that the plant is worth about $750,000.

A dispatch from Boston dated February 11th, says: Boston was in the dark to night, for the electric lights were not turned on. The heaviest snowstorm of the year set in early this morning, Telegraph, telephone, police and fire alarm wires are down, and to avoid the danger of fire from broken wires the mayor this afternoon ordered the electric light companies not to turn on the currents. The West End street railway company had a large force of men and sleds at work all day cleaning the rails and the big electric snow plows have been running all day.

ELECTRIC RAILWAYS.

The Eckington & Soldiers' Home Railway company of Washington, D. C., has applied to Congress for permission to extend its electric railroad.

An injunction restraining the People's Street Railway company of St. Joseph, Mo., from stringing wires along the Messanie street line underneath the telephone company's wires has been issued at the instance of Manager Stockwell of the St. Joseph exchange.

The Peachtree Street Electric Railroad company of Atlanta, Ga., will petition the city council for a franchise to construct an electric railroad.

The Edison General Electric company has given the electrical department of Johns Hopkins university two street car motors of 15 horse power each.

The Electric Light & Power company of Towson, Md., which has applied to the legislature for a charter, is empowered to establish and operate lines of electric railway.

The College City Street Railway company of Galesburg, Ill., is considering a change from horse to electric power, and is investigating different motors with a view to purchasing. The company operates six miles of track.

The New Orleans & Carrollton Street Railway company, which has been granted permission to construct an electric railroad, is now investigating the advantages of different ystems. The estimated cost of the improvement is $300,000.

The Jefferson Park & Chicago Electric Railway company has obtained the right of way to operate an electric street car line on Elston avenue from Jefferson Park to Addison street, and from that point east to Southport avenue, where it will connect with the proposed Chicago and Evanston electric railway, which will run between Chicago and Evanston. Electricity will be used as the motive power. It is claimed that the line will be in active operation before next fall. It is proposed to heat the cars by hot water. The road will be about eight miles long, and the running time will be forty minutes.

Car No. 102 of the Manchester line in Pittsburg, having on board thirteen new employes of the company, was wrecked on Beaver avenue on Wednesday morning of last week by the explosion of a dynamite cartridge which had been placed on the track. The explosion occurred as the car was passing the Manchester locomotive works, and, though the concussion was so severe that the car was thrown from the tracks and badly wrecked, not a person was hurt. It is thought that some over zealous sympathizer with the company's striking employes may have caused the explosion.

Electric railway interests in Baltimore are active. The Central Passenger Railway company, which lately applied to the city council for authority to use the overhead system, will be reorganized and the capital stock increased. The cost of equipping this road with electricity will be $225,000. The Baltimore, Canton & Point Breeze Railway company has applied to the city council for a franchise to build an electric railroad on certain streets. The North Avenue Electric Railway company will petition the legislature for authority to construct an elevated roadway, by means of which the center of the city will be reached. The Baltimore Traction company has secured a controlling interest in the North Baltimore Passenger Railway company, which operates 24 miles of street railway. The main lines of the system will probably be cabled and electricity adopted on the subsidiary lines.

TELEPHONE.

It is computed that the fifty long-distance lines which the American Bell Telephone company is putting up between New York and Chicago will consume 8,526 tons of copper. The total length of wire will be 98,000 miles.

It is proposed to erect telephone exchanges in the Japanese towns of Kyoto, Osaka and Kobe. The proposals are to be considered during the present session of the Japanese Diet. The estimated cost of the exchanges is $250,000.

TELEGRAPH.

Complaints are made as to the irregular working of the Turkish telegraph lines, especially those in Syria. It is said to be nothing unusual to send "telegrams" from Beyrout to Port Said by steamer.

The Spalding Telegraph company has filed articles of incorporation with the secretary of state at Albany, N Y. Its line is to begin at Ogdensburg, St. Lawrence county, and stretch from there to New York city, thence to Trenton, N. J., and across Pennsylvania to Wilmington, Del. The company starts with a capital of $1,000 only.

The telegraph station at Sewickley, Pa., on the Baltimore & Ohio railroad, was entered on the night of February 1st by two men, with the intention of robbing the express office. The telegraph operator, Silas T. Ament of Manor Station, was bound and gagged and carried to a boiler house near by, and robbed of his overcoat, money, and a gold watch. The men thrust revolvers into his face and threatened him with death if he should make a move, or give any alarm. About daybreak Ament succeeded in releasing himself by rubbing the ropes with which he was tied against a nail in the wall until they broke.

TRADE NEWS.

The Bernstein Electric company, Boston, is running the factory overtime to fill orders for incandescent lamps.

Gould & Watson, Boston, are well pleased with the orders for wire received through their branch office at Chicago.

The Redding Electric company, Boston, is busy filling a large number of orders for the watchman's electric register.

The Electrical Specialty company of Pawtucket, R. I., will be represented by F. H. Angel at the Buffalo convention. It may be mentioned incidentally that Mr. Angel will have a number of electrical novelties in his "inside pocket."

The Samson Cordage works, Boston, will probably be represented by Treasurer H. G. Pratt at the Buffalo convention.

Whitmore & Robinson, Boston, are contemplating making a change in their business location on account of increased business.

The Dow Adjustable Light company, 309 Washington street, Boston, is in receipt of a number of orders for its novel little fixture.

The Perkins Electric Switch Mfg. company, Hartford, Conn., will, in all probability, be represented at the Buffalo convention by Secretary F. W. Davis.

The shipments of the Jewell Belting company, Hartford, Conn., for the month of January, were largely in excess of those for the same month last year.

On the evening of February 26th the Brotherhood of Electrical Mechanics of Chicago will give a ball at Battery D. A display of electrical decorations is promised.

The Porter-Leavitt Electric company, Providence, R. I. is now located in its new factory building, and is in a position to meet its rapidly increasing western business.

General Manager G. H. Poor of the W. S. Hill company, Boston, states that he has several new electrical devices which will soon be placed upon the market.

General Manager L. G. Burnham of the Electric Gas Lighting company, Boston, has gone on a pleasure trip to Havana, Cuba. He is expected to return before February 20th.

The National Telephone Mfg. company, Boston, recently installed a large number of their telephones at the Jewett stock farm near Buffalo. It is expected to extend this service in the near future.

The Consolidated Electric Manufacturing company, Boston, now settled in its new quarters, exhibits one of the most complete displays of electrical goods and gas fixtures in New England.

The Newton Rubber company, Boston, is offering a line of new cells for storage battery purposes. For strength and durability these goods commend themselves as once to the purchaser desiring a first-class article.

The Shipman Engine company, Boston, has recently received a number of large contracts for its engines, an order for six as a sample lot having come from one of the departments of public works in upper New York state.

The Crocker-Wheeler Electric company during the Buffalo meeting will exhibit motors running at the office of the company's Buffalo agents, F. P. Little & Co., adjoining the Brœzel house. Otis Bros. will show a pump operated by a ½ horse power Crocker-Wheeler motor.

The Kalamazoo Electrical Supply company is installing an interesting electrical plant in the new public library building at Kalamazoo, Mich. The building will have all modern improvements, and this plant will be one of its most interesting features. George H. Meeker, Chicago manager of the New York Insulated Wire company, has secured the contract for a complete electric conduit system in the building. Black core wire in Vulca ducts will be introduced throughout the building.

The Lodge & Davis Machine Tool company, Cincinnati, has just closed a contract with the state college of Kentucky at Lexington, to furnish an equipment of improved machine tools for the new mechanical hall. This is the leading university of Kentucky, and elaborate preparations are being made for the instruction of pupils in machine designing and construction, as is demanded by the latest shop practice. The wood working department is already in operation, and as soon as the iron working shops are fully under way the faculty can offer students the best possible advantages for gaining a thorough mechanical knowledge, as all machinery and appliances are of the latest improved design.

Chas. A. Schieren & Co., New York, have just issued a catalogue that cannot fail to be appreciated by customers. The success of the house is largely due to the fact that it is constantly studying the demands of the trade, and the catalogue is an evidence of a close attention to detailed information. Special attention is called to the "electric" and "perforated electric" belting, also to the new improved "round solid" leather belts. All of the Schieren leather belting is made from pure oak (bark) tanned leather, which is tanned in the oak bark regions of Pennsylvania, Maryland, West Virginia and Tennessee. The company has enlarged its lace leather tannery in Brooklyn, and now its facilities are of the very best.

The Rockford Electric Manufacturing company, Rockford, Ill., manufacturers of the Mayo system, has presented to the trade its catalogue for 1892. The company explains that its aim always has been to make machines of the simplest and most efficient type; in other words, machines that will not require an expert electrician to look after them, but can be tended by any mechanic or engineer. Superintendent Geo. A. Mayo needs no introduction to electrical people, having been in the front rank of electrical engineers ever since the infancy of the business, and every machine is built and tested under his personal supervision. This close attention to details of course enables the company to produce the most excellent work.

A friend of Superintendent W. R. Brixey, of the Kerite Works, Seymour, Conn., claims for him the distinction of having produced the heaviest and largest vehicle of its

class that has ever been turned out. Returning recently from a European tour, Superintendent Brixey brought back an idea of this rolling monster, and Messrs. Hall & Godfrey have produced what is claimed to be the heaviest draft wagon in America. The vehicle has a freight capacity of 35 tons of kerite from the manufactory to freight depot, and is hauled, it is said, by ten teams of horses. Many novelties were seen by Mr. Brixey while abroad, but a genuine surprise was reserved for his return to Connecticut. He is quite proud of his "ozonator."

BUSINESS.

Fletcher's sleet proof "sure grip" lamp support and Fletcher's sleet-proof pole pulley are kept prominently before the trade by the Electrical Supply company, Chicago.

Manager Paul G. Fiedler of the Boston Braid Manufacturing company was in New York last week. Mr. Fiedler will represent his company at the coming convention.

The Chicago Electric Motor company, Springer building, Chicago, is having a very satisfactory run on repair work in different lines, having found it necessary recently to employ a largely increased force of workmen. The rewinding and repair of heavy armatures is made a specialty.

The Decker Electrical & Novelty Manufacturing company has recently been organized in Detroit by C. H. Decker, a gentleman well known in the electrical trade. This company has a number of novelties and electric specialties that will undoubtedly make the foundation of a profitable business.

The Eddy Electric Mfg. company, Windsor, Conn., is working an average of 14 hours a day in order to meet the demands for new machinery. This company, it will be remembered, recently received, through its western agent, G. A. E. Kohler, the order for the generator which will furnish power for the Love underground electric railway conduit now building on the North Side, Chicago.

J. M. Fisher, manager of the Mosher Arc Lamp company recently received a very interesting letter giving an account of the opening night in a Chinese theater in Canton, China, when several of the Mosher lamps were used in different parts of the house. The fact that a new light as "large as the moon" was to be used on the occasion was widely advertised and the letter states that a crowd of at least twenty thousand people were in attendance.

Jas. G. Beckerleg, Chicago, is having a very active demand for his back pressure valve. Among recent purchasers are the following: Forest City Electric Light & Power company, Rockford, Ill.; Missouri Steam Heating company, St. Louis; Illinois Malleable Iron Works, Marshall Field & Co., and S. W. Lamb & Co., Chicago. Mr. Beckerleg has arranged to make these valves on a large scale, and is prepared to supply even the larger sizes on short notice.

Although the firm of Alfred F. Moore of Philadelphia, manufacturer of insulated electric wires and cables, have discontinued its western agency in Chicago, the users of "Moore's wire" will not be materially delayed in the receipt of supplies, as this concern has a reputation for quick shipment of all orders for regular goods. This house is one of the oldest in this line, and one of the largest, and for years its goods have had an excellent reputation. All correspondence sent direct to the Philadelphia office will receive prompt attention.

The Union Electric Works, Springer building, Chicago, are securing a number of wiring contracts and are introducing into apartment houses several novel devices. One of these appliances includes a letter box and annunciator system. A push-button in connection with the annunciator can be operated by the visitor and enables him to ascertain whether the occupant is in the room or not without making a trip to the top of the building. This apparatus has recently been put into a number of fine apartment houses in Chicago, and is giving general satisfaction.

The La Boiteaux Electric Motor & Fan company, Cincinnati, is making preparations on a large scale for placing on the market during the coming season a novelty in the way of a ventilating motor fan. There will be two patterns made, one of which can be placed on a stand or desk, in the center of the room, the entire machinery making a complete revolution every few seconds, throwing the air in every direction. The other fan is to have an oscillating movement, and can be fastened to the wall at any angle. Mr. Varwig, a prominent Cincinnati capitalist, is at the head of this company, and John Maxwell is business manager.

J. L. Somoff of New York recently installed a plant in Mr. Wilmerding's house on Ninety-third street, New York, consisting of 250 miniature one candle power lamps of low voltage. The lamps were connected in series of ten on a 110 volt circuit. From ten to fifteen of these lamps were distributed in each room, and were inclosed in colored Japanese lanterns, making a very pleasing effect. The expense for such a plant, it may be mentioned, amounts to no more than in a case of 16 candle power lamps which require 3-10 ampere. Mr. Somoff also furnished a diamond dealer in Minneapolis, Minn., with some of his "grain" lamps, which are used to show the brilliancy of his diamonds. The lamps are placed in close proximity to the gems, but are hidden from view, and the light is concentrated upon the stone by a miniature reflector.

G. A. Harter, manager of the Electrical Construction company, 43 45 Franklin street, Chicago, has a large amount of work now under contract which indicates the approach of a very active season. Among the recent contracts closed by this company and now well under way are the following: Leiter building, State street, Chicago, to be occupied by Siegel, Cooper & Co., wiring for 15,000 incandescent and 400 arc lights, making one of the largest plants in a single building in the world; Victoria Hotel, Chicago, wiring for 2,400 incandescent lights, with a National generator and complete electrical equipment; Lexington Hotel, Michigan avenue and Twenty second street, Chicago, wiring for 3,600 incandescent lights, with a generator made by the Akron, O., Electrical Manufacturing company, with a complete electric equipment; the Equitable Life Insurance building, Des Moines, Ia., wiring for 1,500 incandescent lights, with generator. In addition, this company has on hand a large number of small contracts.

The Kartavert Manufacturing company of Wilmington, Del., offers to consumers the product of fiber known as "Kartavert." Many attempts have been made to produce an article for the purpose for which Kartavert is designed, but the imperfections and want of uniformity of these products have greatly limited their usefulness. Kartavert is insoluble in hot or cold water, benzine, turpentine, oils, ether, bi-sulphide of carbon, and other solvents. Acid and alkalies affect it but slightly. It resists the entrance of oils. It does not ignite readily, and will withstand a high degree of heat. Contact with water will not affect it, but if soaked for some time, it will swell slightly, but will resume its original size on drying. It can be glued to itself or other substances. It has, practically, no cleavage, nor stratification, and is very tenacious. Kartavert is classified as hard and flexible. Hard Kartavert holds an intermediate position between metal and the various ebonites and plastics. In its physical properties it somewhat resembles horn. It is very strong and tough, and is not readily fractured by a blow. Flexible Kartavert differs materially from the hard, and is not applicable as insulation. It is an excellent substitute for leather, which it somewhat resembles. It is not injuriously affected by hot or cold water, oil, ammonia, or resinous substances. For car-box washers and cap-packings, hot and cold water packings, compression washers, valves and packings for air pumps and for carriage axle washers, it is said to be unsurpassed. Kartavert is made into sheets, rods and tubing, and in three colors, indian red, white and black. The weight of a cubic inch is a trifle less than 4-5 of an ounce.

ELECTRICAL STOCK MARKET.

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, February 13th, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	102½	103
Edison Illuminating company of New York	80½	81½ Ex. Div.
" " " Brooklyn	72½	77½
" " " Boston	100	105
" " " Chicago	130	140
Edison Ore Milling company	15	20
United States Electric company of New York	15	25
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomson-Houston Electric company	51	52
" Preferred "	26	27
Westinghouse Electric company	13	13½
North American Phonograph company	2½	5
New York " "	2½	5
Automatic Exhibition company	2	3

ELECTRICAL PATENTS.

Issued Feb. 9, 1892.

468,336. Trolley Wire Support. Jonathan P. B. Fiske, Lynn, Mass.

468,338. Magnetic Toy. George A. Goodson, Minneapolis, Minn.

468,388. Elevated Electric Conduit. Charles O. Newton, Homer, N. Y.

The fifth claim reads as follows:
"An elevated structure having a central inclosed space and a wire way therein, a footwalk alongside thereof, and a branch structure having an inclosed wire way, with wires connected to the wires in the main structure, and having a footwalk connected to the main footwalk."

468,411. Carbon Holder for Arc Lamps. Samuel P. Parmly, Chicago, Ill.

Claim two is:
"The combination of a carbon-rod with a carbon-holder, the two connected by a swivel-joint, said holder provided with two channels and a thin separating rib, so as to receive two carbons side by side, a temporary or spring clamp for each of the carbons, and a single permanent clamp for both of the carbons, so that either may be independently adjusted, but both may be simultaneously locked in a fixed relation."

468,412. Arc Light Globe Holder. Charles A. Pfluger, Chicago, Ill.

468,413. Arc Light Hanger for Inside Use. Charles A. Pfluger, Chicago, Ill.

468,414. Electric Alarm Clock. William S. Burroughs, St. Louis, Mo.

468,416. Dynamo Electric Machine. George E. Dorman, Chicago, Ill.

The claim reads:
"In a multipolar dynamo machine a cross-connecting device consisting of a drum within the armature, said drum having thereon a series of insulated rings, each ring provided with a series of bars connected to its outer edge and running parallel with its axis, securing bands which pass longitudinally about the rim of such drum, and securing the rings and surrounding rings which pass about and secure the bars."

468,426. Electrically Heated Smoothing Cylinder. Willis Mitchell, Malden, Mass.

468,440. Automatic Sprinkler System. Charles L. Fortier, Milwaukee, Wis.

468,444. Burglar Alarm. Isaac L. Silverberg, Moses Reichman and Gustavus Troxler, Jr., Newark, N. J.

468,451. Magneto Electric Machine. John Hunt, New York.

468,473. Repeater for Electric Circuits. Moses G. Crane and Frederick W. Cole, Newton, Mass.

The ninth claim reads as follows:
"The combination of a number of main-circuit magnets in independent main circuits, with a relay and local circuit therefor, and circuit breakers controlled by the several main-circuit magnets and arranged in series in said local circuit, as described, and independent circuit closers in said local circuit at each main-circuit magnet, adapted to be operated to close said local circuit when the circuit breaker controlled by the corresponding magnet remains in abnormal position beyond a predetermined period of time."

468,474. Combined Switch and Switch Box. Albert L. Rohrer, Lynn, Mass.

468,487. Electric Lighting System. Sylvanus L. Trippe, New York, N. Y.

468,492. Electric Motor Truck. Francis O. Blackwell, Boston, Mass.

468,497. Lightning Arrester. Elihu Thomson, Lynn, Mass.

The third claim is:
"A lightning arrester, consisting of a form or support of plastic insulating material having conducting particles molded in its surface and arranged contiguous to one another, but not in actual contact, so as to form a succession of small disruptive spaces in the discharge-path."

468,500. System for Operating Glow Lamps by Means of Multiphase Currents. Johannes F. H. Gorges, Berlin, Germany.

468,526. Motor Gearing for Electric Cars. Elbert B. Phillips, Cleveland, Ohio.

468,540. Ore Separator. Henry Cane, Spokane Falls, Wash.

Claim two reads:
"In a magnetic ore separator, a magnetic drum, an endless belt passing thereover, a band roller and a supplemental guide-pulley, a supplemental endless belt located beneath said guide pulley and main endless belt, a washing and receiving trough located under the lower extremities of both endless belts, and a washing and collecting trough located beneath said magnetic drum and the upper end of the supplemental endless belt."

468,575. Electric Railway System. William J. Ogden, Baltimore, Md.

The claim is:
"In a double-track system for street railways, the combination of a single conductor centrally located between the tracks and having two contact edges and a width to permit two trolley rollers in contact with opposite edges of said conductor to freely pass each other without contact between them and without leaving the conductor, and arms hinged to the cars, respectively, and each carrying a trolley roller which rests removably in contact with said conductor."

468,585. Electric Cable. William Vogler, Somerville, Mass.

468,597. Electrical Indicator. Marion A. Deuel, Rochester, N. Y.

468,599. Magnetic Separator. Erminio Ferraris, Turin, Italy.

468,654. Electric Connector. George Gibbs, Milwaukee, Wis.

468,686. Electric Governor. John T. O'Brien, Kearney, Neb.

This invention consists in the combination of a curved solenoid, a curved perpendicular armature, a series of contacts, a circuit closer and opener operated by the perpendicular armature, a series of resistance coils and a series of electro-magnetic cut-outs; also in the combination with the perpendicular armature of an air dash-pot for modifying its movements.

468,690. Ring Armature. John G. Poole, New Haven, Conn.

468,697. Resetting Device for Annunciators. Ralph A. Schoenberg, New York, N. Y.

468,700. Device for Preventing Shadows of Electric or other Forms of Lamps. James B. Sheldon, St. Louis, Mo.

468,706. Magnetic Extractor. Horatio W. Southworth, New York, N. Y.

468,708. Electric Railway. Charles W. Thomas, Jersey City, N. J.

468,711. Electric Arc Lamp. Addison G. Waterhouse, Hartford, Conn.

468,716. Electric Motor. James T. Wilson, Tyrone, Pa.

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468,752. Rheostat. Alton J. Shaw, Muskegon, Mich.

468,753. Apparatus for Stopping Engines or other Motors. Jacob P. Tirrell, Boston.

468,755. Telegraphy. William F. Wentz, Newark, N. J.

468,772. Insulator Coupling. Louis McCarthy, Boston, Mass.

468,773. Insulating Coupling. Louis McCarthy, Boston, Mass.

468,774. Machine for Marking Mail Matter. Martin V. B. Ethridge, Everett, Mass.

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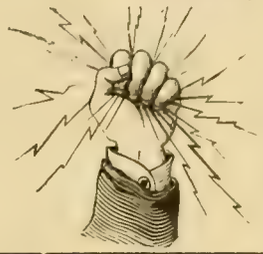

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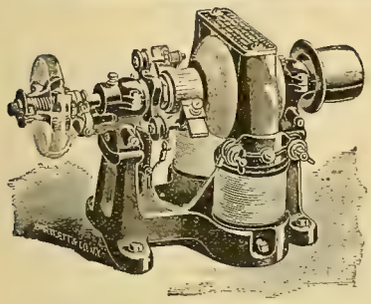

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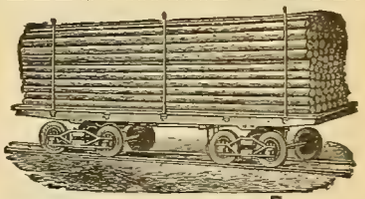

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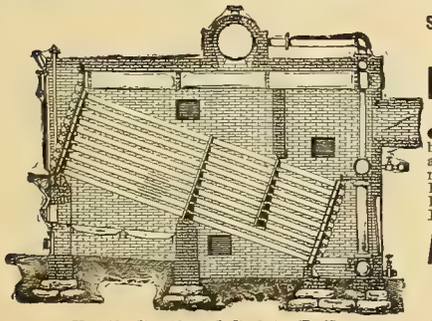

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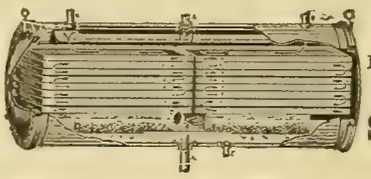

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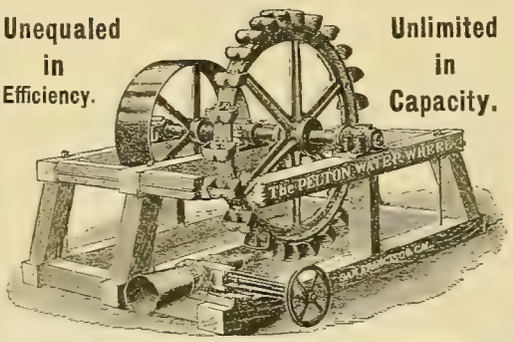

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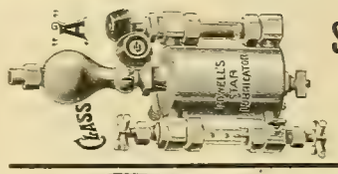

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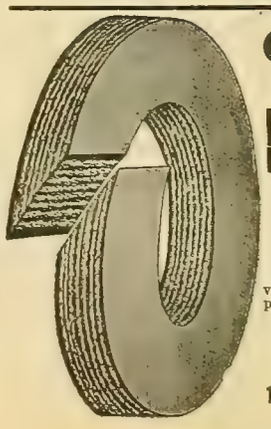

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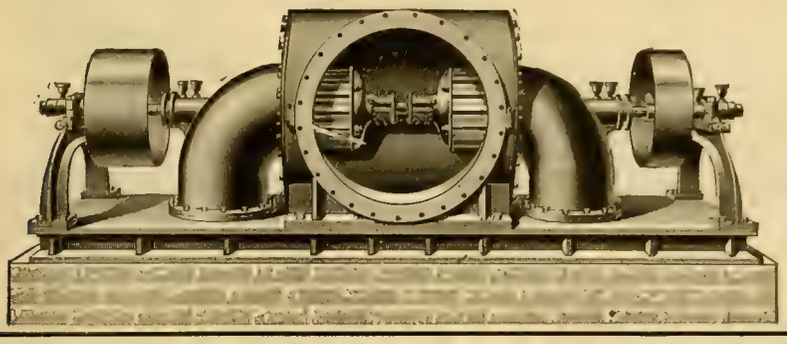

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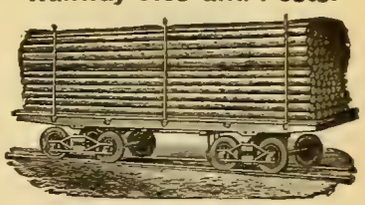

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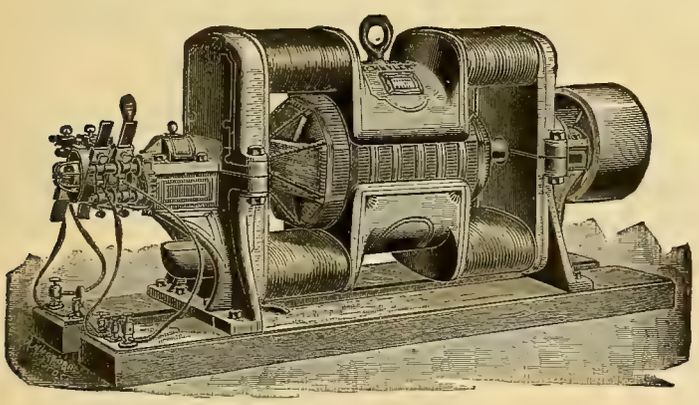

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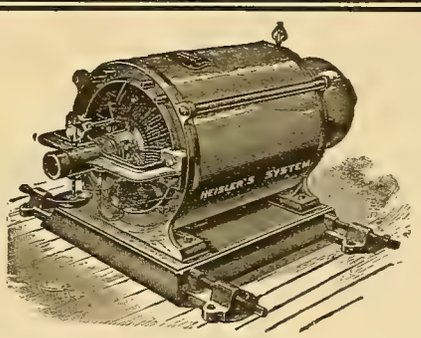

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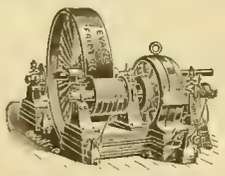

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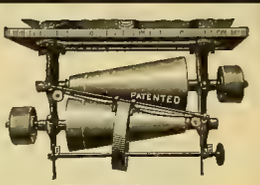

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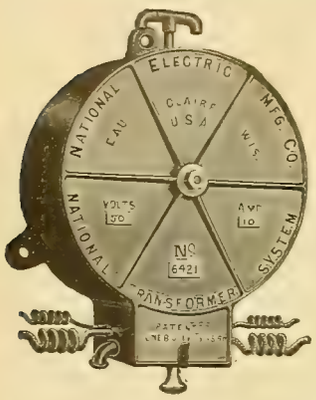

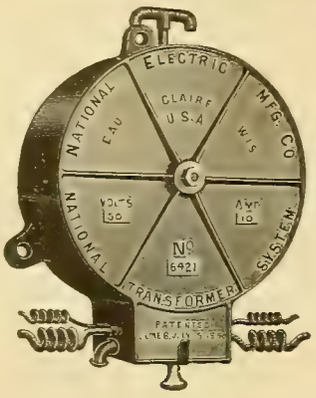

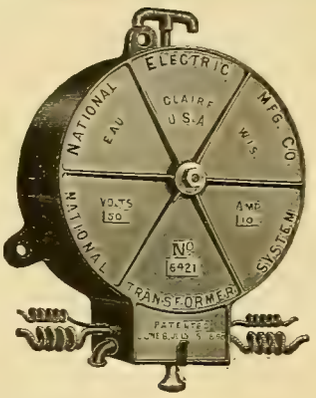

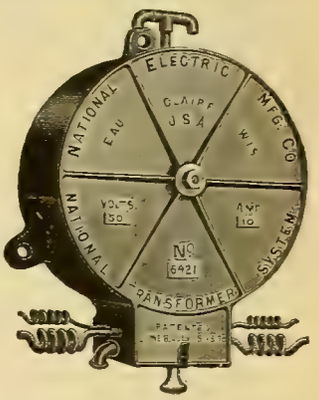

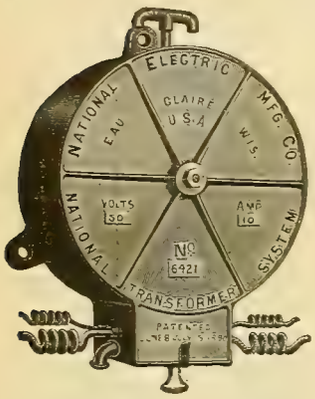

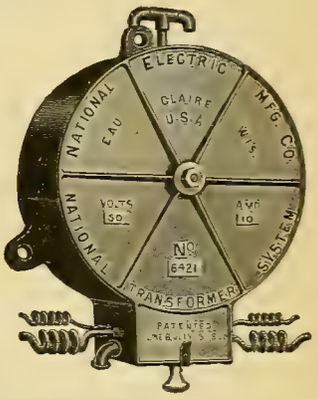

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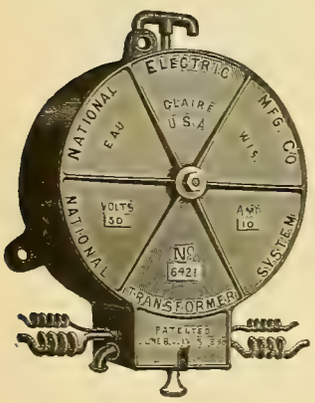

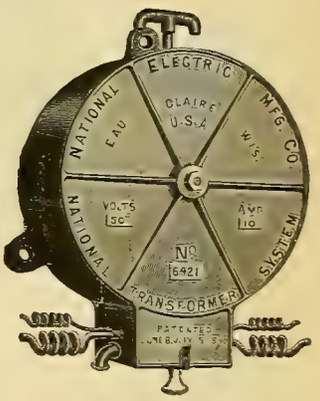

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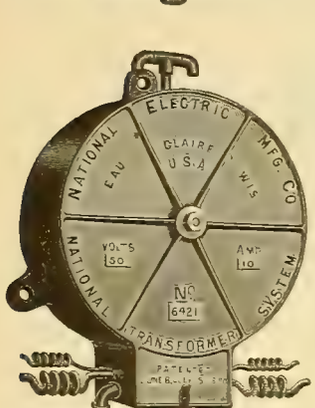

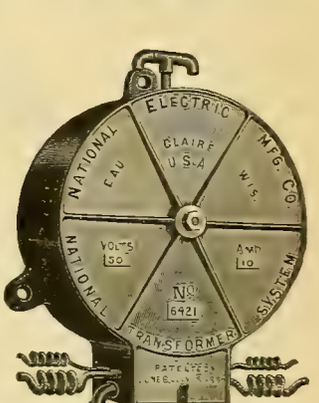

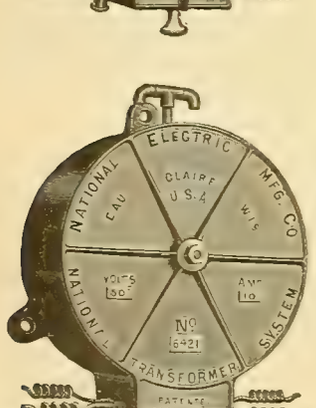

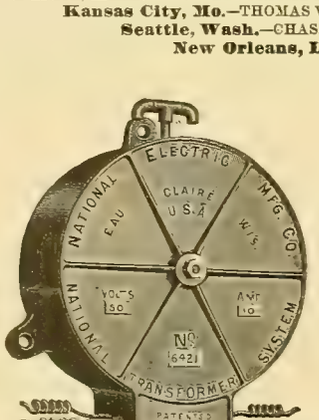

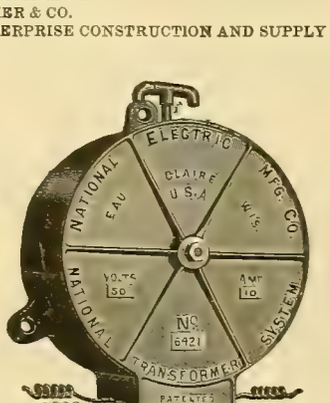

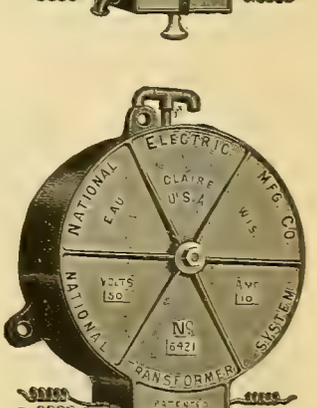

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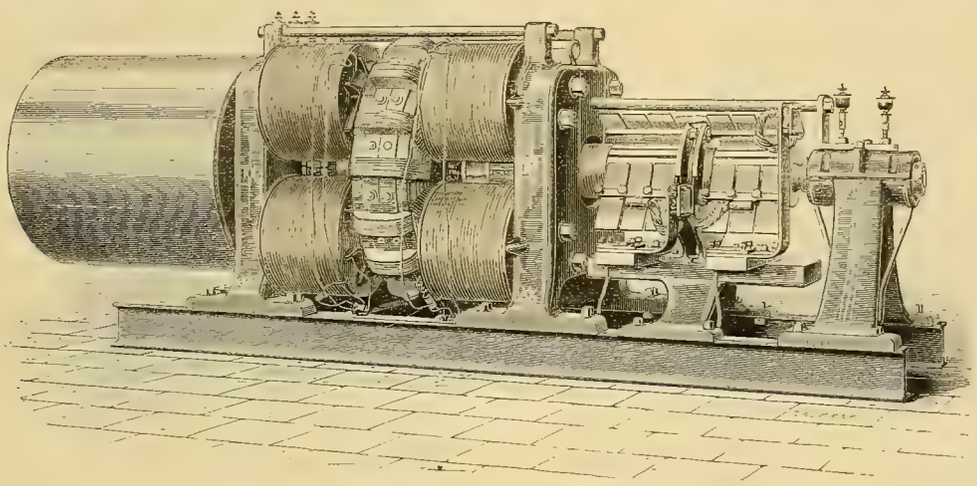

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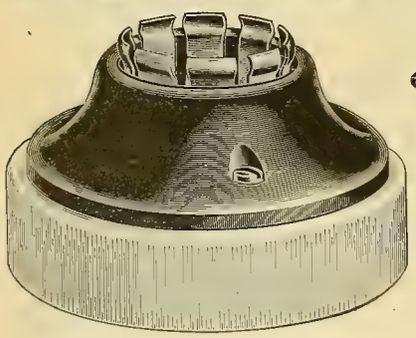

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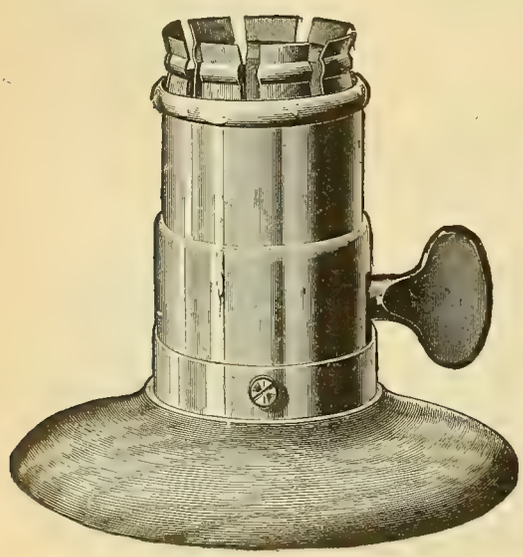

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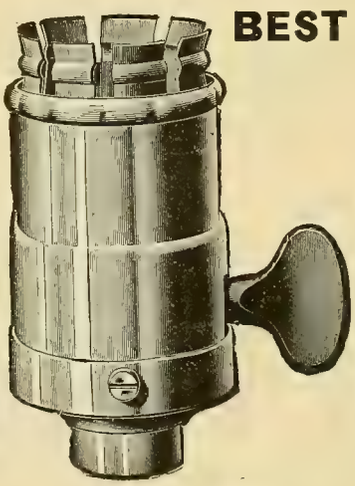
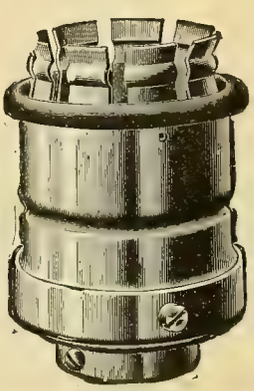


No. 110. Key Socket.



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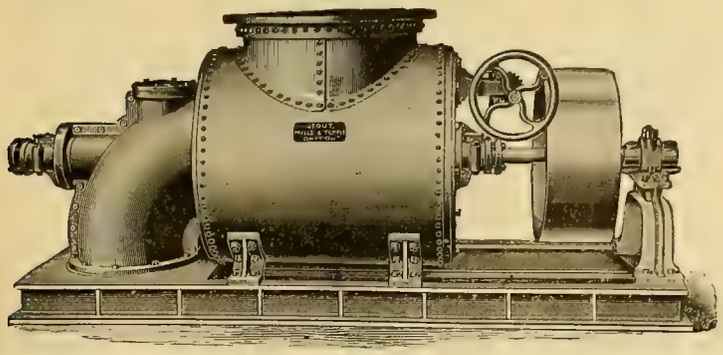

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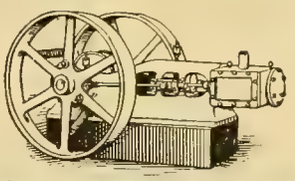

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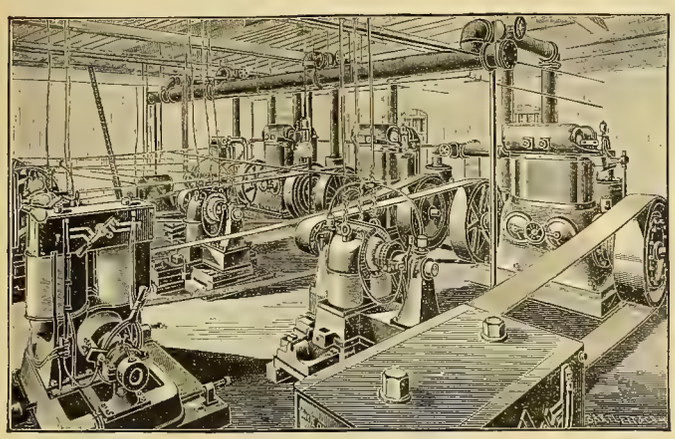

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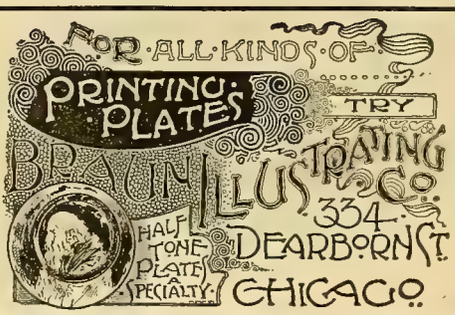

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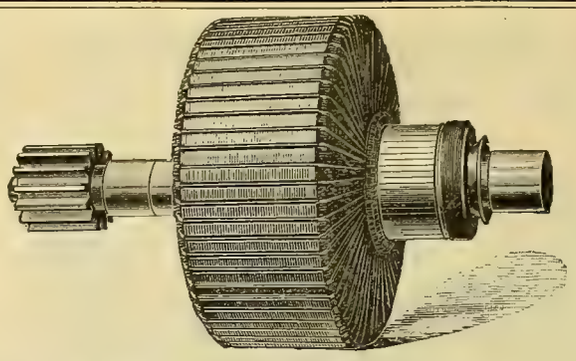

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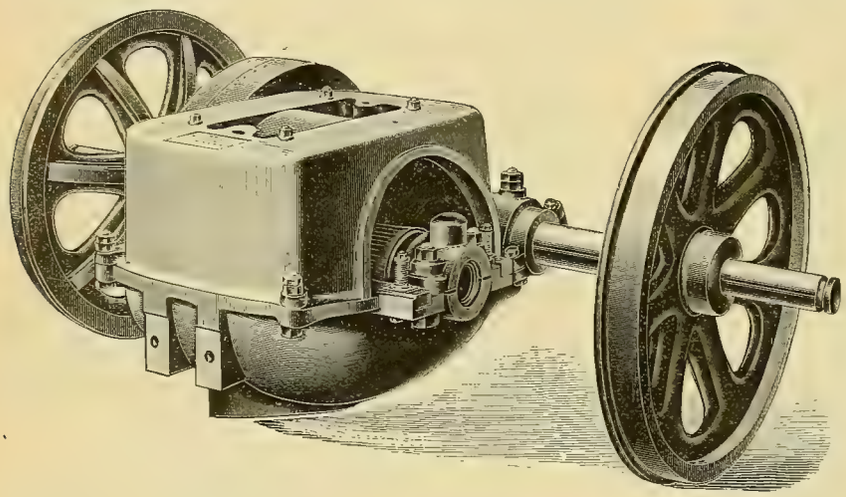
HAVE PLACED UPON THE MARKET A

NEW STREET RAILWAY MOTOR.



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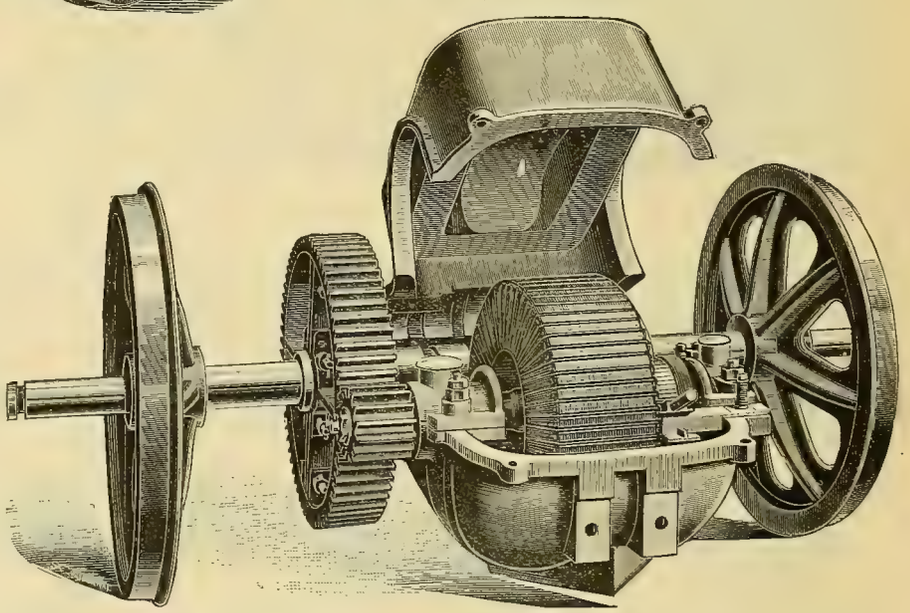

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1st Fact: The Perkins Incandescent Lamps have a higher efficiency than any lamp on the market. We would like to send you a barrel, if you are not already using them. We know you will never regret it.

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5th Fact: Last but not least. We want your business.

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The Wirt Improved Dynamo Brush.

NO SPARKING OR CUTTING OF THE COMMUTATOR.

READ WHAT PRACTICAL USERS SAY ABOUT IT.

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GENTLEMEN:—We have been using four No. 32 Wirt Dynamo Brushes for about a month. We find that they do not spark at all and cause but little wear on the commutator, keeping the surface of the latter smooth. The Wirt Brush is entirely satisfactory, and superior to any we have used. Yours truly,

THE CHICAGO COPPER REFINING CO.,
W. I. HITT, Sec'y.

THE COLUMBIA,
LEADING THEATER OF CHICAGO.

THE ELECTRICAL SUPPLY CO., Aug. 23, 1891.

GENTLEMEN:—The brushes are running with much less sparking than any I have ever tried. Evidently they are an improvement.

Respectfully, GEO. CARSON.

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GENTLEMEN:—We have been running your brushes on our Edison Dynamo for two months and find they are a decided improvement.

HENRY MUNSTERMAN,
Chief Engineer.

CHICAGO, Aug. 22, 1891.

THE ELECTRICAL SUPPLY CO.,
Michigan Avenue and Randolph Street, Chicago.

GENTLEMEN:—We have used a set of your Wirt Brushes on an Edison Dynamo, and have had no sparking and scarcely any attention required during that time. The brushes furnished by the makers of the same dynamo were always more or less troublesome, and required frequent resetting and dressing of the commutator. I would now consider it a hardship to be obliged to use the old brushes.

Yours truly, (Signed) R. C. PAGE,
Engineer Libby Prison Museum.

MARYSVILLE, O., Jan. 2, 1892.

THE ELECTRICAL SUPPLY CO., Chicago, Ill.

DEAR SIRS:—The brushes came in good order, and after giving them a trial I find them to be the best brushes we ever used, as they run smooth and do not cut the commutator, or spark. We will order more. Very truly, R. TURNER,
Chief Engineer Marysville Light & Water Co.

WEST KENTUCKY INSANE ASYLUM,

HOPKINSVILLE, KY., Dec. 20, 1891.

THE ELECTRICAL SUPPLY CO, Chicago.

GENTLEMEN:—Having used your Wirt Brushes for over a month, I am satisfied they are all that you claim for them. Please send me your general catalogue. Yours respectfully,

JNO. G. LUTZ.

CHICAGO, Nov. 19, 1891.

THE ELECTRICAL SUPPLY CO., Chicago, Ill.

GENTLEMEN:—After trying one set of your Patent Dynamo Brushes, I have put them on all three of our incandescent dynamos, and like them so well that I would not be willing to use the old style of brush again. Yours truly,

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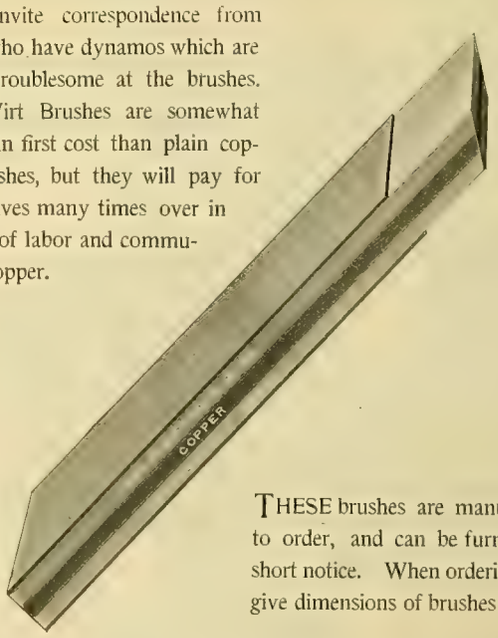
GENTLEMEN:—I am much pleased with the Brushes. I gave them the most severe test I know of, placing them on a commutator where *even carbon* brushes were not successful in reducing the sparking, and where there was a very heavy current at high potential, with a constant "chewing" up of the copper. Your Brush has eliminated all trouble, and I have asked our Company to order a number of them, when I shall use them on our other dynamos.

Yours truly, R. H. STERLING,
Electrician Denver Consolidated Electric Co.

WE invite correspondence from those who have dynamos which are at all troublesome at the brushes. The Wirt Brushes are somewhat higher in first cost than plain copper brushes, but they will pay for themselves many times over in saving of labor and commutator copper.



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To the gallon.
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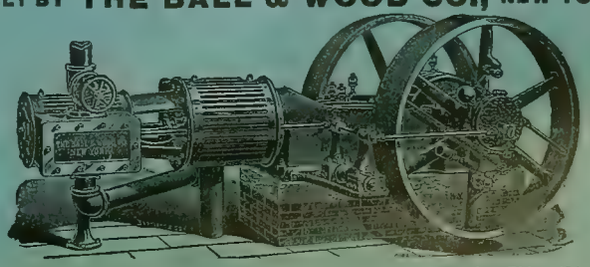

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Telephones, Electric.
Detroit Electrical Works.
Western Electric Co.

Test Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Detroit Electrical Works.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Stilwell & Bierce Mfg. Co.

Typewriters.
Densmore Typewriter Co.

Water Wheels.
Pelton Water Wheel Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works
Roeblings Sons Co., J. A.
Sperry Elec. Mining Machine Co.

Short Railway Generators

ARE NO LONGER A NEW TYPE. THEY ARE

STANDARD,

And the record they have made for themselves cannot be surpassed. Inquire in Rochester, Jamestown, Covington, East Liverpool, Muskegon.

The Jamestown Street Railway Company report as follows: JANUARY 6, 1892.

* * * * * * * * * * * * * * * * * * *

On Sunday morning last it commenced snowing very hard, and so continued all day Sunday, Sunday night and Monday. We were obliged to put forth every effort to prevent blockading of the road, which we succeeded in doing.

* * * * * * * * * * * * * * * * * * *

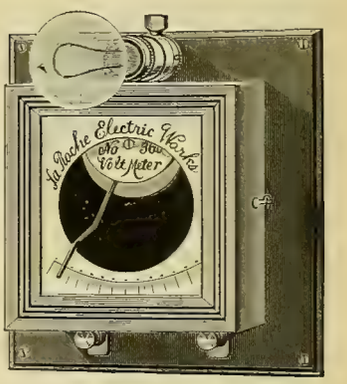
On Sunday morning we started your Generator No. 2 at 6:30 a. m., and continued to use the same until Tuesday morning at 3:30 a. m, when we shut it down. This Generator was in continuous service during the entire time, and was not even sanded, nor the brushes touched. It did not use to exceed one-half quart of oil. We consider this remarkable because of the hard work the Generator was doing. * * * * * * * *

Yours very respectfully, GEORGE E. MALLBY, Superintendent.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, OHIO.

ON TOP!



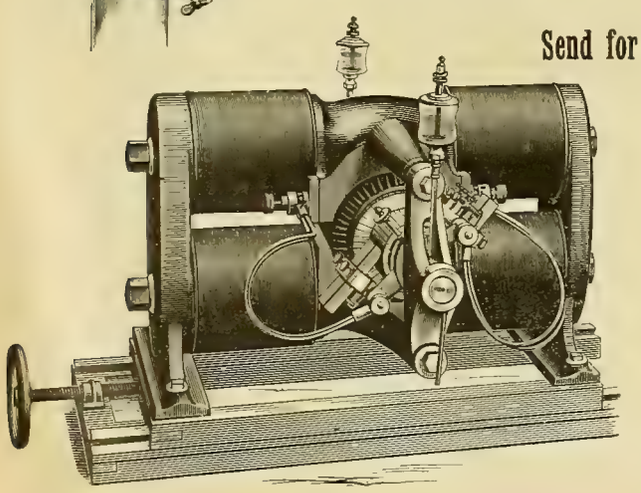
ALTERNATORS FOR CENTRAL STATIONS.
MOTORS FOR ANY CIRCUIT.
DIRECT CURRENT DYNAMOS of all sizes for ISOLATED LIGHTING.

LA ROCHE ELECTRIC WORKS,

116 & 118 North Sixth Street, PHILADELPHIA, PA.

Send for Our New Catalogue.

Agents Wanted in all Parts of the Country.



OKONITE TRADE MARK

WE HAVE

OKONITE TRADE MARK

C-A-R-L-O-A-D-S

Of moulded carbons, plain or coated.

THOUSANDS

Of Bryant key and keyless sockets, and wall sockets for all standard systems.
Bryant double pole switches. Paiste switches. Main and porcelain branch blocks.
Swan tied and loose filament lamps, all voltages.

MILLIONS

Of feet of Okonite wires, and——*Well, send us your orders, and see how quick WE CAN FILL THEM.*

OKONITE TRADE MARK

CENTRAL ELECTRIC COMPANY,

OKONITE TRADE MARK

116 and 118 Franklin St.,

CHICAGO.

OKONITE TRADE MARK

THE "WARD" LAMP

Of the standard type, to run on incandescent circuits, direct current, has been before the electrical trade for a little over two years.

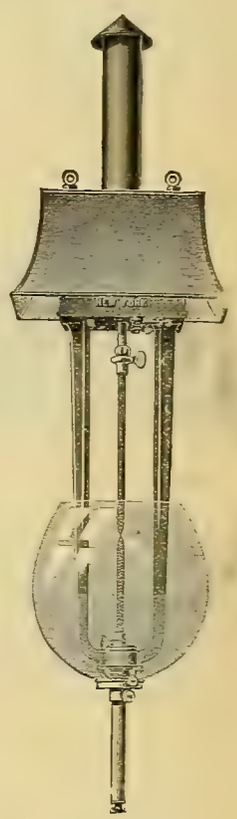
Within that time many thousands of this type have been installed and satisfactorily operated.

It is the only lamp for this purpose, none other having met with even ordinary success.

There are to-day a large number of central stations throughout the United States which are using from one hundred to a thousand "Ward" Lamps each, in connection with their incandescent plant.

The installation of isolated plants on which the "Ward" Lamps are in operation have increased rapidly during the last year, and we are at liberty to refer to many isolated plants, on which there are from fifty to two hundred "Ward" Lamps in operation.

From time to time the Company has brought out and put on the market different styles of lamps to be operated on constant potential circuits, among which styles are the railway lamps to run ten in series on 500 volts, each lamp being provided with an automatic resistance equal to the resistance of the lamp, by which means the resistance in the line is kept constant; the alternating current lamp for use on alternating incandescent circuits, runs in multiple arc on 50 volts; a line of focusing lamps adapted to the different uses of photo-engraving, theatrical side lights, stereopticon work, search lights, etc.



LAMP AND HOOD

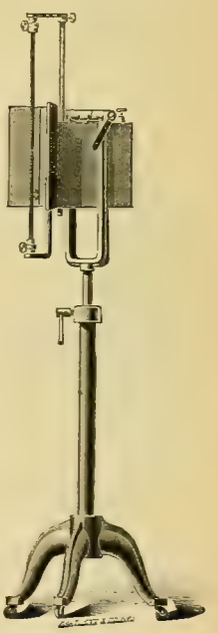


PHOTO-GRAVURE LAMP.

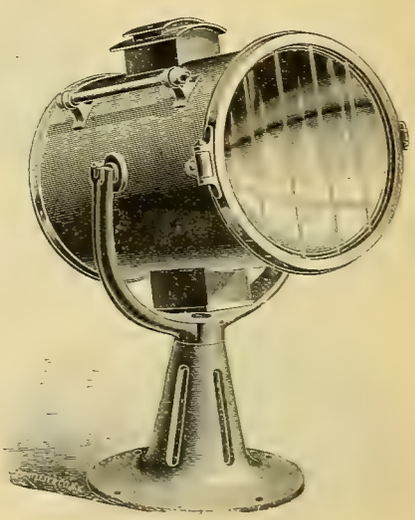
ORGANIZED 1881.
INCORPORATED 1883.

HERBERT TORREY, PRESIDENT.
R. B. COREY, GEN'L MGR.

THE ELECTRIC CONSTRUCTION AND SUPPLY CO.,

MANUFACTURERS OF

ARC LAMPS.



SEARCH LIGHT.

NEW YORK.
TELEPHONE BUILDING.

CHICAGO.
PHENIX BUILDING.

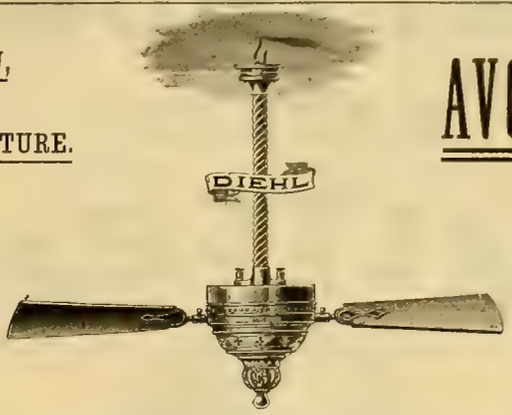
"AN OCTOBER TEMPERATURE IN MIDSUMMER."
THE DIEHL ELECTRIC MOTOR FANS

INSURE PERFECT VENTILATION,
FREEDOM FROM FLIES,
DELIGHTFUL TEMPERATURE.

AVOID SHAFTING AND BELTING,
ALL ANNOYANCES,
DISFIGUREMENT.

PROFITABLE TO HANDLE.

REQUIRE NO ATTENTION.



OUR CUSTOMERS OUR STRONGEST ENDORSERS.

CORRESPONDENCE SOLICITED.

DIEHL & COMPANY, ALL KINDS OF ELECTRIC FANS, **385 Broadway, N. Y.**

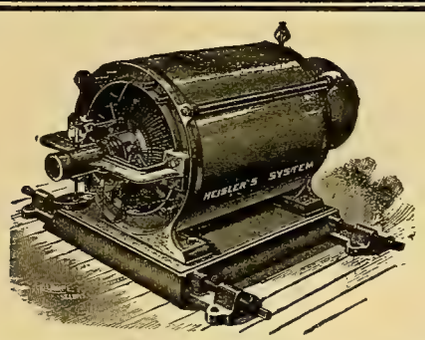
HEISLER ELECTRIC CO.,

DREXEL BUILDING, PHILADELPHIA, PA.,

MANUFACTURERS OF THE ONLY

LONG DISTANCE SERIES

Incandescent Lighting Apparatus



THAT IS SELF-CONTAINED, AND ABSOLUTELY AUTOMATIC IN REGULATION.

Noted for Brilliancy of Light and Great Efficiency.

—ALSO—

Series Sockets and Lamps for Arc Light Circuits.

SEND FOR CIRCULAR.

READ THIS!

IT SPEAKS FOR ITSELF.

The Wightman Electric Manufacturing Company

Scranton, Pa., Oct. 26, 1891.

The Standard Paint Co.,
2 Liberty Street.
New York.

Gentlemen:-

Owing to the absence of the writer from the factory, your letter of the 15th inst. has remained unanswered. We now hasten to reply to same.

We take pleasure in saying that your P. & B. Armature Varnish, Insulating Compound, and Tape have always proved just what you have claimed for them, and wherever we have recommended them they have met with the same favor. The P. & B. Tape is especially adapted for making waterproof joints, if properly applied.

Yours very truly,

THE WIGHTMAN ELECTRIC M'F'G CO.,
Oscar Urban
Superintendent.

P. & B. Insulating Compounds, Armature Varnish and Waterproof Tape.

The Standard Paint Co., 2 Liberty St., New York, N.Y.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

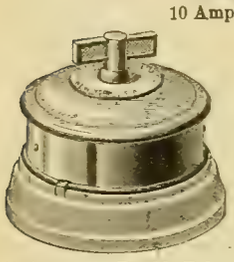
EDISON
PATENT
RATCHET
SWITCHES.

5 Amperes — Single Pole.

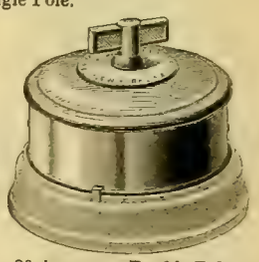
10 Amperes—Single Pole.

10 Amperes—Single Pole.

5 Amperes—Single Pole.


15 Amperes—Double Pole.

40 Amperes—Double Pole.


20 Amperes—Double Pole.

INCOMBUSTIBLE.

10 Amperes—Double Pole.

PORCELAIN BASES.

10 Amperes—Double Pole.

INSTANTANEOUS.

Special attention is drawn to our new style **FIVE** and **TEN** ampere, single pole switches. They are SMALL, NEAT, HANDSOME, and surpass all others of similar capacity on the market.

EDISON GENERAL ELECTRIC COMPANY.

FOR PRICES ADDRESS NEAREST DISTRICT OFFICE.

DISTRICT OFFICES:

CANADIAN: Edison Building, 77 Bay Street, Toronto, Can.
CENTRAL: 173 and 175 Adams Street, Chicago, Ill.
EASTERN: Edison Building, Broad Street, New York.
NEW ENGLAND: 25 Otis Street. Boston, Mass.
PACIFIC COAST: Edison Building, 112 Bush Street, San Francisco, Cal.
PACIFIC NORTHWEST: Fleischner Building, Portland, Oregon.
ROCKY MOUNTAIN: Masonic Building, Denver, Colo.
MEXICAN AND SOUTH AMERICAN DEPARTMENT: Edison Building, Broad Street, New York.
EUROPEAN OFFICE: 34 Victoria Street, Westminster, London, S. W., Eng.

IMPERISHABLE

UNDERGROUND.

RESISTS

ACIDS.

The Indurated Fibre Pipe

—FOR—

ELECTRICAL SUBWAYS.

143 Liberty Street, Room 336,

NEW YORK CITY.

EASILY

LAID.

PERFECT

INSULATION.

TAKE A GOOD LOOK

AT THIS

TRADE MARK.

It will be to your interest to have it on every coil or reel of high grade insulated wire that you buy in future.

TRY THE NEW KERITE AND YOU WILL BE CONVINCED.

Factory: SEYMOUR, CONN.
W. R. BRIXEY, Supt.

Eastern Office: 16 Dey St., NEW YORK.
W. H. ECKERT, Gen'l Agent.

WESTERN OFFICE: 225 DEARBORN ST., CHICAGO.

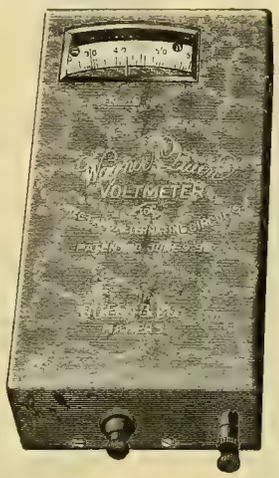
F. W. CUSHING, General Western Agent.

QUEEN & CO., PHILADELPHIA.

We beg to call attention to our great variety of Ammeters and Voltmeters for Central Station Switch-boards, for Isolated Plants, for Street Railways, for Marine Installations, for portable use, for direct currents, for alternating currents, for constant work, for experimental purposes, for accurate measurements, and for practically all the conditions which arise. Some of our specialties in this line are illustrated herewith. Correspond with us before ordering Measuring Instruments.

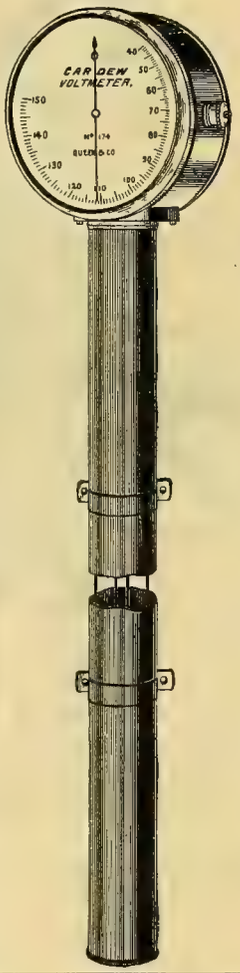
Wagner-Queen Voltmeter.

A new type of portable voltmeter, which is direct reading for both *alternating* and *continuous* currents. It is compact, durable, constant, accurate, dead-beat and low in price. Designed especially for testing voltage in consumers' houses and along the line. An indispensable instrument.



Other Apparatus.

Besides Ammeters and Voltmeters, we have a full line of Galvanometers, Resistance Boxes, Testing Sets, Testing Batteries, Photometers, Tachometers and in fact every instrument which an electrician requires in making measurements of current, E. M. F. and resistance.

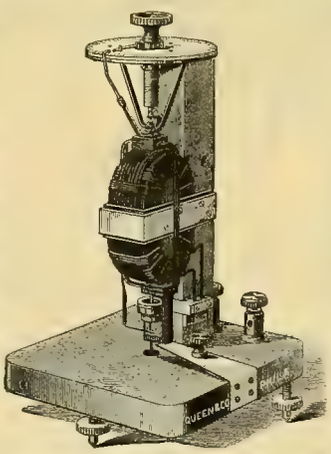


Cardew's Patent Voltmeter.

We beg to announce that we have acquired the American Patents which cover this celebrated instrument. It is too well known to need description here, but we wish to emphasize the fact that it is the recognized standard voltmeter for both *alternating* and *continuous currents*. The indications are extremely accurate, and the scale is direct reading under all circumstances. An entire absence of magnets, no temperature correction, dead-beat pointer, constancy of calibration and the fact that it can be depended upon, make the Cardew of great value to those who appreciate a strictly first-class instrument. By means of extra resistance tubes, it is possible to calibrate these voltmeters up to 1,500 or 2,000 volts, for measuring primary alternating and arc circuits of high potential.

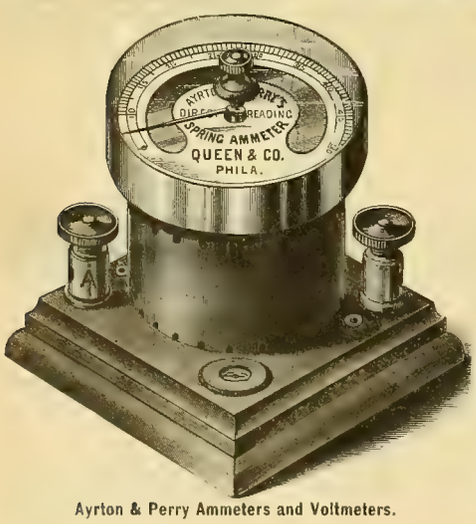
Queen's Electro-Dynamometer.

This instrument measures either *alternating* or *direct currents* with absolute accuracy. It is a means of saving much expense when used as a standard with which to compare the ordinary commercial ammeters. Especially recommended for laboratory work where the closest results are necessary.



Suggestions.

Our wide experience frequently enables us to offer suggestions to intending purchasers as to the best instruments for a specific purpose. We shall be pleased to answer such inquiries and also to send our handsomely illustrated catalogue No. I–66 to interested parties. When writing please mention the WESTERN ELECTRICIAN.



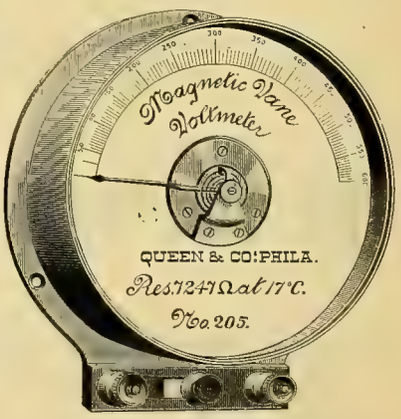
Ayrton & Perry Ammeters and Voltmeters.

Ayrton & Perry Ammeters and Voltmeters.

These are portable instruments for direct currents, which have been largely used both in this country and in England. They contain no permanent magnets, are unaffected by dynamos and have direct reading, proportional scales. We are closing out our present supply at prices *one-half what they were one year ago.*

"Magnetic Vane" Ammeters and Voltmeters.

Especially adapted for Central Stations and Isolated Plants. They are excellent commercial instruments, being handsome in appearance and sufficiently accurate for all but the most exact work. They contain no permanent magnets nor delicate parts, and have wide, open scales. The prices are very low, considering the product.



Magnetic Vane Ammeters and Voltmeters.

THE DENSMORE.

THE WORLD'S GREATEST TYPEWRITER.

Official Typewriter of the Convention.

In Operation on the Great New York Electrical Special.

Convention Headquarters, Iroquois Hotel.

Densmore Typewriter Company, 202 Broadway, New York.

C-S SPECIALTIES.

C-S Reflector Shade.

Made of Aluminum with ground glass diffusion plate. A strong white light exactly where needed, and nowhere else. A soft white light throughout the room. Quadruples the effective light of any lamp.

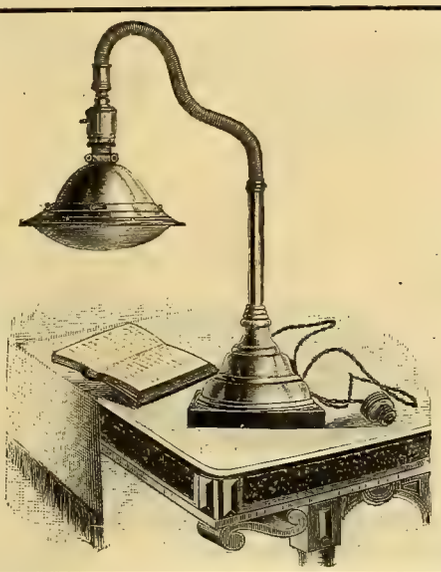
C-S Portable Lamp Stand.

Has flexible arm which holds lamp indefinitely in any position at will. Arm indestructible and may be curved or coiled into an endless variety of graceful shapes.

The Cutter Electrical & Mfg Company,

27 SOUTH 11th STREET,

Philadelphia, - Pa.



COMPLETE STOCK OF ELECTRIC RAILWAY SUPPLIES.

TROLLEY WIRES,		TROLLEY POLES,
SPAN WIRE,		TROLLEY BASES,
FEEDER WIRE,		TROLLEY WHEELS,
GUARD WIRE,		TROLLEY HARPS.
MAGNET WIRE,		TROLLEY SPRINGS,
FUSE WIRE,		TROLLEY CORD,
SWITCHES,		BEARINGS,
CROSS-OVERS,		BUSHINGS,
TURN-OUTS,		GRAPHITE BUSHINGS,
INSULATORS,		RUBBER BELLS,
TROLLEYS,		FEEDER BELLS,
POLES,		CHICAGO CLAMPS.
POLE BRACKETS,	ELECTRIC HEADLIGHTS,	INSULATING TAPE,
PULL-OVERS,	GEARS, PINIONS,	EYE BOLTS,
POLE RATCHETS,	RAWHIDE PINIONS,	TURN BUCKLES,
STRAIN CLAMPS,	RESISTANCE BOXES,	PORCELAIN KNOBS,
CURVE INSULATORS,	STATION EQUIPMENT,	PORCELAIN CLEATS.

ELECTRIC MERCHANDISE CO. 11 ADAMS ST. CHICAGO U.S.A. ELECTRIC RAILWAY SUPPLIES EXCLUSIVELY FOR ALL SYSTEMS SEND FOR CATALOGUE W.H. MASON, GEN'L MGR.

THE LA BOITEAUX ELECTRIC MOTOR & FAN CO.

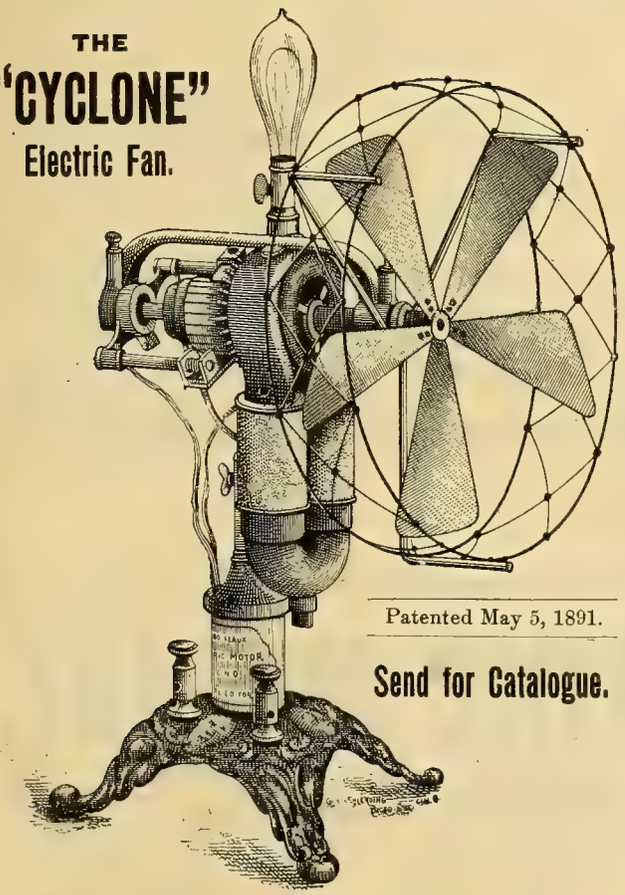
The La Boiteaux Electric Motor and Fan.

Patented May 5, 1891.

THE

"CYCLONE"

Electric Fan.



Patented May 5, 1891.

Send for Catalogue.

The superiority of these Electric Fans, compared with any heretofore invented, is in our Patent Oscillating and Rotary motions, which, while creating a current of air, distributes same so equally, that the temperature is the same in all parts of the room, at the same time overcoming the objections and unhealthy effects of being under a continuous current of cool air, as produced by the ordinary Revolving Fans.

They are also entirely noiseless, and do not create the unpleasant grinding sound usually accompanying the motion of the ordinary Centrifugal Fan.

The accompanying cut illustrates our Patent Electric Fan with Rotary Motion, as adapted for use in Offices, etc.

This style is constructed to rest upon an Enameled Iron Pedestal, or may be set on the top of partitions usually in offices to divide same into compartments. While the **Fan** is in motion, **the Motor as well as the Fan revolves on their base at the slow speed of Ten Revolutions per Minute** (while the speed of the Fan is 2,000 Revolutions per Minute), the double motion thereby causing a cool wave of air, the effect of which can be readily felt at a distance of ten yards from the Motor in all directions, and it is distributed in such a gradual manner, that the unpleasant effect of a continuous current in one particular spot is overcome.

The Oscillating Fan is constructed to be placed on a sideboard, shelf, or elsewhere against the wall. The speed of the Fan is the same as in the preceding style, viz., 2,000 revolutions per minute; but in place of the Motor and Fan revolving on the center of its base, it has an Oscillating motion, **from right to left in a half circle,** thereby distributing the air throughout the room equally in all directions, with the same effect as the Rotary motion style.

They are furnished **with or without** the Electric Lamp attached, as desired.

All our Motors can be attached to any incandescent circuit by a flexible cord, and may be moved at pleasure to any part of the room.

All Motors carried in stock are wound 110 volts constant potential.

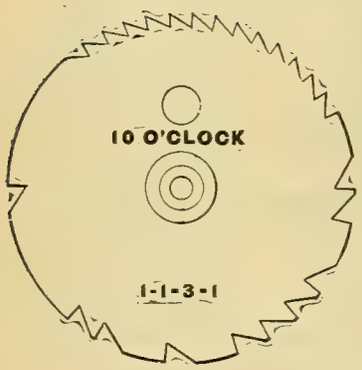
THE LA BOITEAUX ELECTRIC MOTOR & FAN CO., 376 Walnut St., Cincinnati, O., U. S. A.

Individual Arc Light and Motor Cut-Out.

EACH CLASS HAS ITS OWN "COMBINATION."

EASILY APPLIED.

INEXPENSIVE.



Saves Mileage of Circuits.

Secures Payment for all Current used.

Gives Central Station Control of every Lamp.

Makes Scattered Business Profitable.

MONEY-SAVING.

RELIABLE.

Individual lamps or Motors, or groups of these, cut in and out at will from Central Station, without affecting others in same circuit.

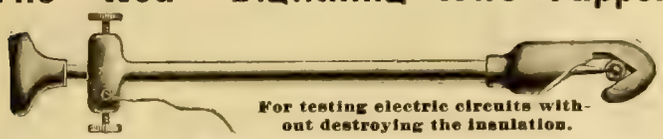
For Terms and Particulars, Address

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY, NEW YORK.

THOMAS STURGIS, President. *WM. C. LANE,* Sec'y and Treas. *C. P. MACKIE,* Gen'l Manager. *S. S. BOGART,* Gen'l Agent.

The "Neu" Lightning Wire Tapper.



For testing electric circuits without destroying the insulation.

USE IT ONCE

AND YOU WILL WONDER

How you ever got on without it.

FOR SALE BY ALL ELECTRIC SUPPLY DEALERS, OR BY

G. S. NEU, 110 Centre Street, NEW YORK.

THE CRESCENT INSULATED WIRE AND CABLE COMPANY,

MANUFACTURERS OF

SEAMLESS RUBBER.

FACTORY AND MAIN OFFICE:
TRENTON, NEW JERSEY.

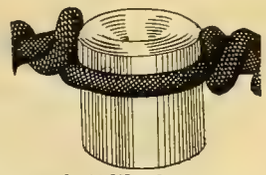
THE JOHN A. ROEBLING'S SONS' COMPANY,
GENERAL WESTERN AGENTS,
171 and 173 Lake St., CHICAGO, ILL.

Modern.

LATEST IN INSULATORS.
PRICES REDUCED.
One-Half Former Quotations.

Write for price and particulars.

SECURITY INSULATOR CO.,
136 Liberty St., New York.


Antediluvian.

FOR SALE CHEAP!!!

Four 400-light, 240 ampere, Thomson-Houston Incandescent Dynamos, 110 volt.
Two 25 light, 2,000 c. p. American Arc Light Dynamos.
One 50-light, 2,000 c. p. Sperry Arc Dynamo.
700 Goose Necks, T.-H. Municipal Sockets, Shades, etc., complete.
45 miles No. 10 Wire, American Electric Co.'s make, used about nine months.
One 10-light Weston Arc Machine, with 8 double lamps, 2,000 c. p., A 1.
Twelve 12-light Knowles 2,000 c. p. Arc Dynamos.
100 2,000 c. p. Schuyler Arc Single Lamps.
Ten 3 h. p. Daft Motors, 220 volt, new.
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Sixty 2,000 c. p. Single American Lamps.
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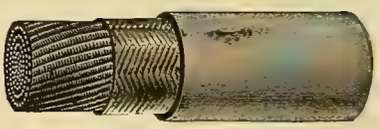

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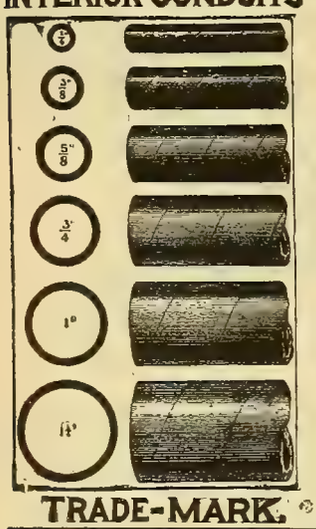

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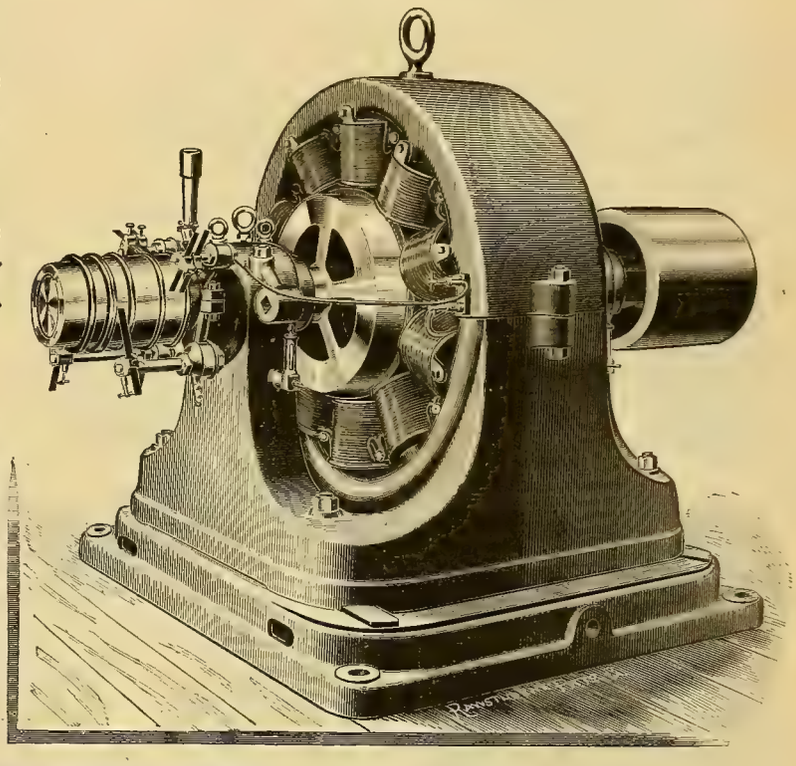

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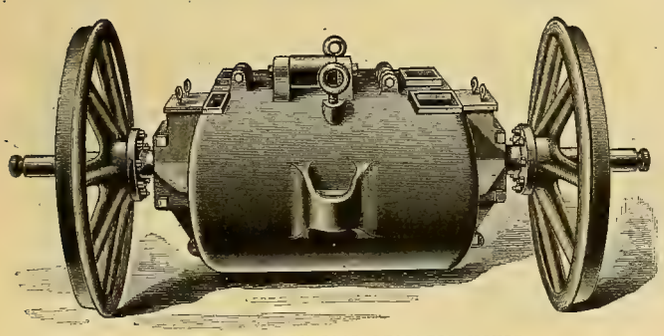

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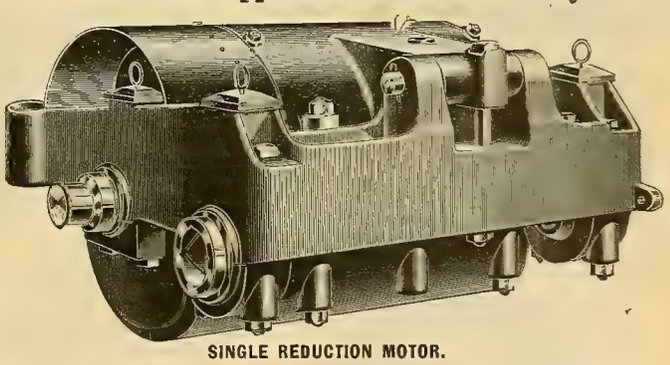

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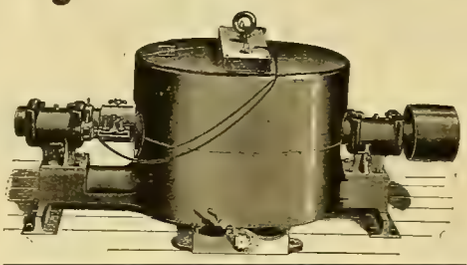

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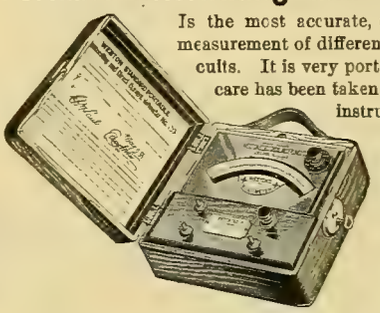

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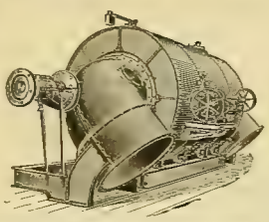

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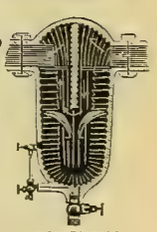

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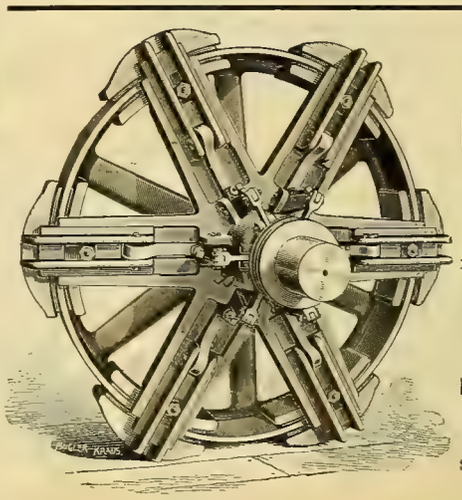

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Vol. X. CHICAGO, FEBRUARY 27, 1892. No. 9

Electricity at the World's Fair.

The illustration on this page gives an excellent idea of the appearance of the electricity building at the World's Fair as it looked on the day when the photograph was taken—February 9th. Although work on this building has lagged somewhat in comparison with what has been accomplished on the other buildings now under way at Jackson Park, much progress has been made in placing the steel trusses in position. These arches form the skeleton of the great building, and an idea of their size can be gained by noting the comparative minuteness of the men who were at work upon them when the photographer took the picture.

Contractor Johnson's reports to the committee on grounds and buildings show that 77 carpenters, 37 laborers and 32 iron workers are employed on the building. The lumber placed in position amounts to 2,639,809 feet, and 28 trusses are in place, leaving only the center diagonal arches yet to be erected, and for these the wood work is already in position. The contractor estimates that all the iron and wood work will be finished by May 1st. This, however, does not include the roofing, which is provided for by a separate contract. The general features of the design of the building have several times been described in the WESTERN ELECTRICIAN.

Col. R. C. Clowry, one of the directors of the World's Columbian Exposition and chairman of the committee on electricity, made a speech at the recent annual dinner of the officers of the Western Union Telegraph company in New York that was the feature of the evening. The colonel gave a description of the proposed electrical features of the fair and of the electricity building. His speech was listened to with much attention, and great enthusiasm was manifested.

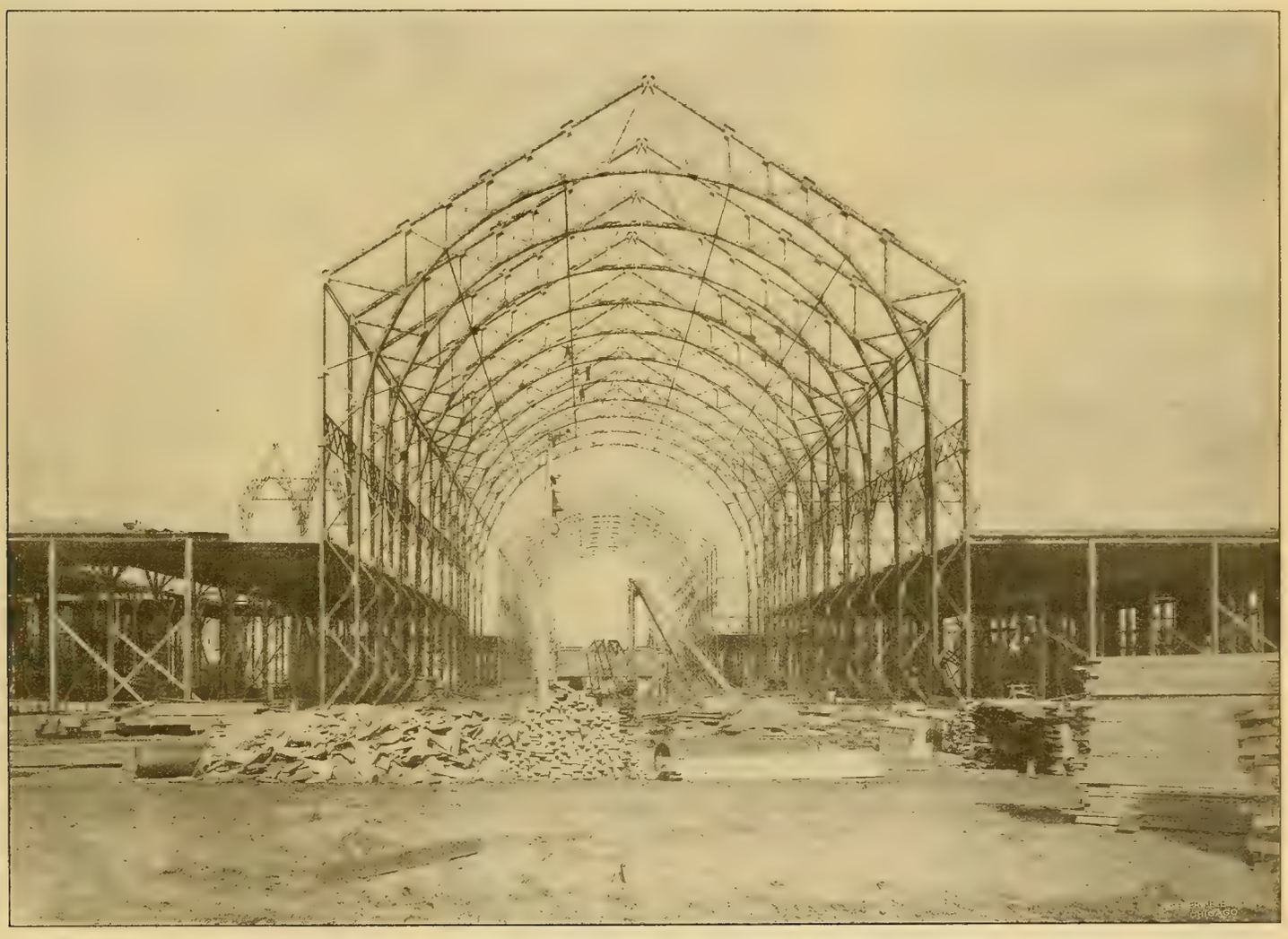
Printed copies of the prospectus of the electrical department will soon be issued.

Foreign manufacturers intending to make electrical or other exhibits should obtain copies of the "New Regulations Governing the Free Importation of Articles for Exhibition at the World's Columbian Exposition." No customs duties will be collected by the government on foreign articles sent to the exposition for exhibition unless they are sold. Secretary Foster of the Treasury Department at Washington, announces that "it is the purpose of this department to secure expedition and security to all articles imported for exhibition at the Chicago exposition, without the exaction of customs duties, fees or charges, and to arrange the proceedings on entry so as to afford the utmost convenience and dispatch." That this result may be attained the regulations referred to have been drawn up and printed in pamphlet form, and can be obtained on application.

In the recently issued prospectus of the department of transportation there is this reference to electric railway exhibits: "Street railways—surface, underground and elevated—are to be shown very completely in this department. Everything relating to their permanent way and equipment is here included, with the single exception that electric motors must be shown in the department of electricity. Cars and other supplies for electric roads belong in this department—a division which, while seeming to be arbitrary, is evidently necessary."

One of the questions in dispute between the National Commission and the directors of the World's Fair has been settled. It is in relation to the transportation, housing, reception and handling of exhibits. At a joint conference of representatives of both bodies it was agreed that the work be done by the local corporation, subject to the supervision of the director-general.

The London *Electrical Engineer* of February 5th says: "Intending exhibitors must not tarry if they mean to obtain space at the World's Fair. The date fixed for receipt of applications is the 29th of February, and after that date applications can only be received subject to space being available. The London office is at the Society of Arts, Adelphi." This applies only to British exhibitors. While it is greatly desired that all applications should be in at the earliest possible date so that the allottment of space may be begun, applications for space will be received and filed at the electrical department for some weeks to come. Arrangements have been made whereby provisional applications can be sent in. This allows the prospective exhibitor to withdraw his application, in whole or in part, should he find himself unable to make a display at the fair.



ELECTRICITY AT THE WORLD'S FAIR.—PRESENT APPEARANCE OF THE ELECTRICAL BUILDING.

In speaking of the steam and electric plant for the Masonic Temple, *Iron Age* says that it is estimated by competent and well-informed engineers that the power plants now installed in the office buildings of Chicago would aggregate almost if not quite as much horse power as one of the largest and best equipped steel rail works.

Central Stations of the Brush Electric Light Company of Buffalo, N. Y.

During the last year, to meet the steadily increasing demand for light, the Brush Electric Light company of Buffalo, has extended its central station on Maurice and Elk streets in East Buffalo so as to give a new engine room and additional accommodation in the dynamo room. A Corliss engine of 1,500 horse power capacity has been put down, and the necessary foundations provided for the 1,000 horse power engine, which is about to be moved from its present position, and put down alongside the new engine.

This station at present supplies 1,200 arc lamps, the majority of which are used for public lighting in the South Eastern district, covering an area of about 18 square miles. The average length of each of the seventeen circuits is six miles, or twelve miles of wire, giving a total length of over 200 miles of wire.

A 1,000 horse power Corliss compound condensing engine has supplied the power since July, 1889. The cylinders of this engine are 26 inch by 52 inch by 48 inch, and are arranged in the tandem form with a receiver on the high pressure cylinder, into which the steam discharges from the high pressure cylinder, and after encountering a worm, fed from the main steam pipe, passes into the low pressure cylinder in a dry condition, thus effecting a considerable saving, and doing way with all priming. The cylinders are steam jacketed, and the steam from them and that from the main steam pipe is returned to the boilers by means of a Westinghouse steam loop of 1¼ inch iron pipe. A jet condenser of 32x12 inch stroke receives the steam from the low pressure cylinder, the power for driving the injection, air and boiler, feed pumps being derived from the main line of countershafting. The fly wheel of this engine is 24 feet in diameter, with a 60-inch face, and running at a speed of 72 revolutions per minute, drives the 54-inch leather belt on the main line of shafting.

The new 1,500 horse power Corliss engine is very similar in detail to the older one, with the exception of the arrangement of the cylinders which are in this case abreast or "twin." The cylinders have diameters of 30 inch and 60 inch respectively, with 60 inch stroke, the fly-wheel having a diameter of 28 feet, with a 76 inch face, and rotating at a speed of 65 revolutions per minute, drives the main line of shafting by a 72-inch plain leather belt. The condenser in this case is driven by a separate engine, but the arrangement of the steam receiver is precisely similar to that in the 1,000 horse power engine. As evidence of the very substantial character of the work a brief description of the foundations will be interesting.

The foundations are built on a bedding of crossed timbers 12x12 inch, and on them 12-inch of concrete made from broken stone and Portland cement. The foundation bolts are in 4x4 inch wooden boxes with 18x18 inch iron anchor plates in pockets of sufficient size to permit inspection of the nuts. Over 200,000 hard-burnt bricks and 650 barrels of Portland cement were used, and it is pretty safe to say that whatever happens to the rest of Buffalo these foundations are going to remain right there.

In the boiler room are placed six 200 horse power boilers of the National water tube type, supplying steam at a pressure of 130 pounds to the main line of steel spiral weld 14 inch piping after passing through a Westinghouse steam separator, Snow duplex pumps supplying the water from the Buffalo creek, which passes at the immediate rear of the building. Coal and stores are readily obtained from the special track of the Buffalo Creek railroad which runs to the station, thereby saving many difficulties and expenses in transportation.

In the dynamo room are placed eighteen 65 light Brush machines, one 70 light Western Electric, and one 80 light Wood machine. These are grouped in fours, with the usual regulating devices and ammeters, and are driven by means of a plain leather belting from the 7 inch line of countershafting by Hill clutch pulleys which permit of any machine being started or stopped independently of the others. A view of this room is presented in Fig. 1.

The oiling of the main bearings of engines, dynamos and countershafts is accomplished by means of an oil tank, placed at a height sufficient to insure a good head, from which the oil passes to the various bearings by means of iron pipes, and, after passing through, is returned to the tank by a small centrifugal pump driven from the main line of shafting, and after passing through a strainer again returns to the bearings. Great economy and efficiency in the oiling is thereby obtained, as well as a material saving in labor.

The switch-board is of the usual spring jack pattern, and has polarity indicators on each of the seventeen circuits, as well as lighting arresters.

The entire absence of anything approaching crowding of the machines, the great fault and danger in so many

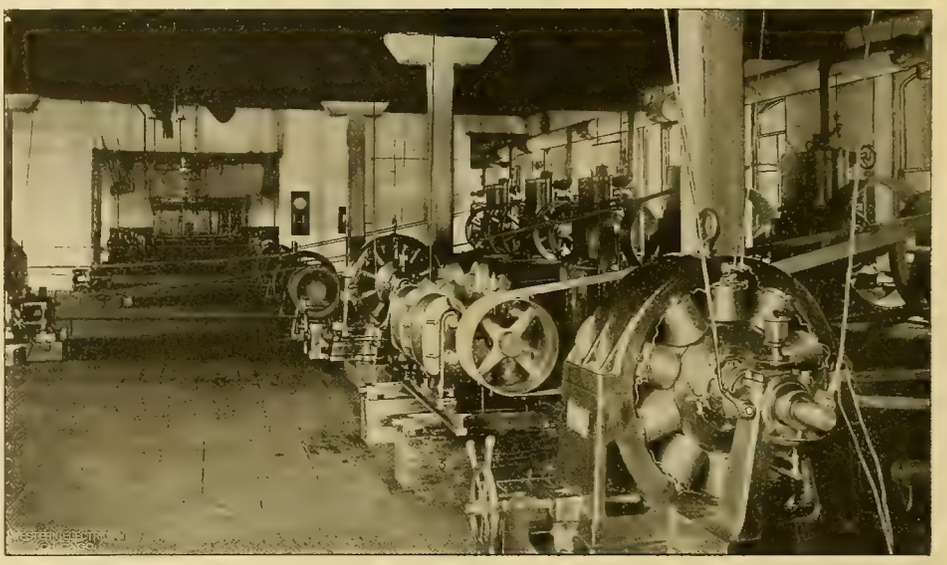


FIG. 2. CENTRAL STATIONS OF THE BRUSH ELECTRIC LIGHT COMPANY, BUFFALO, N. Y.

central stations, reflects great credit on the management in avoiding this short-sighted policy.

The whole structure is built in a very substantial manner of brick, in a rectangular form with a dividing wall down the center, separating the dynamo room from the engine and boiler rooms, the latter also being separated from the engines by an 8-inch brick wall.

Repairing tools and materials are kept on hand so that all repairs on the dynamos are carried out on the spot by special skilled labor, thus effecting a considerable saving in time and freight.

The whole work of construction has been executed from the designs of C. R. Huntley, general manager of the company, and under the supervision of Mr. Cornwell, the engineer.

This company has also a station on the West Side, from which private arc lights, incandescents and motors are operated. This station is interesting historically, being the first to supply alternating currents in this country. Twelve 80 horse power boilers of which several are fired by natural gas, give the necessary steam power to thirteen 60 horse power and one 125 horse power standard Westinghouse engines, running at speeds of 280 to 320 revolutions per minute, and generating the current by means of Brush 65 light machines for the arc and power circuits and by Westinghouse alternators to 5,500 incandescent lamps. Fig. 2 gives an excellent idea of the dynamo room of this station.

Attached to the store room below the general offices of the company on Washington street is a repairing room in which lamps, motors, switches, etc., are attended to, power for the lathes being supplied by a 2 horse power motor.

The stations, repairing shops, and outside construction work are the evolution of many years' experience of the multitudinous requirements of an electric light plant, and apparently leave little to be desired; but in the forward march of electricity it is safe to assume that when the next National Electric Light association meeting takes place in Buffalo the Brush company will again have something new and interesting to show the members in the way of practical developments of the supply of light, heat and power by electricity.

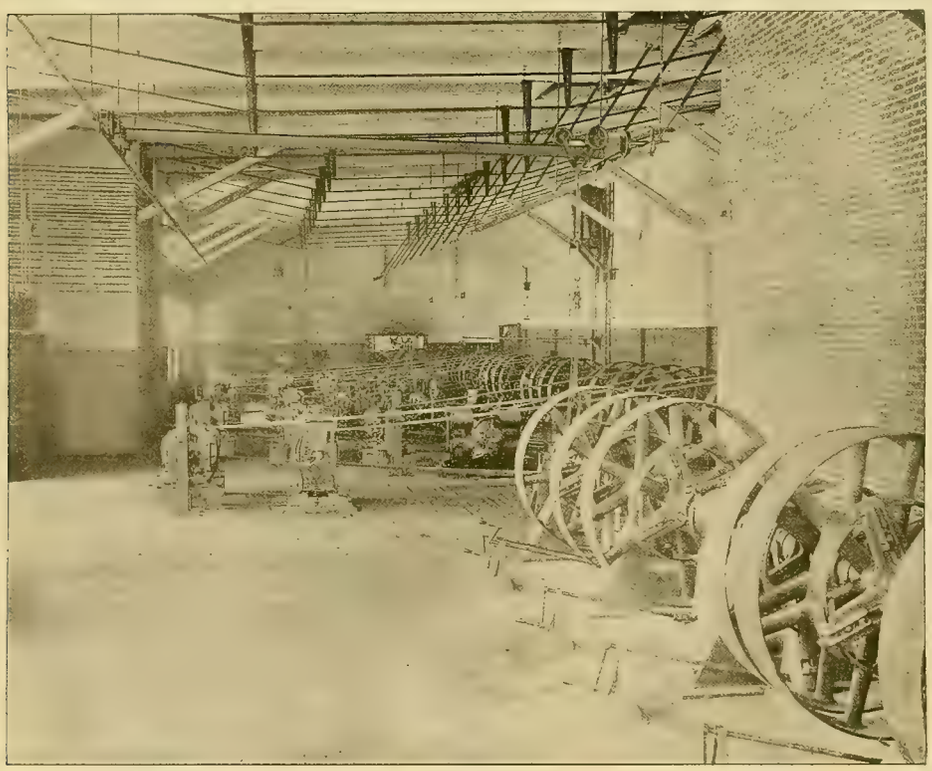


FIG. 1. CENTRAL STATIONS OF THE BRUSH ELECTRIC LIGHT COMPANY, BUFFALO, N. Y.

Project for an Electric Line from Chicago to St. Louis.

It is reported that an air line electric railroad is to be built to connect Chicago and St. Louis. A company known as the Chicago & St. Louis Electric Railway company has been organized at St. Louis, it is said, and it is stated that a corps of engineers has already started out from that city to survey the route, which is to be absolutely straight and 250 miles long. It is proposed to make the trip in two hours and a half, in coaches drawn by a peculiarly shaped motor car devised by Dr. Wellington Adams of St. Louis.

Buffalo's Isolated Electric Light Plants.

Buffalo has shown its appreciation of the modern method of illumination in a most substantial manner. Its streets are well lighted, arc lights furnished by the local central station companies predominating on the principal business thoroughfares and in the most exclusive residence districts. The central station companies are well patronized by business men, commercial lighting forming a large part of the business. Probably the greater part of the electric lighting in commercial houses, however, is from isolated plants. These are to be found in all parts of the city furnishing current for manufacturing concerns, large retail establishments, office buildings and hotels. Many of these plants have been in operation for several years and all of them appear to give satisfaction. A trip through these isolated plants will be found interesting to all who desire to follow the development of incandescent lighting, furnishing as it does an object lesson in electrical engineering. Despite the experience of years, however, the Buffalo business men do not appear to realize the importance of providing suitable accommodations for electrical machinery. Thus, for instance, nearly every isolated plant in the city is crowded into some out-of-the way corner which could be used for no other purpose, and generally damp, dark and poorly ventilated. Yet these plants, under such unfavorable conditions, give satisfactory results, both in point of efficiency and economy.

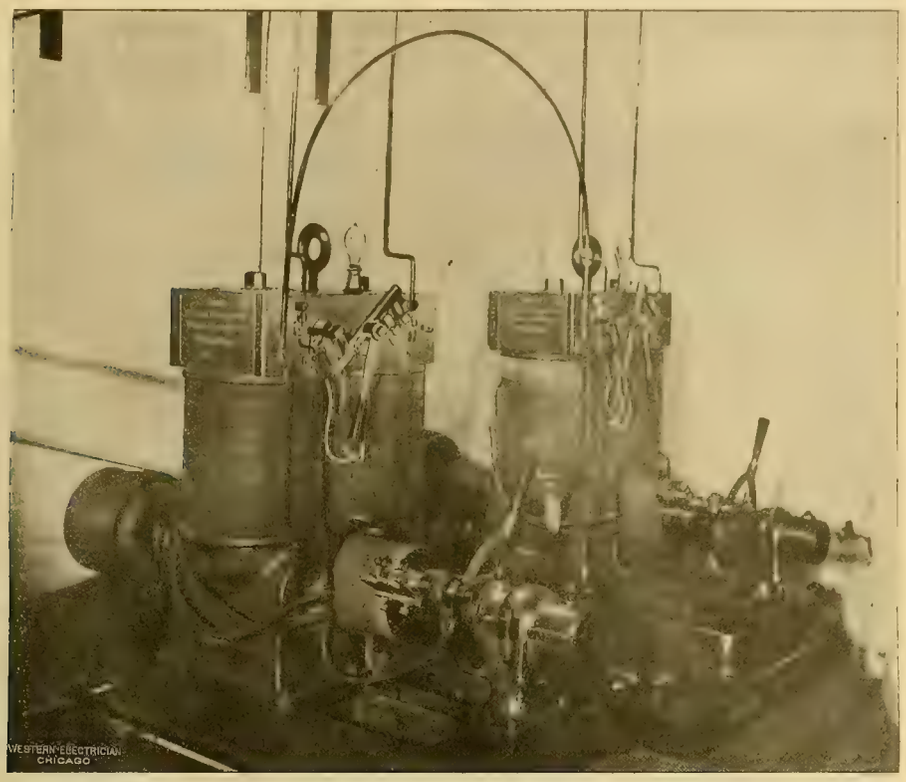


FIG. 1. BUFFALO'S ISOLATED ELECTRIC LIGHT PLANTS.

One of the latest plants installed is that of the Masonic Temple on Niagara street. In this plant, a view of which is presented in Fig. 1, there are two 20 kilowatt Edison generators, driven by a New York Safety engine. They are all crowded into a little room with just enough space left for the dynamo tender to get about and examine the machines. This plant furnishes current for lights in the offices throughout the building and also for the large hall in the upper part of the structure. This assembly room is one of the largest in the city and the lighting effects are admirable. The plant was installed by the Edison General Electric company, whose Buffalo headquarters are in this building.

In striking contrast is the plant which furnishes current for the Broezel House on Seneca street. Ample space was provided for in the plans for this hotel when the structure was rebuilt two years ago. At that time two Thomson-Houston incandescent dynamos of the spherical armature type were installed. A view of these machines and the switch-board is presented in Fig. 2. This plant, it is stated, requires very little attention and gives perfect satsfaction. In this hotel special attention was given the fixtures, which are unusually attractive. In the hotel office, the parlor and dining room, wrought iron fixtures predominate. The plant was installed by F. P. Little & Co., Buffalo.

Probably the most interesting lighting effects to be seen in Buffalo, and undoubtedly the most striking illumination for show windows, is that of Barnes, Hengerer & Co., the dry goods merchants on Main street. This establishment is one of the largest in the Queen City and occupies a handsome building in the center of the retail district. At the entrance to this building is an immense globe illuminated by electric lights. Hundreds of incandescent lamps are distributed in the show windows, and the flood of light from this store attracts the attention of strangers long before the store is reached It is certainly a very brilliant and attractive display. The generating plant, which is installed in the basement of the building, is illustrated in the accompanying cut, Fig. 3. Two Edison machines are employed and 1,800 lights are used in the offices, the salesrooms and the show windows.

No doubt many of the delegates to the convention will take occasion to inspect the American Glucose company's works during their visit to Buffalo. The extensive works of this company, the largest in the world, are located on the lines of the principal railroads centering in Buffalo, with track connections to all parts of the works. The immense buildings, from eight to ten stories high, cover many acres of ground with excellent facilities for the receipt and shipment of merchandise, either by rail or by water, and the expensive machinery and appliances found in every part of the establishment, perfected by years of costly experiments, makes the plant one of the most valuable in the country. It is not therefore to be wondered that this company at an early day introduced electric lighting into its factory. The advantages of the electric light in such an establishment are apparent and do not require enumeration here. The company has several times enlarged its plant and now has two 720 light Edison machines and one small generator, shown in Fig. 4. The lights are distributed throughout the works. An idea of the magnitude of the business of this concern can be gained from the fact that the annual output of the company aggregates 250,000,000 pounds. This large concern employs 500 men. The Buffalo works alone consume 150 tons of coal daily, which, with the corn and product require the handling of 840 tons of freight per day—an aggregate of more than quarter of a million tons of freight annually. Owing to the increasing demands of the business the company is now preparing to extend its works and at the same time build a large electric light plant which shall in fact be a good sized central station, to supply current for illuminating the several buildings of the plant and the grounds. This will be one of the most interesting installations in Buffalo.

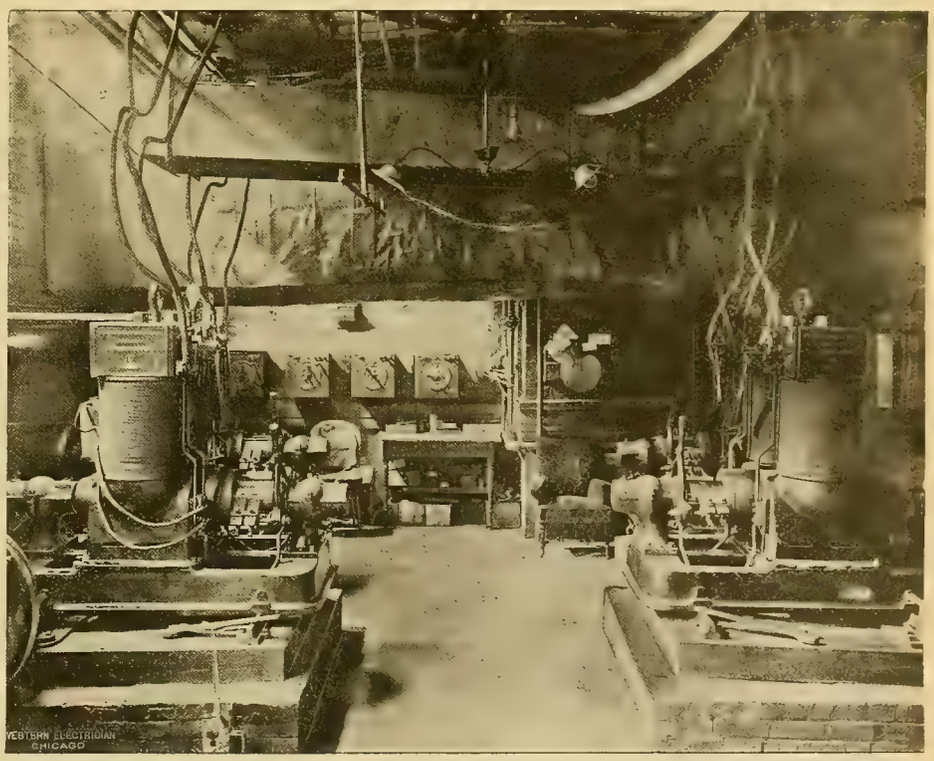


FIG. 3. BUFFALO'S ISOLATED ELECTRIC LIGHT PLANTS.

Train Lighting by Accumulators.

The electric train lighting plant of the Jura-Simpson company of Switzerland is said to be the largest in Europe It extends in all to about fifty passenger cars of all classes and to about half a dozen baggage cars. A number of additional cars are now being fitted up so that shortly, it is expected, there will be 120 electrically lighted cars, having from 600 to 700 lights in use. Accumulators are used, and the outfit for each car weighs about 242 pounds. The batteries are arranged in a movable box, which can be readily lifted by two men. Each battery consists of three hermetically closed ebonite boxes, securely fixed in the main inclosing box. Each ebonite box is again subdivided into three parts, and each of the latter contains a cell, there being thus nine cells, connected in series, with a pressure of eighteen volts. The capacity of each battery is 120 ampere hours. Three-watt lights are employed (equal to 18 volts and .17 ampere), making an available lighting duration for each fully charged battery of from 700 to 750 candle hours. The candle power of the lights in the two-axle cars of all kinds varies from thirty to fifty-five candles, and in the three-axle first-class cars amounts to seventy candles. The latter cars are provided with two battery sets each, and the former with one battery. The lighting capacity for the passenger cars extends over from ten to fifteen hours, and for the baggage cars over a still longer period, twenty hours and more, even when all the lamps are in constant use. The lamps are fixed to the car roofs. The spent batteries are taken in special cars from the several principal stations to Fribourg, where they are recharged and returned to their proper destinations.

Light, Heat and Power Service of the Thomson-Houston Company, Buffalo.

The Thomson-Houston Electric Light & Power company of Buffalo is a consolidation of the old Thomson-Houston and United States companies. This company operates two plants, the old Thomson-Houston station on Court, Pearl and Express streets, in the center of the business district, and the old United States station at Black Rock, which was illustrated in the last issue of the WESTERN ELECTRICIAN. In the accompanying cut is illustrated the dynamo room of the old Thomson-Houston station, from which heat is dispensed as well as light and power. This heating system is one of the principal features of this station, and will no doubt be examined with interest by delegates to the convention.

The heat is circulated from the exhaust main of the station by the Barnard vacuum system, thereby causing no back pressure upon the engines and doing away with the probability or necessity of water ramming in the steam heating pipes. The Thomson-Houston company is at present heating five large buildings from this central station, and finds that the revenue from the exhaust steam heating compensates for the disadvantages that can be charged to a high pressure station. It is just the question of gain by the use of exhaust in condensing as against the revenue received from the sale of exhaust steam for heating purposes. Added to this there is of course the advantage derived from a station centrally located. The principle of the Barnard apparatus used by this station is simply the application of a surface condenser through which the feed water passes on its way through the feed water heaters to the boilers and an ejector connected to the condenser to relieve it of the air liberated from the condensed vapor. The condenser is also connected to a main air pipe, which in turn is connected by branches to the air cocks of the several radiators in the building to be heated.

The action is simple. Steam is turned on from the main exhaust from the station into the exhaust pipe running to the building to be heated. The ejector on the condenser is then started, creating a vacuum in the condenser and through that, creating a vacuum in all the radiators in the building to be heated. The exhaust steam then rushes through the main pipes into the radiators to fill this space. As fast as the condensation takes place new steam follows, thus affording as complete circulation as if the steam were forced through by pressure. All the return drips are brought back by gravity from those localities whose elevation renders the return practicable. This water is returned to a main receiving tank at high temperature, is mingled with the main feed, and is pumped through the heaters to the boilers.

The method used in laying the street main is effective and still inexpensive. The main steam pipes, returns and air pipe, are laid inside large virtified tile, being supported at intervals of fifteen feet by cast iron spiders, placed at the joints of the tile and perforated around the edges so as to allow any moisture that may gather within this air space inside of the tile to flow back to the station. The provisions for expansion and contraction are made entirely in the formation of the runs, long bends being given to the run at both ends of the service. With five inches of vacuum on the condenser the steam has been, in the coldest weather this winter, circulated through the coils of the American block, and the attention required by this system has been practically nil.

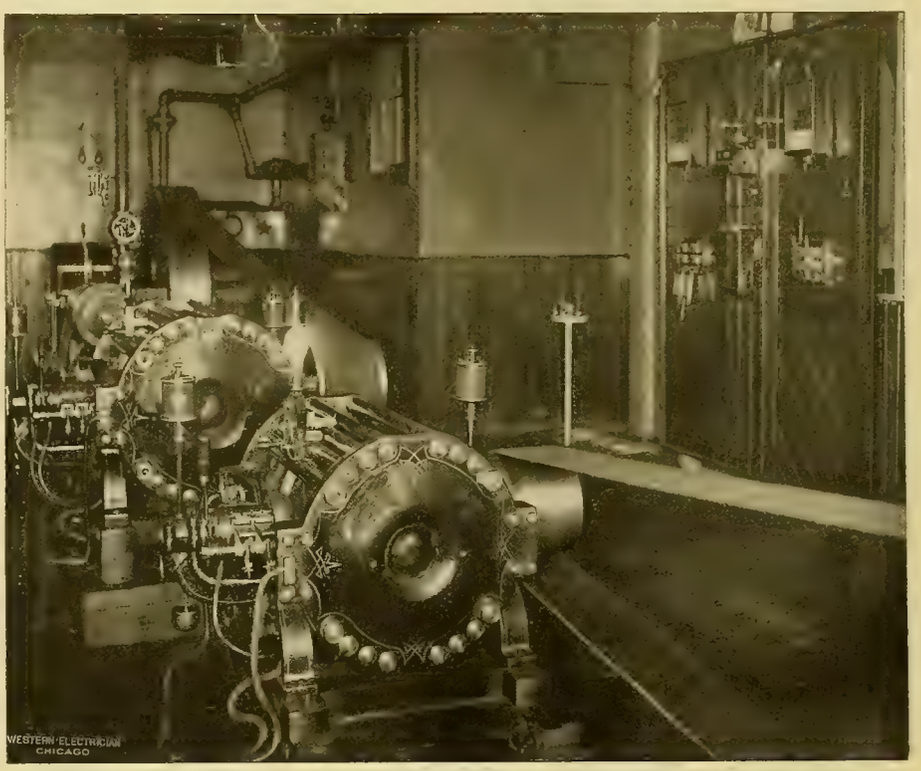


FIG. 2. BUFFALO'S ISOLATED ELECTRIC LIGHT PLANTS.

With a demand for steam heating at from 25 to 30 cents per square foot of radiating surface it can readily be seen that by the sale of this steam, as far as economy is concerned, the company is placed on at least as good a basis as a condensing station. Take for instance a building containing 4000 square feet of radiation,—a fair example taken from practice. At 25 cents a foot this would bring in a revenue of $1000 a year at a cost of simply the interest upon the investment in the street main.

This station dispenses light on all systems and for all purposes—the incandescent, all day, every day in the year; Arc service for street lighting, arc commercial lighting and power service. The company has about 480 city lights, about 190 commercial arc lights, and about 4000 or 4500 incandescents. The motor service has but just been started, but is rapidly growing, giving promise of large proportions.

This station has 1080 horse-power in Rice engines built by the John T. Noye company of Buffalo, and 15 arc light dynamos, three of which are of the Western Electric, 65 light, high tension type. The remaining are the Thomson-Houston standard 50 light machines. In addition there are two 1500 light Thomson-Houston alternating machines, one 750 light Thomson Houston alternating dynamo, one 500 light Thomson-Houston incandescent dynamo and one 95 horse power Thomson Houston 500 volt generator. The method of driving is tandem direct, and by line shaft. A traveling crane built by Harrington, Son & Co., of Philadelphia, affords facilities for handling the large dynamos. Running under the floor, with branches beneath the armature of each machine is a large duct, supplied from a blower on the second floor with cool air at about 5 ounces pressure, thus delivering upon the armature of each machine a cool blast, greatly adding to the efficiency of the machines. In the boiler room are four large horizontal tubular boilers, fitted with Brightman stokers, and one 160 horse power Corliss vertical boiler fitted with shaking grates and one 160 horse power Reynolds boiler, likewise supplied with shaking grates. From the boiler room to the second story of the building the ashes from boilers are elevated by means of elevator chutes, from which place they are delivered by chutes to the wagons. On the second story is located the stock rooms, testing and lamp-repair department, and the machine shop, in which all the mechanical and electrical repair work is done, all armature and field work being rewound, as well as all the repair work on engines, being done by the company. This shop is connected by an overhead track to the overhead track on the first floor, so that any piece of machinery can be carried from any place on the first floor through hatchway to the second floor, and thence over any particular machine in the machine shop. The exhaust steam heaters, one 500 horse power Berryman and one 900 horse power Stewart, are located upon the second floor, receiving their supply through a twenty-four inch main from the floor below, and exhausting what vapor remains unused into the smokestack.

LIGHT, HEAT AND POWER SERVICE OF THE THOMSON-HOUSTON COMPANY, BUFFALO.

The proposed plan for connecting Newark, N. J., with Jersey City by means of an electric railway is being rapidly put into operation. The Plank Road company of Jersey City is undertaking the construction of the line as far as its property extends. When it has completed the road to the city lines of Newark and Jersey City, it will form an alliance with the Newark Passenger company on one end and with the Jersey City & Bergen Railroad company on the other end. The negotiations have been so far completed, it is reported, as to render it absolutely certain that the Plank Road line will become part of the system of the Newark Passenger company. The overhead system will be used throughout.

Photography as Applied to the Investigation of Electrical Phenomena.[1]

By C. Kammeyer.

Several months ago, while engaged in some experiments on fuses and fuse wire, I found considerable difficulty in arriving at correct conclusions regarding the behavior of different fuse metals while in the act of melting or exploding under the action of a current. It occurred to me that by causing the fuse while in the process of dissolution to make its own record upon a sensitized photographic plate properly focused by means of a lighted candle or match held near the fuse terminals, the shutter of the lens is closed, the plate holder inserted, and slide withdrawn. All these preparations can take place while the room is suitably illuminated. The fuse is now inserted (the switch being open, of course) and the room made dark. The lens is uncapped, the circuit closed, and the fuse allowed to blow. The slide of the plate-holder being replaced, the holder is changed for a fresh one, another fuse inserted, and the operation repeated as often as desired, or as often as the number of plate holders will admit. If it is desired to

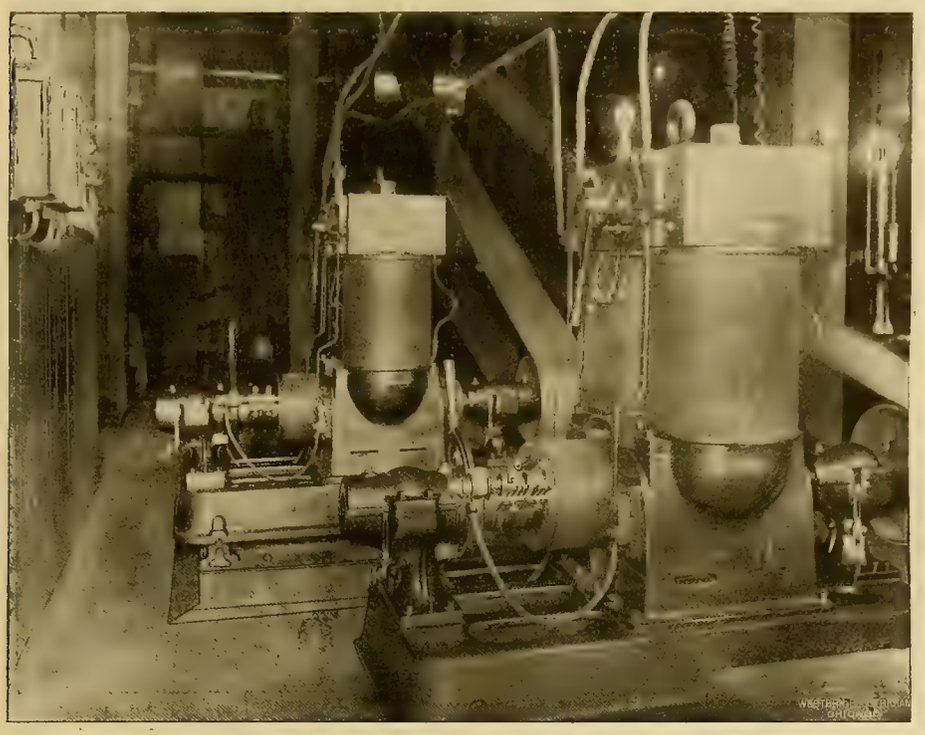
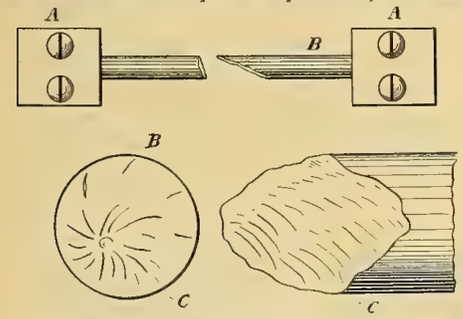


FIG. 4. BUFFALO'S ISOLATED ELECTRIC LIGHT PLANTS.

some valuable information might be obtained. The results far exceeded my expectations, and to-night I am enabled through the courtesy of your club to present to you some interesting specimens of photographs made from fuses of different capacity, shape, and material while in the act of fusing, or blowing, or whatever you may please to call it.

Before going any farther I wish to state that if you expect to hear an elaborate scientific essay full of abstruse theories and problematic conclusions you will be disappointed. I have handled the subject in a by no means systematic manner, and can at best give you only the results of my experiments, leaving it to some member better posted electrically and chemically to explain the whys and wherefores which will under certain conditions bring about various results; in fact, in order to make my modest efforts in this line of investigation of any real practical value to the electrical fraternity it is very necessary that some



FIGS. 1 AND 3. PHOTOGRAPHY AS APPLIED TO THE INVESTIGATION OF ELECTRICAL PHENOMENA.

member more competent than I take up the subject where I shall leave off, and I hope that the possibilities hinted at by the pictures I am about to present to you will prove of sufficient interest to kindle the ambition of some one, urging him to follow up and complete the subject.

For the benefit of those who wish to repeat any or all of the experiments I will briefly describe the arrangement of dark room, camera, circuits, etc. The sketch, Fig. 7, represents a room, or closet, from which all daylight or artificial light is excluded. Upon a dark mat background are arranged the terminals between which the fuse to be tested is in circuit. These terminals may consist of ordinary clamps mounted at suitable distances apart upon an insulated base. In some instances I have found an ordinary porcelain entrance fuse very convenient, although its glossy surface is apt to give trouble on account of the reflection of the electric spark, or arc. Two wires lead through light-tight holes in the wall, or partition, to the source of current. A switch is interposed to make and break contact, as desired. The camera being set up and

1. Read before the Chicago Electric club, February 15, 1892.

increase the current gradually up to the melting point of the fuse, a suitable arrangement of the circuit, such as a rheostat or reactive coil must, of course, be provided.

After a desired number of plates have been exposed they may be developed, which, by the way, requires considerable care on account of the briefness of the exposure.

was a slight report and the fuse had disappeared, but no spattering of melted metal or metallic vapor was discernible.

No. 2 shows a porcelain fuse block with a 15 ampere and a 20 ampere stamped fuse connected in series. On short-circuiting the secondary terminals of a 50 light 50 volt transformer, the smaller or lighter fuse instantly

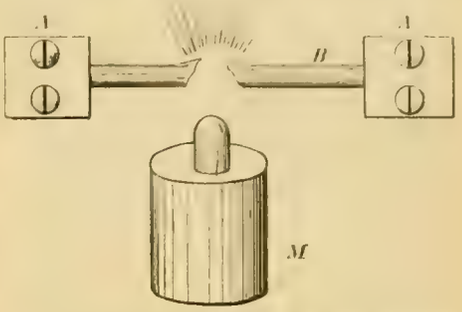
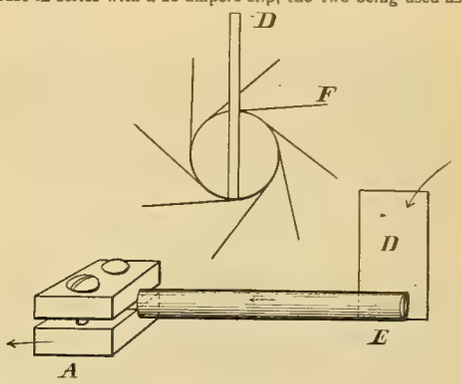


FIG. 2. PHOTOGRAPHY AS APPLIED TO THE INVESTIGATION OF ELECTRICAL PHENOMENA.

opened the circuit, and similar to the first experiment the action took place quietly and without any spattering of metal or any apparent production of gases or vapor.

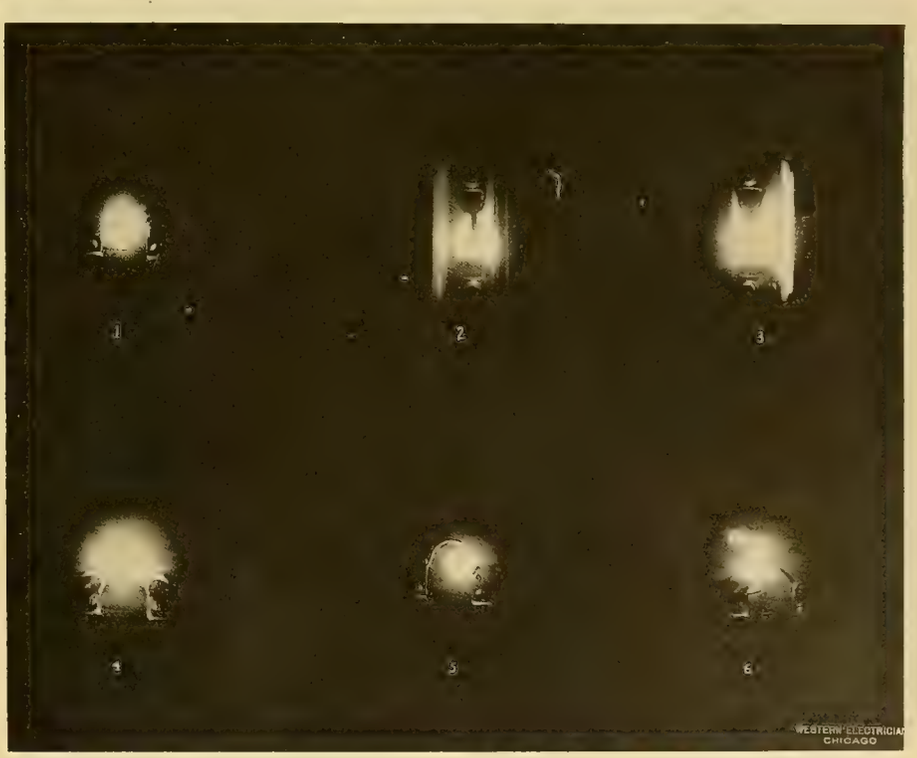
The third plate shows the action of a 20 ampere stamped fuse in series with a 20 ampere slip, the two being used as



FIGS. 4 AND 5. PHOTOGRAPHY AS APPLIED TO THE INVESTIGATION OF ELECTRICAL PHENOMENA.

a short circuit of the secondary terminals of a transformer. The results are similar to those in the last experiment.

Plate No. 4 shows a single 20 ampere strip in series with 50 amperes. You will notice a small cloud of vapor



PLATES 1 TO 6. PHOTOGRAPHY AS APPLIED TO THE INVESTIGATION OF ELECTRICAL PHENOMENA.

The plates should, of course, be of the utmost sensitiveness. I have found Cramer "C" plates to give very good results, indeed.

I will now show you some plates made from fuses of various carrying capacity, when subjected to the action of a 50 volt alternating current.

Plate No. 1 shows a 15 ampere fuse stamped out of sheet metal; it was connected in series on a circuit carrying 50 amperes, the current being turned on suddenly. There

connecting the two poles. This, I believe, consists of the higher heated or vaporous metal at the instant of explosion, and before it has had time to be dissipated. The conditions under which this fuse was blown were similar to those of the first experiment, with the difference that in this instance there was more metal to be vaporized. This would tend to prove that, other conditions being equal, the closer the safe carrying capacity of a fuse is kept to its actual fusing point, the less danger we have from perma

nent short circuits or arcs being established by a blowing fuse. This point I consider of great importance, and I shall revert to it later.

Taking plate 5, we have a piece of 18 ampere (so called) fuse wire of a certain make, subjected to a load of 50 amperes. The rupture of the circuit took place rather quietly, with little vapor. I want to call your particular attention to the peculiar arch shaped form of the piece of wire while evidently in a semi-fluid state. At the same time the plate shows the unreliability of fuse connections when made by means of a screw and washer. The cross section or carrying capacity of the fuse is almost certain to be reduced at the point of contact with the result that the rupture takes place at the weakest point. In this

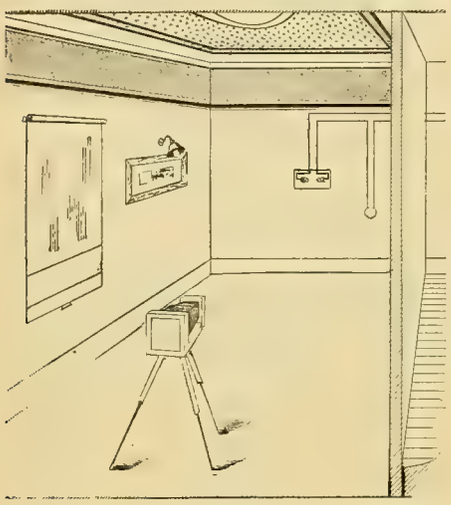
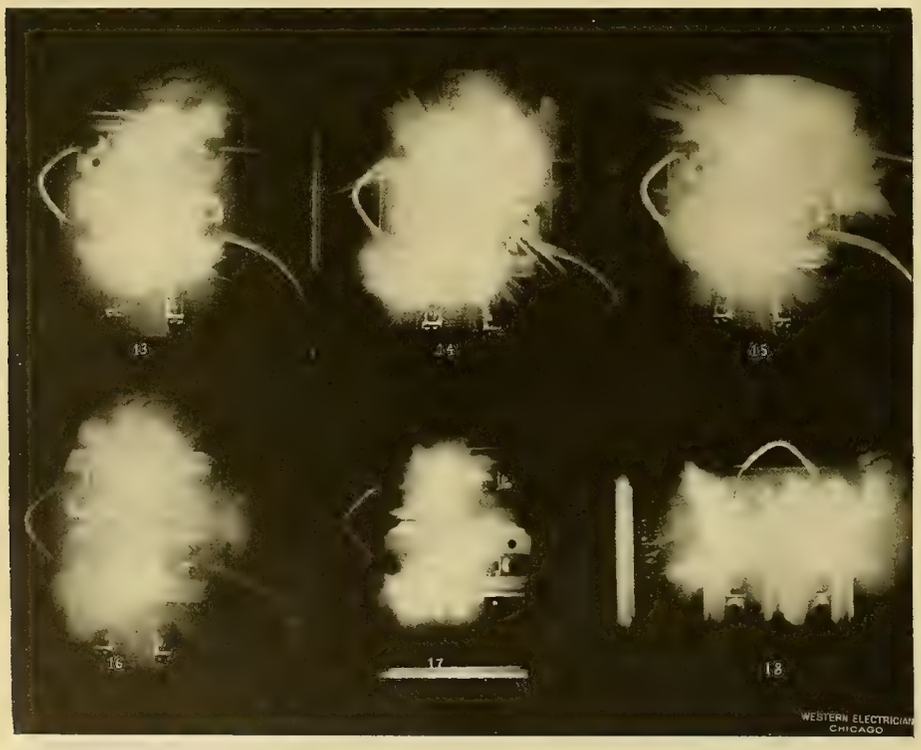


FIG. 7. PHOTOGRAPHY AS APPLIED TO THE INVESTIGATION OF ELECTRICAL PHENOMENA.

instance the hot gases rising suddenly evidently carried the semi-fluid end of the fuse with them, the end of the fuse next to the left-hand clamp being the cooler and remaining comparatively undisturbed.

In plate 6, showing a piece of 44 ampere wire of the same make under similar conditions, we have almost the same results, but with considerably more vapor or gas thrown off.

Plate 7 shows two 44 ampere wires under similar conditions, the two pieces of fused wire being in series with each other, both mounted on a double pole entrance block. The current passing through both pieces of wire simultaneously, we naturally would expect both fuses to be ruptured. The photograph shows they were not. And why not? Simply because two pieces of fuse wire cut from the same spool are not sufficiently uniform in cross section

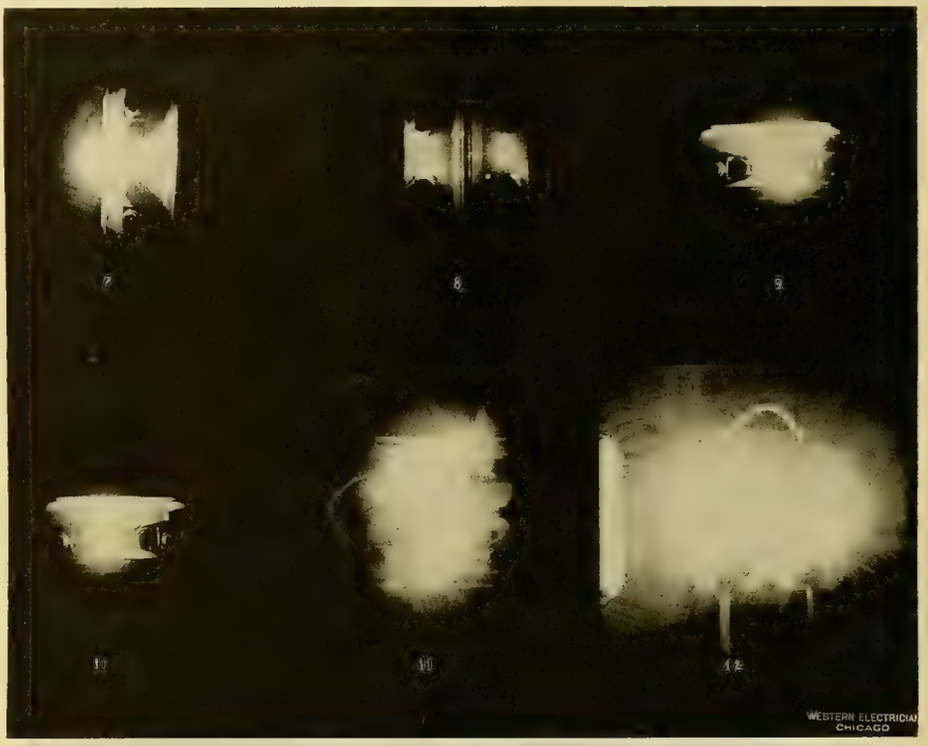


PLATES 13 TO 18. PHOTOGRAPHY AS APPLIED TO THE INVESTIGATION OF ELECTRICAL PHENOMENA.

or carrying capacity to bring about the looked for result. To prove to you that it is lack of uniformity, we will take two pieces of fuse wire of such small carrying capacity that the difference, if any, in relation to the fusing current is very small. Plate No. 8 shows two pieces of 1 ampere wire subjected to a 50 ampere current. Both pieces are ruptured because the fusing current is of such strength as to overcome any slight difference in the fusing point or carrying capacity of the wire.

I will now call your attention to a phenomenon which at first seemed somewhat paradoxical in its nature. Plate No. 9 shows two pieces of 18 ampere fuse wire mounted horizontally on a fuse block, The current being turned on, the usual flash and report took place, and upon examination I found that both fuses had disappeared. I will state here that in all former experiments whenever fuses have blown, all of the fuse metal disappeared, and any portions of the fuse which showed in the plates were of course photographed before they had time to fall. Now, the photograph clearly shows that in reality only the lower fuse actually exploded. Did the upper fuse melt by induction, or on account of hot vapor or gases which would naturally arise? I am inclined to think that the latter explanation is the correct one. To satisfy myself that this peculiar action was not due to some defect in the fuse wire, I repeated the experiment by using two exactly similar strips of fuse metal (15 ampere) with the result shown on plate 10. As in the former case both fuses had disappeared, while the photograph shows the upper fuse intact at the time the actual rupture or break in the lower fuse occurred.

In all the preceding experiments a 50 volt alternating current was used. Some of our direct current friends, unconsciously, perhaps, look upon the word "alternating" as indicative of danger or trouble. To show you that the direct current, under certain conditions, is far more vicious in its character, I want to call your attention to a few plates showing the behavior of fuse metals when subjected to the action of a direct, continuous current. Plate 11 shows two pieces of two ampere fuse wire in series used as a short circuit of a 100 volt direct current. The fuses are, of course, ruptured instantly, but with much more vicious results than in the preceding experiments. A con-



PLATES 7 TO 12. PHOTOGRAPHY AS APPLIED TO THE INVESTIGATION OF ELECTRICAL PHENOMENA.

siderable quantity of gaseous vapor is evolved, and the explosive nature of the rupture is much more marked.

Plate No. 12 shows 5 ampere wire under similar conditions, and with similar results.

No. 13 shows two pieces of 15 ampere wire, the fuse block being placed horizontally.

In No. 14 we have 10 ampere wire under the same conditions.

In No. 15 we have two pieces of 5 ampere wire, the discharge, if such it may be called, being exceptionally vicious, while in No. 16 we have some 15 ampere sheet metal slips, showing that the nature or the rupture is due to the character

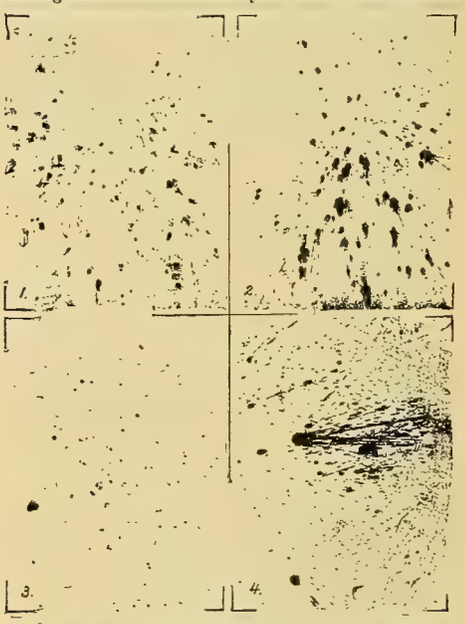


FIG. 6 PHOTOGRAPHY AS APPLIED TO THE INVESTIGATION OF ELECTRICAL PHENOMENA.

of the current rather than to the quality of the metal employed.

Plate No. 17, with two pieces of 10 ampere wire, is remarkably free from the spattering action noticeable in the last five or six plates; merely a few drops of melted metal can be discovered around the edges of the fuse block.

No. 18 shows these melted particles or drops of heated metal more plainly. I am unable to account for these plates showing such different results from plates 11 to 16 when the conditions under which the rupture or blowing took place were almost identical in each instance mentioned.

These plates showing the cloud of metallic vapor occupying the space between the two fuse terminals clearly convinces me that the use of covered fuse blocks is to be avoided as much as possible. The metal in its gaseous form, unless carried off by the air or allowed to dissipate itself as rapidly as possible, must certainly form a destructive

PLATE 25. PHOTOGRAPHY AS APPLIED TO THE INVESTIGATION OF ELECTRICAL PHENOMENA.

arc between the fuse supports, and if any inflammable material be near, the inevitable result must follow. Another point which has occurred to me is this: Is there not a possibility that a fuse blowing in this vicious manner may set fire to any dust or other inflammable particles that are apt to collect in flour and saw mills? I think the subject is well worth close investigation, and possibly the number of so called "spontaneous combustions" may be lessened thereby.

Plate No. 19, and especially plate No. 20, present a very peculiar formation of the vapor cloud referred to in connection with the last six or seven plates. Two 30 ampere wires were connected in series, with the result that the lower fuse was blown and contrary to our previous experience the upper fuse remained intact. By observing the picture you find that the explosion took place in a downward direction, the funnel shaped cloud having the appearance of a ring or puff of smoke frequently observed issuing from a locomotive smoke stack, which, as we all know, is caused by the exhaust steam being suddenly blown in or through a cloud of smoke before the latter has left the stack. I am inclined to believe, therefore, that the fuse wire in question first becomes fluid or semi-fluid in its center or interior the cooling action of the surrounding air leaving a sort of shell or skin on its surface. The imprisoned vapors or gases upon receiving a sufficient pressure burst through this coating, carrying the outer shell or film with them, this film at the same time becoming volatilized. I have repeated the experiment several times, but did not succeed in producing this peculiar formation of vapor a second time. Possibly some particular formation or density of fuse wire is necessary to bring about this unique result.

Leaving the 100 volt direct current, we will return to the alternating and investigate some of the phenomena produced by a 100 volt transformer.

Plate 21 shows a 26 ampere slip of fuse metal suddenly subjected to a 50 ampere current, The rupture takes place quietly, with little or no vapor or gases being evolved.

Plate 22 is a slip of the same capacity subjected to 100 amperes, with very little difference in result; the increased current melting the metal a trifle more rapidly is the only change we notice.

In plate 23, with a 50 ampere slip subjected to 140 amperes, we have what I should call an ideal "blow-out." The circuit is opened quickly, quietly, and with scarcely any evolution of gas or vapor.

In plates 24 and 25 we are enabled to observe the action of a fuse under a pressure of 1,000 volts alternating. The length of fuse was the same as in former experiments (2 1-2). One would naturally expect a very violent action, but quite the contrary took place. The explosion or rupture was scarcely forcible enough to make a decent impression on the photographic plate, showing that the dreadful alternating current is in reality a very gentle and quiet affair, provided it is kept within proper bounds. Of course, if unrestrained, it will, like all forces of nature, become dangerous, harmful and vicious.

Plate 26 shows the result of short-circuiting a 2,000 volt

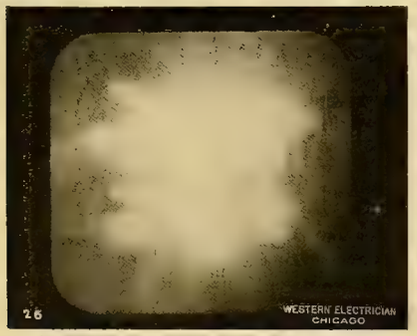


PLATE 26. PHOTOGRAPHY AS APPLIED TO THE INVESTIGATION OF ELECTRICAL PHENOMENA.

transformer with a piece of 2 ampere fuse wire. The rupture caused an arc to be established between the terminals, a distance of 2 1-2 inches, and before the current could be switched off the intense blaze had caused the plate to be over-exposed, with nothing but a blotch of light as the reward of our trouble.

In conclusion I wish to say that at some future time I intend to repeat some of these experiments in a more systematic manner, taking not only different kinds of fuse wire under varying currents, but also trying wires of various metals, such as copper, aluminium, zinc, iron, etc., and if permitted, I will be pleased to present the results to you in a similar manner as to-night.

DISCUSSION.

CHAS. WIRT: I do not know whether everybody realizes the beauty of the method which showed the operations taking place in such a remarkable short space of time as occurs when a fuse is blown in short circuit. If any of you would try, as I did, to solder a fuse across a pair of terminals when there was a difference of potential of 220 volts, you would get a lasting impression of the quickness with which a fuse is blown out. It is altogether impossible for our senses to form a clear idea of what is going on under such circumstances, although the camera shows it very clearly.

I am inclined to think that Mr. Kammeyer has unconsciously been a little unfair to the direct current, and I want to ask him whether he has been strictly impartial in treating the two currents. As I understand it, he took a limited current and a fuse with a certain capacity, and then applied the current by the switch. Is that so, Mr. Kammeyer?

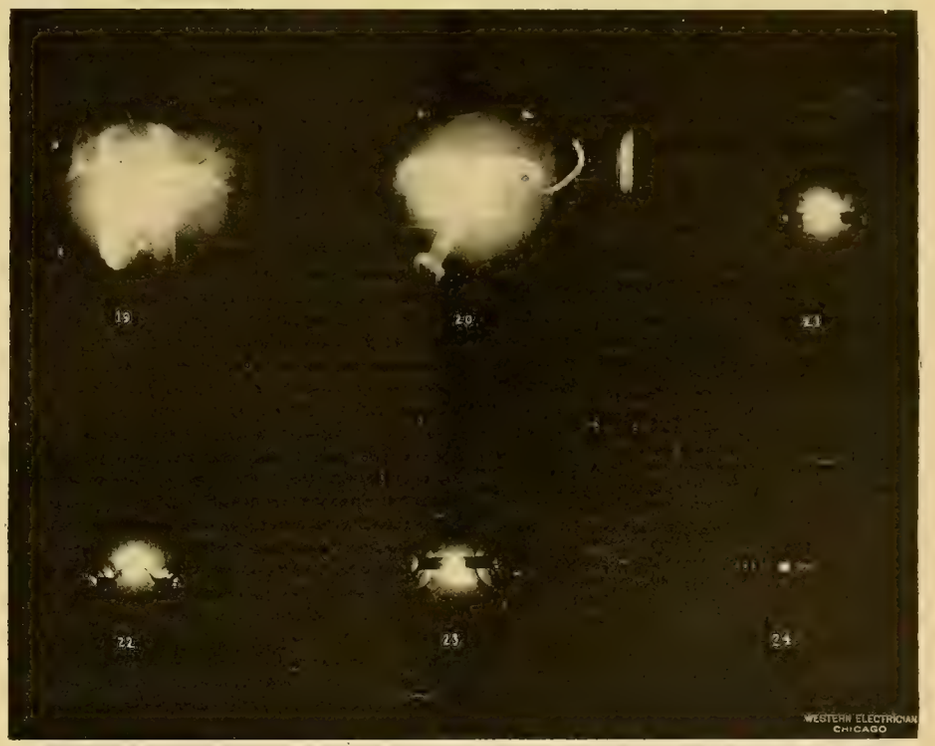
MR. KAMMEYER: To a certain extent that is so. But in some instances I short circuited an alternating current of 50 volts and a direct current of a hundred volts. But I firmly believe that a continuous current is of a more vicious nature. The alternating current, from the very fact of its being alternating, will not produce those effects that I showed you were produced by a hundred volts direct current.

MR. WIRT: I have observed that the fusing with the alternating current did not occur with the suddenness that marked the direct current, but my impression is that Mr. Kammeyer has taken the alternating current and applied it in a limited manner, and that in the case of the direct current the fusings were made with an unlimited current directly applied.

Mr. Kammeyer spoke of the variations of wires on the same spool, and attributed that to the variations in diameter or cross sections of the wire. I think that it is more likely that those variations in capacity occur from variations in composition, for I have observed myself that wire having a uniform cross-sections, from the same spool—I am speaking now of soft fuse wire—is liable to vary in specific resistance as much as 40 or 50 per cent. in a few inches.

When I heard of the paper to which we have listened to-night, and got an idea of the direction it would take, I concluded to try some experiments in a manner which would cause the fuses to make their own record. I found for sale three distinct kinds of fuse wire. One is a very soft, very fusible wire, which is much used, I believe, and is evidently very carefully prepared. Its characteristics are low fusing point and high resistance. Another kind of wire that I found in three or four different stores had a little higher fusing point and somewhat lower resistance, still a rather soft wire. Another wire with which I have been working is very much harder. It has a higher melting point, still sufficiently low, and very much lower resistance than any of the others. I have been blowing some of those fuse wires, and some of the results are apparent upon the sheets of paper which I have here, and other results are apparent on my fingers. These records on the papers were formed by putting the paper at a distance of 12 inches from the fuse, and then short circuiting a current of 220 volts, which was the only current I had access to at the time. I found it in all the cases necessary to solder the fuse wire at the blocks. I tried screws, but found they were unreliable. The fuse is extremely liable to break loose at one end when the principal effort of the explosion is expended at that point. These results Fig. 6 show a little of the variations that it is possible to get. They vary all the way from a clean piece of paper to a mass of charcoal. In some cases the paper burned and destroyed the record. They do not show the different kinds of fuse wire, and the results of the different lengths and the different capacities, but I can state the practical results very briefly. I find that the low melting point, high resistance wire is comparatively the worst as regards explosive effect. It makes a tremendous cloud of vapor and a sort of dull explosion, and throws a shower of red hot globules of meltedmetal, which retain the heat quite a considerable time. Those are the characteristics of such a fuse wire. You can all see the spatter of the melted globules on that piece of paper Plate 2, Fig. 6. It was burned part way through. In other cases it set the paper on fire, and spoiled the record. Those were at a distance of 12 inches from the fuse wire, and the fuse wire was partially inclosed in a receptacle, open, of course, on top. I adopted that form of receptacle particularly to get the explosive effect in one direction, to make a clear record. Then I changed to a wire with a little higher fusing point, and considerably lower resistance, which I find in the electrical supply stores of Chicago, which behaved somewhat better, but it was still what I would call a nasty wire. It gave a heavy explosion, a dense cloud of vapor, and more or less of that scattering of fire; still not so much. Plates 1 and 4, Fig. 6.

The third fusing wire, which perhaps would not commend itself from its physical qualities at once, is, to my mind, the best. It is sufficiently hard to stand the pressure of a binding screw. It has a fusing point which enables it to be more easily soldered without endangering the wire, and it is still so low that it would not set fire to any inflammable substance at the melting point. But my experiments show that the fusing does not occur. It gives off a flash, and the flash is the dangerous feature. This fuse wire has a very low specific resistance. The result of that is that for a given capacity it is a small wire. This seemed important to me before, and it seems now even more important since these experiments. The fuse going off on a short circuit gives a report like a pistol. It throws the melted metal with little flash and little vapor. The metal strikes the paper, and shows its characteristics —a spatter of bright metal in no case hot enough to burn the paper. Plate 3, Fig. 6.



PLATES 19 TO 24. PHOTOGRAPHY AS APPLIED TO THE INVESTIGATION OF ELECTRICAL PHENOMENA.

ELMER A. SPERRY: This has certainly been an instructive and interesting paper to me, and I can also say that it is ingenious. The idea of rendering it possible to automatically record what is passing during the explosion of a fuse wire seems to me to be one that almost marks an epoch in this branch of the electrical science.

I, however, could not help but think that there were other things that could have been said with reference to it, and, as Mr. Kammeyer stated in the latter part of the paper, these will be presented at some future time.

It seems to me that one thing that would be of interest to us all would be to turn the spectroscope upon the subjects and allow the camera to work through it, and find if the absorption bands were the same while burning the various metals under these peculiar conditions.

Another very important thing, it seems to me, to be determined, would be the action of the vapor in the magnetic field. I have noticed some peculiar things. For instance,

[*Continued on page* 123.]

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CONSIDERABLE space is devoted in this number of the WESTERN ELECTRICIAN to the electrical features of Buffalo, which, taken in connection with the illustrations in last week's issue, will give an excellent idea of the progress that has been made in electric lighting in the convention city. At this time it is not inappropriate to call attention to the excellent illustrations that are presented from week to week in this journal. This has been one of the most attractive features of the WESTERN ELECTRICIAN, and the standard established will bear favorable comparison with that of any class publication in the country.

IT seems to be taken for granted that the Buffalo convention will adopt the suggestion of President Huntley to hold only one convention each year hereafter, and it is also the general belief that James I. Ayer, of St. Louis, has been slated for the presidency. To these propositions there is no objection, but the suggestion that the next convention be held in Chicago in 1893, and that the officers elected in Buffalo hold over until the Chicago convention, is not altogether satisfactory. It is pointed out that the association is going from one extreme to another in the matter of time, and that, while there is no objection to Mr. Ayer for president, there should be a Chicago man at the head of the association in 1893. In this connection it is suggested that should the present policy be followed and Mr. Ayer elected president at Buffalo, the next convention should be held at St. Louis some time next fall, when a Chicago man can be selected to preside over the convention at Chicago during the World's Fair.

CARL KAMMEYER'S paper on "Photography as Applied to the Investigation of Electrical Phenomena," read at the last meeting of the Chicago Electric club, excited a great deal of interest. The lantern slides exhibited showed the appearance of a number of makes of fuse wire while exploding. Mr. Kammeyer stated that he found the alternating current caused a fuse to blow in a less "vicious" manner than the continuous current, and he presented an ingenious theory as to the reason for this action. After the lecture there was a discussion in which it was generally agreed that Mr. Kammeyer had opened up a method of investigating the action of fuses that could be followed and, doubtless, valuable results attained.

DURING the last year 23,244 patents were issued in this country, an average of nearly 2,000 a month. This leads a contemporary to assert that "the inventive genius of the American people is even more fertile in these times than it was in other times." Rather should it be inferred that the patent lawyers are reaping a golden harvest. An examination of many of the patents issued during the last twelve months leads to the conclusion that more ingenuity and originality were displayed in the preparation of the specifications and descriptions of the devices patented than in the machines themselves. The suggestion that the appropriation be increased is no doubt a good one, and it might be added that the money be expended in securing the services of competent examiners. Some provision should be made to insure the retention of valuable men. The patent office has long enough been a training school for patent lawyers.

BROOKLYN'S cable line is already beginning to develop those symptoms that have made the Chicago and San Francisco systems so unpopular. A cable car on Montague street with six passengers aboard had a startlingly rapid and perilous descent down the hill between Columbia Heights and the ferry gate a few days ago. The gripman became confused when he found the car leaving his control and failed to pick up the cable after dropping it at the power house. When he did attempt to pick it up the car had gained such momentum that the grip failed to take hold. An effort was then made to apply the brakes but as they work only automatically in connection with the grip they were practically useless, and the car started down the hill with no machinery in operation. At the foot of the hill the car had gained terrific speed, and when it finally dashed into a "bumper" the passengers were thrown forward in a heap and many of them seriously injured. The car, of course was wrecked.

The good people of Brooklyn who objected so long and strenuously to the trolley system are beginning to realize that between the non-controllable grip car and the so-called "deadly trolley" system the latter is by far the safer and more desirable.

A LONDON technical journal, *Electricity*, in speaking of the World's Fair, has the news that "Work is in a much more backward condition than could be wished, and it is said the exhibition will not be anything like complete until the spring of 1893." Possibly some of the readers of the English paper, which is a comparative fledgeling in the field of electrical journalism, may be misled by this statement. They should understand that it is entirely incorrect. It was decided in 1890, shortly after Congress had voted that Chicago should have the World's Fair and before a stroke of work had been done at Jackson Park, the site of the exposition, that the date of opening should be May 1, 1893; and our English friends may rest assured that the fair will be open for visitors at that time. Inasmuch as the exhibition is held to commemorate the four hundredth anniversary of the discovery of America, the dedication services, when the buildings will be turned over to the president of the United States, will be held in October of this year. The exposition will in no sense be opened until the date named, however, which is the time that has continuously been in view since the work of construction was begun. The work is progressing satisfactorily. A view of the present aspect of the electricity building is shown in this issue.

MUCH surprise is frequently expressed at the great strides that have been made in bringing electrical devices prominently before the public, and securing their adoption by great corporations. No better example of this can be found than in the development of the electric railway in this country. It is only a short time since the idea of operating street railways by electricity was first discussed by capitalists, yet to-day the number of important roads and hundreds of miles of railways equipped with the electric system bear evidence of the progress that has been made. Improvements have, of course, been introduced from time to time, and radical changes have been made.

The electrical press has much to do with the favorable reception which the public has extended to electrical apparatus. Despite the phenomenal growth of the industry the electrical papers have always been found in the lead. They have promoted a general interest in everything electrical, and by acquainting the public with the advances that have been made in the art, have created a demand for the introduction of electrical apparatus. The fact that such a corporation as the Illinois Central railroad would consider the subject of introducing electricity as the motive power on its suburban lines shows the lively interest that has been created by these journals. The ability of the American electrical press is generally recognized today, and it has become an indispensable factor in electrical development.

WHILE the mayor, city council and citizens' committee have been discussing schemes for increasing the street railway facilities of Chicago, the street car companies have been gradually diminishing the number of cars operated. This is clearly proven by the reports submitted by the companies to the city last week, when they were obliged to pay their quarterly licenses into the city treasury. Comparison with the reports for the corresponding quarter of last year shows that the much abused North Side cable railway was the only corporation which increased the number of cars on its lines. The South Side and West Side companies took off fourteen cars. It is such methods that cause the public to look with distrust and disfavor on all corporations holding valuable franchises. The street railway companies of Chicago have protested frequently that they have done all that was possible under the circumstances. Yet their own reports prove the falsity of the statements. These companies should be compelled to put on more cars and furnish improved service for cross town lines or give up their franchises. The only excuse at present is that they are running the full extent of their cable stations. If further extensions are impossible with this system, another should be substituted that would admit of extensions. The old horse cars on Indiana avenue and the cross town lines should give way to an electric system. It is a disgrace to the city of Chicago to have such inadequate means of transportation.

RAPID transit in New York city has so long been a topic of discussion without any appreciable advance being made, that many who have attempted to follow the numerous plans proposed have despaired of reaching a practical solution. It was thought that the adoption of an underground tunnel plan by the Rapid Transit commission would insure relief from the present unsatisfactory service, but now the outlook is no better than it was a year ago. The whole question has been reopened by the opponents of the tunnel plan who propose an open-air viaduct system, and just now the discussion of the relative merits of the tunnel and viaduct systems is being conducted with renewed vigor. Chauncey M. Depew is reported as saying: "I was in Europe last summer and rode through the London underground roads. They are mean and disagreeable things to ride in." Referring to the Greathead tunnel road Mr. Depew says: "The English people don't like it, and they don't patronize it any more than they can help. No, we do not want an underground road in New York." In the proposed viaduct plan it is suggested that the top of the New York Central's tunnel be torn out, and over it an improved elevated structure be erected from the Harlem down to the Grand Central station, thence by viaduct across to the center of the block between Second and Third avenues, and down to the City hall in as straight a line as possible. Below Forty-second street the plan proposes the erection of an immense viaduct with storage houses.

It is claimed on behalf or the new system that the plan has been approved by prominent engineers, and that the New York Central will co-operate with the commission in the building of the rapid transit line. Plenty of capital will be forthcoming for the new road it is believed, while on the other hand it has been asserted that the city would have to be bonded in order to raise the money for the underground system. If this is the case it is certainly a serious matter, as the people will object to being taxed for an improvement in which private capital cannot be enlisted.

[Continued from page 121.]

we were trying some heavy fuse wire, taking, I think, about 370 amperes to blow it, and in a large number of tests for fuse wire worked as shown in Fig. 1, say, for instance, *AA* were the termini or blocks to which the fuse *B* was attached, the end of the fuse wire to the right would blow, as indicated, and the other end would come off, as shown. I supposed it to be due to a current of air, operating upon the high temperature of vapor to wipe this part of the metal (to the right) out of existence. By changing the conditions so that the air could not possibly have any effect on the fuse, it was shown that it could not be the air current. About a 40 horse power dynamo stood, say, eleven feet away, and I have no doubt that the radient field of that machine, although very slight indeed, had something to do with the persistent direction in which the molten metal seemed to be swept away from the metal that remained. It made no difference what was placed between them. We did not try iron, but nothing else placed between would change it. In rotating the rods of fuse wire, the metal was swept out on the same side in every instance. Then it had occurred to me that if a photograph of the fuse were taken, for instance, with a magnet in the position shown in Fig. 2, so that the field could radiate up to it, the lines of force would blow it out as indicated in the cut, *M* being the magnet.

Another fact that was of interest to me was to observe carefully the effect upon the wire after it had blown, to look very carefully at the demarcations upon the end of the fuse wire. When magnified they might be illustrated by Fig. 3. There was generally a center established, and about that center certain radial lines ran; however, they were not exactly radial. Some of them seemed to take a certain direction, as shown at *C*. The thought occurred to me instantly, isn't it due to the fact that the lines of force encircle the conductor—of course, supposing the circle at *B*, to be the end of the conductor, and the current going through the wire in that direction (indicating), the field of force would be lines circulating around the wire in the direction of the hands of a watch; was it not a fact that the influence of the lines on the molten metal or on the vapor caused the demarcation? Was it not a fact that the field had some influence upon it? I mean the field of its own wire. These lines are also shown upon the beveled end to the right in Fig. 3. And it occurred to me that a photograhic arrangement could be made something like Figs. 4 and 5. Supposing this (indicating) to be the original fuse wire, and *A* the fuse block taking the fuse wire and sawing it at point *E*, and placing a copper terminal, for instance, as shown at *D*. Now, suppose this to become the positive pole, the current to pass in direction of the arrows. Now, then, to look at the whole arrangement with a camera we would have the state of affairs shown in Fig. 4. We could see the end of the straight fuse with merely the sheet of metal *D* between us, and have the scintillations, or have whatever blew out, gases or metal, in the line of a tangent, indicated at *F*, which the sensitive plate would instantly record, and we could see in this way whether the field of the wire itself had an influence upon it. It seemed to me that it would be of interest to determine if the field of the wire influences the gases that were passing from the fuse. In place of the fuse in Fig. 4 metallic foil could be employed to connect approaching cylindrical surfaces of rods with coincident axes. By this means the relative influence of the rotary field upon the various substances could be easily studied.

In regard to the point brought out by Mr. Wirt that fuse wire taken from the same spool varied, I have had occasion to test a great many fuses, and I have not been able to discover any such percentage of difference as he names. However, I have observed a small percentage of difference, and the explanation of it that has always satisfied my mind was that in some instances the fuse wire has been bent at some points along its length more than others. I have noticed that if you take a fuse wire and bend it back and forth until it becomes somewhat crystalized in its nature and hard, so that a bend will tend to occur somewhere else on the wire than where you try to bend it, that wire will blow at that point very much quicker than it will where it is softer; and I have no doubt that a casual observer would think that there was something wrong in the texture of the fuse wire, whereas it was a condition that was produced by its having been bent at one point more than at another.

THE CHAIRMAN: Mr. Kammeyer speaks of the danger of the blowing of fuses in the dust of mills. I think we could get around that very readily by putting the fuse box outside of the dust room. With reference to the conditions in the melting of a fuse, while Mr. Sperry's explanation will cover part of it, I think that in addition to the crystalization there may be a difference in density in different parts of the same fuse; that when that fuse is drawn a larger piece might be forced through at one point than at another. That is a difference of diameter of the original piece. You have all no doubt seen iron rails drawn in the rolling mills, where at the first few drawings the mass is irregular in shape and of different diameters. A difference in diameter of a very small amount would make a difference in density as it passed through.

ALEX. DOW: I have observed the same phenomenon that Mr. Kammeyer has noted, namely that under certain conditions the material of a fuse will be completely dissipated. That in fact the blowing appears to be a molecular disintegration rather than a melting. Some eight years ago, I made a number of observations on the behavior of overloaded conductors, and it appeared to me that the phenomenon observed was analagous to that known as static repulsion; exactly the same thing seen on a small scale in the gold leaf electroscope, where the similarly

FRANKLIN'S STATUE AT THE WORLD'S FAIR.

charged films repel one another. I can imagine that if a conductor is enormously overcharged with electricity, its molecules will repel one another so violently that the force of cohesion cannot hold them together. The probability of any fuse blowing disruptively might be expressed as an equation in which a factor of impressed current would be divided by the specific cohesion of the metal.

But I disagree altogether with Mr. Kammeyer in regard to dispensing with covers for fuse blocks. I think that when fuses of any size are used, the cover is absolutely necessary. I saw once the effect of short circuiting a generator of 1,000 volts and 150 amperes on a so-called 20 ampere fuse. The flying fuse metal set fire to the dynamo tender's overalls. The conditions were apparently favorable to disruptive blowing, but the metal flew in large enough particles to have done considerable mischief.

I think all fuses suffer from oxidation of surface, in which case, the interior of the fuse may [illegible] the exterior, and the break of surface will then cause the discharge of molten metal. [illegible] it would not be very expensive, and certainly would be efficient in preventing the trouble.

MR. KAMMEYER: I want to reply to Mr. Dow's reference to covered fuses against uncovered fuses. I noticed about a year ago in the Stanley transformer fuse box that the fuse wire was covered with a small piece of rubber tube, and it proved to be a preventive against the spattering of metal. A fuse wire covered with a tube of rubber or any non conducting material is not cooled by the surrounding air, and you do not find that sputtering discharge that we have where a fuse blows in the open air.

As far as placing the fuse box outside of the building is concerned, I am afraid Mr. Haskins would have to run a good many feet of wire simply to avoid an explosion of this kind. I would advocate covering the fuse wire with a braided covering or an air tight covering at least that allows a piece of metal to heat equally on the surface as well as in the interior, and prevents spattering every time. I have noticed 1,000 and 2,000 volt currents under those conditions without any results of this kind.

MR. ARMSTRONG: I have had some little experience with fuses, and I think there is more trouble with re-fuses than there is with fuses.

Mr. Kammeyer found that a direct current makes more explosion than the alternating. May it not be that the alternating current is confined to the outside of the fuse wire, and that it simply evaporates the wire and gradually melts it away like an icicle until it gets down to the lowest particle by continuous evaporation? And that the direct current heats on the inside first and then explodes? In other words that the alternating current is simply an evaporization of the wire, and the direct current is an explosion?

MR. KAMMEYER: That seems to me, to be an entirely new theory advanced by Mr. Armstrong. At least, it is new to me, that the alternating current should have that peculiar action on the wire, while the continuous current has the opposite action. There may be something to that, because the appearance of those plates tends to confirm Mr. Armstrong's theory, if you noticed them closely enough. In fact some of the fragments of the fuse after the explosion had taken place, looked like an icicle, and if I remember correctly, this explosion took place under the action of the alternating current. The direct current has nothing of the fuse wire left to speak about.

MR. SPERRY: I was also interested in the fact that Mr. Kammeyer has stated, but an altogether different explanation occurred to my mind. I remember when watching some experiments with a percussion drill, operated by an alternating current, the current was of a very slow phase and you could watch its action very easily. I noticed that whenever the terminals were drawn apart it was very seldom that a spark occurred, although there were 220 volts and about 40 amperes. Now, why is this? There is no doubt that by using an alternating current, or using a current that is divided up in undulations in this way, the heaviest current may be broken without a particle of spark. It is an undoubted fact that the circuit is broken by some means at a time when there is no current in the line. There is an instant on that particular kind of an alternating current when there is no current, and I suppose that there is a time in the most rapidly alternating current when there is no current, and undoubtedly the rupture of the fuse takes place at this time, which explains, in a measure, the want of vividness in those photographs where the alternating current is used. This is the explanation that occurred to me.

Franklin's Statue at the World's Fair.

The decorations on the electricity building at the World's Fair will be very elaborate. One of the most striking features of these decorations is the statue of Franklin, which will occupy a most prominent position at the south entrance to the electricity building. This figure has been pronounced one of the finest that will be seen at the exposition. In the accompanying cut an excellent idea of this statue is presented.

A St. Louis man named Ward conceived the idea the other day, while intoxicated, that he was more powerful than an electric car. To prove this he wandered to Seventh and Locust streets and waited for a car. Car No. 43 of the St. Louis Suburban railway was first along and as it reached him Ward stepped into the middle of the track and lowered his shoulders to the effort. He was thrown nearly thirty feet and was picked up unconscious. He was sent to the city hospital after being taken to the dispensary and is reported to be in a critical condition.

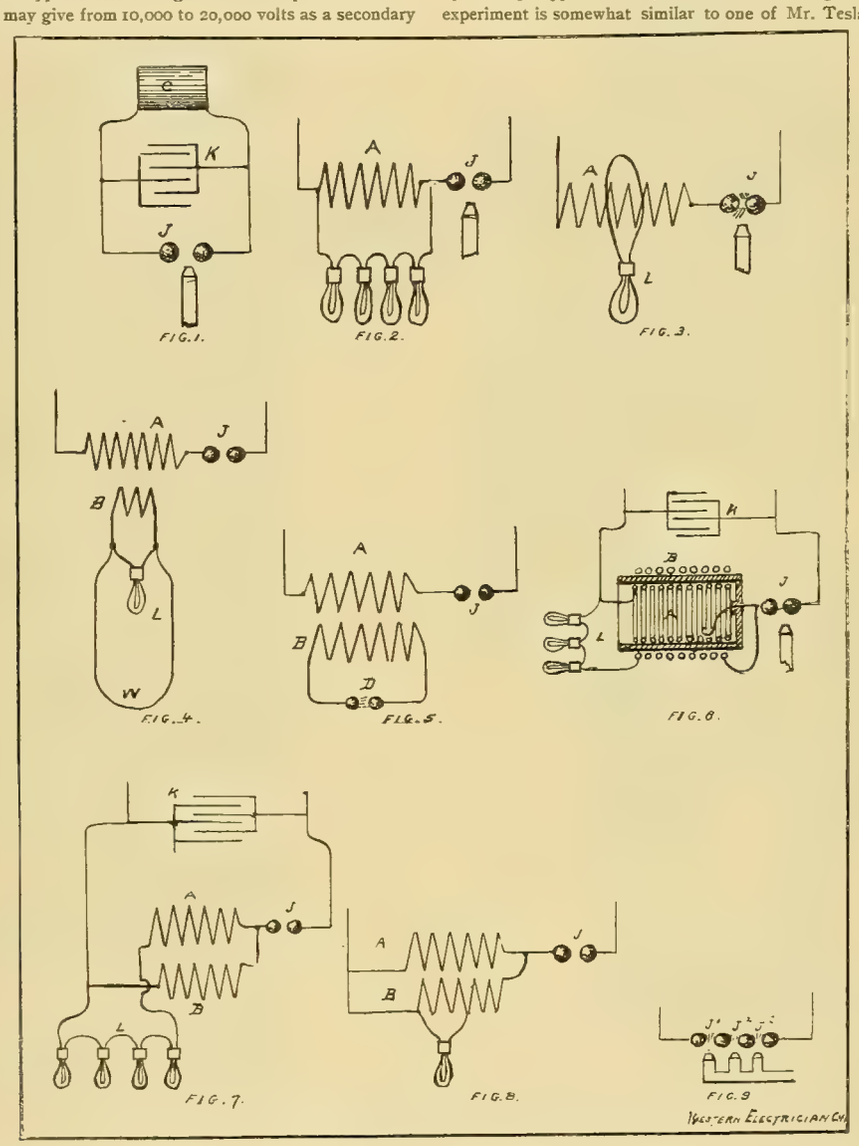
Further Experiments with Condenser Spark and Air Jet.

By Elihu Thomson.

In a prior communication I described some effects which were obtained by the induction of Leyden jar or condenser discharges passing through coils, or helices, upon other coils or helices, placed in inductive relation with the former, and the effects of the use of an air jet or blast upon the spark discharge of a condenser as acting to enhance the inductive effects of the discharge, were alluded to.

It is my purpose in the present paper to still further emphasize the novel actions brought about by allowing a stream of air to play upon the discharge obtained from a condenser connected to the terminal of a high potential coil, such as a secondary whose primary is fed by alternating currents of any frequency.

Fig. 1 typifies this arrangement. C represents a coil which may give from 10,000 to 20,000 volts as a secondary to a suitable primary fed with alternating currents of suitable voltage. The terminals of this coil are connected to the condenser K, as indicated, and the discharge of this condenser is effected by means of terminals at J, and an air jet is allowed to play upon the discharge at J for the purpose of making use of discharges of very high frequency. In other words, the inductive effects of the discharge passing across the gap J, which, without the presence of the air jet would be quite feeble, may be enormously enhanced, and represent in fact the passage of currents of extraordinary frequency. Thus, in Fig. 2, if a coil A of a few turns of heavy copper wire, even as large as a quarter of an inch in diameter and, say, 15 to 20 turns, wound to a diameter of about 6 inches, be interposed in the path of the discharge, or in series with the discharge terminals at J, the self-inductive effects of this coil are such that a number of incandescent lamps in series are lighted in shunt to it. Without the air jet at J, the lamps do not incandesce. This experiment shows the presence of enormous self-induction in A, as its actual resistance can be but a very small fraction of an ohm.



FIGS. 1 TO 9. FURTHER EXPERIMENTS WITH CONDENSER SPARK AND AIR JET.

The presence of such high self-inductive action in A, naturally suggests that it may be used as a primary and produce strong inductions in a parallel circuit. Thus, in Fig 3, if a single turn be taken around the coil A, and an incandescent lamp L, demanding twenty-five volts and two amperes of current, be connected across the terminals of the single turn, as shown, the lamp at L is lighted by the inductive effects, but this does not occur without the air jet at J.

Another demonstration of the extremely high frequency of the discharges is indicated in Fig. 4, where two or three turns of conductor are placed in inductive relation to the coil A, such as are indicated at B. In the figure they are represented as being separated, but it is to be assumed that they are wrapped around the coil A, and perfectly insulated therefrom. Several turns in B are sufficient to illuminate the lamp at L, depending upon its voltage and its resistance, even though its terminals are solidly shunted by a heavy copper wire W, several feet in length. This experiment is somewhat similar to one of Mr. Tesla's experiments in that it depends upon the enormous frequency of the discharges in B. The effects are practically *nil* without the air jet playing at J. If the coils A and B be employed as a simple induction coil without an iron core, it is found that at a distance of a quarter of an inch at J, with the air jet passing, very heavy thick sparks pass at D, which space may be made three-quarters of inch in length, the sparks resembling Leyden jar discharges, although the number of turns in B are only 20 and in A about 10. Both coils are constructed of very heavy copper wire and the turns kept apart, the average diameter of the coils being 6 inches.

In Fig. 6 is shown a modification in which the outer coil consisting of about 20 turns of copper wire about a quarter of an inch in diameter, and the inner coil about 12 turns of somewhat similar gauge, are connected together so as to form, as it were, a closed circuit with each other through the lamps at L. The discharges are sent through the system as before by the air jet spark at J from the condenser K, fed by high potential alternating currents of 10,000 to 20,000 volts. The lamps at L are brilliantly lighted in this experiment. Variations of the effective length of the single coil A, which is made of bare wire, can be obtained by a sliding contact, as indicated in the figure. This contact may be made to include more or less of the turns of A.

A modification of the experiment, Fig. 6, is shown in Fig. 7, in which two coils, A and B, are connected in multiple, but the coil A is connected through the lamps, which are brought to high brilliancy on the passage of the discharge at J with the air jet playing thereon. The coil B has the greater number of turns in this experiment and probably feeds its lamps through the coil A by a sort of local current flowing through the two coils in series, though this is very difficult to determine. If on the passage of the discharges across J there are unequal inductions in the coils A and B, which set up currents local to the lamps, we would have an action analagous to the flow of current locally to two coils connected in multiple arc when they are in unequal positions with respect to a changing magnetic field, causing an inequality of electromotive forces to exist.

Fig. 8 shows that with the coils connected in multiple, even though the turns be unequal it is easy to light a lamp L which spans a few of the turns in the outer coil. The lamp used in this case was a 100 volt lamp. The vigor of the self-inductive actions is certainly remarkable, and with the ordinary periodicities of alternating current, namely 125, or 250 alternations per second, initially supplied, effects due to very high frequencies are very readily obtained. The actions appear to be more vigorous the larger the condensing surface in K, the longer the spark at J, and the more vigorous the air jet used. The air jet hitherto employed by me has been of very moderate pressure and I expect to increase its force with the construction of a much larger apparatus for getting these inductive effects.

It would appear that we have in the air jet and the spark discharge a partial solution of the problem of obtaining very high frequencies in a fairly continuous manner.

Fig. 9 shows an arrangement which may be found more effective when working with very powerful apparatus, that is, a series of spark-gaps J^1, J^2, J^3, each of them provided with air jets blowing therethrough. A much higher potential will be required to leap these combined spark-gaps while the extinguishing action, or the blowing action of the jets will be equally vigorous in each space.

The apparatus is so simple and of so little cost to construct even for obtaining, by inductive actions of this character, sparks of great length and extremely high voltage, that it is contemplated to construct a much larger apparatus than that which has hitherto been used. The coil B in these experiments while made of a few turns of heavy, coarse wire, was in my former communication described as constructed of a much larger number turns of fine wire immersed in oil, and it was shown that torrents of long sparks could readily be obtained therefrom. The ratio of inductions between the coils A and B seem to be approximately those in an ordinary transformer and while it is very difficult to estimate from the length of spark alone the actual voltage existing, yet it is certainly true that very many thousands of volts potential difference exist between the terminals during the passage of such sparks as 7 and 8 inches in length. The striking distance, however, appears to increase much more rapidly than the potential, and if the law holds good, it would appear to be easy to secure sparks of very great length by extending the scale of my experiments. It may be remarked here that in reference to striking distance, it is a question whether there is not a certain potential which from a certain sized terminal will strike at any distance. It would appear that in order to prevent the discharge from passing into the air either in the form of a brush or a discharge connecting the terminals, the terminals themselves should be made in the form of larger and larger poles kept more perfectly smooth, the higher the potential worked with, and that for voltages as high as 200,000 or 300,000 terminals tipped with small balls, would act practically as points and allow discharge into the air in the form of a brush discharge, if this potential could not actually cause a leap between the terminals.

American Institute of Electrical Engineers.

The American Institute of Electrical Engineers will hold its general meeting in Chicago this year. This was decided at the meeting of the council February 16th. The date of the meeting, however, has not yet been determined, but it is expected that it will be held some time in May. Heretofore the general meetings of the Institute have been held in the third week in May.

According to recent calculations there are at present 206 central stations in operation in Europe.

Arrival and Departure of Mails at Buffalo.

Heretofore at conventions of the National Electric Light association there has been considerable confusion among delegates owing to lack of information concerning the arrival and departure of mails. For the information of visitors to Buffalo during the convention the WESTERN ELECTRICIAN presents the accompanying official table for which it is indebted to B. F. Gentsch, postmaster at Buffalo.

TABLE SHOWING TIME OF ARRIVAL AND DEPARTURE OF MAILS AT BUFFALO.

PRINCIPAL OFFICES.	MAILS CLOSE AT BUFFALO P O FOR							DUE AT DESTINATION ABOUT							DUE AT BUFFALO DEPOTS FROM							
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	A. M.	A. M.	A. M.	A. M.	P. M.	P. M.	P. M.	P. M.
Albany, N. Y.	3 00 a m	7 00 a m	3 00 p m	7 30 p m				2 10 p m	4.45 p m	1 00 a m	3 55 a m					6.15	9 35		7 30	8.10	11.40	5.40
Baltimore, Md.	4.06 a m	7 30 a m	4 30 p m	9 00 p m	11.00 p m			2.40 a m	5 00 a m	8 20 a m	12 35 p m	6 55 p m				7.00	9.35		4 45	8.10	11.40	
Bradford, Pa	8 00 a m	4 30 p m	12 00 m					12 05 p m	8.20 a m						10.25				6 10			
Batavia, N. Y.	4 00 a m	7 00 a m	11.25 a m	3 00 p m	11 00 p m			5.45 a m	8.55 a m	1 35 p m	4 40 p m	12.35 a m				9.35			12 15	7 45	8.10	11.40
Boston, Mass.	4 00 a m	7 00 a m	3 00 p m	5 20 p m	11.00 p m			8.30 p m	11 07 p m	9 40 a m	9 40 a m	2.50 p m				6.15	9.35		8 10		11.40	
Black Rock	6 10 a m	7 00 a m	9.45 a m	10 45 a m	1 15 p m	2 05 p m	4.45 p m	6.25 a m	7.25 a m	10 00 a m	11 00 a m	1.30 p m	2.20 a m	5.00 p m	8.45	10.15	11.15		1.30	3.15	4.15	7 15
Chicago, Ill		9 00 a m	12 00 m	7 30 p m	11 25 p m				12.45 a m	8 35 a m	10.30 a m	4.25 p m			4.00	8.40			3.30	11.30		
Cleveland, Ohio	6.00 a m	9 00 a m	12.00 m	7.30 p m	11 50 p m			10.35 a m	2 35 p m	6 25 p m	12 59 a m	5.45 a m			4.20				3.30	8.20	11.30	
Cincinnati, Ohio	9.00 a m	12 00 m	10.30 p m	11 50 p m				3 00 a m	6.45 a m	10 00 a m	4.55 p m				4.20	6.55			3.30	8.20	11.30	
Dunkirk, N. Y.	6.00 a m	9 00 a m	4 30 p m	11 50 p m				8 25 a m	10 41 a m	6 40 p m	1 56 a m				4.20	9.40			1.00	3.30	11 30	
Detroit, Mich.	6.00 a m	12.00 m	11.00 p m					2.10 p m	9.45 p m	8 30 a m					7.25	4 00			3.15	6.05	9.15	
East Buffalo	5.30 a m	6.30 a m	10 15 a m	1.15 p m	2 15 p m	3 15 p m	5.15 p m	5.45 a m	6.45 a m	10.30 a m	1 30 p m	2.30 p m	3.30 p m	5.30 p m	10.45				12.45	2.15	3.25	5.45
Elmira, N. Y.	7.30 a m	4.30 p m	9.50 p m	8 20 a m				1.45 p m	10 15 p m	1.47 a m	7 20 a m				7.00	11.00			10.25	8.20		
Erie, Pa.	6.00 a m	9.00 a m	12.00 m	7 30 p m	11 50 p m			8.58 a m	12.00 m	3.55 p m	10.25 p m	3.26 a m			4.20				3.30	11.30		
Hamilton, Ont.	5.40 a m	6.40 a m	12 00 m	1 40 p m	3 00 p m	11 00 p m		9.00 a m	11.35 a m	4.00 p m	6.25 p m	9.20 p m	8.40 a m		9.35				5.50	9.00	12.25	
Jamestown, N. Y.	7.50 a m	1.40 p m	7.50 p m					11.20 a m	5.05 p m	11.15 p m					10.30				12.40	7.35		
Lockport, N. Y.	5.15 a m	10 00 a m	2 00 p m	11.00 p m				7.15 a m	11.55 a m	3.50 p m	5.35 a m				9.20				1.35	8.10		
London, Ont.	5.40 a m	6.50 a m	12.00 m	1.40 p m				11.20 a m	1.00 p m	6.50 p m	9.45 p m				9.35				5.50	9.00	12.25	
New York, N. Y.	4.00 a m	7.30 a m	3.00 p m	5.20 p m	7.30 p m	8 20 a m	11.00 p m	7.00 p m	8.37 p m	6.00 a m	5.50 a m	7.45 a m		10.35 a m		6.15	7.20	9.35		8.10	11.40	5.40
Niagara Falls, N. Y.	8.20 a m	11.25 a m	3.00 p m	11 00 p m				9.53 a m	12.55 p m	4.30 p m	1.15 a m				8 35	11.55			3.05	9.00		
Oil City, Pa.	7.50 a m	9.00 a m	8.20 p m	11.50 p m				1.25 p m	9.45 p m	2 05 a m	10 05 a m				7.20				1.00	5.50		
Philadelphia, Pa.	4 00 a m	7.30 a m	4.30 p m	9.00 p m	11.00 p m	8.20 a m		1.00 a m	1 35 a m	7 04 a m	10.00 a m	4.30 p m					7.20	8.45	10.25		11.40	
Pittsburgh, Pa.	7.50 a m	9.00 a m		8.20 p m	11.00 p m			6.20 p m	8.45 p m		7.20 a m	12.30 p m			4.20	7.20				5.50	3.30	11.30
Rochester, N. Y.	4.00 a m	7.00 a m	11.25 a m	3.00 p m	11.00 p m			6.50 a m	9.50 a m	2 50 p m	5.35 p m	1.20 a m				6.15	9.35		12.15	8.10	11.40	
St. Louis, Mo.	9.00 a m	12.00 m		11.50 p m				7.45 a m	5.15 p m		7.45 a m				4.20	7.25			3.30	11.30		
Susp. Bridge, N. Y.	8.20 a m	1.40 p m	3.00 p m	11 00 p m				10.00 a m	3.15 p m	5 05 p m	12.40 a m				8.35	11.55			3.05	9.00		
Syracuse, N. Y.	4.00 a m	7.00 a m	11.25 a m	3.00 p m	11 00 p m			9.20 a m	12.10 p m	5.15 p m	7.50 p m	3.15 a m				6.15	9.35		12.15	8.10	11.40	
Titusville, Pa.	6.00 a m	7.50 a m	2.00 p m	8.20 p m				12.35 p m	1.00 p m	7 58 p m	1 25 a m				7.20				1.00	5.50	11.30	
Toronto, Ont.	5.40 a m	6.40 a m	12.00 m	1.40 p m	3.00 p m	11 00 p m		10 25 a m	1 40 p m	5 30 p m	8.20 p m	10.45 p m	8.45 a m		4.30					9.00	12.25	
Tonawanda, N. Y.	5 15 a m	7.50 a m	10.00 a m	1.40 p m	4.30 p m			6 40 a m	8 39 a m	12 06 a m	2 00 p m	7 07 p m			10.10				3 05	6.25		
Washington, D C.	4 00 a m	7.30 a m	4.30 p m	9 00 p m	11.00 p m			4.10 a m	6 00 a m	10.45 a m	1 42 p m	8.15 p m			3.35	6.15	9 35	11.00	4.45	5.40	12.15	

Famous Electricians and the World's Fair.

The WESTERN ELECTRICIAN has taken some pains to secure data for outline biographical sketches of the electricians whose memory it is proposed to honor by inscribing their names on the electricity building at the World's Fair. An attempt has been made to mention the distinguishing achievements of each, together with the date of his birth and death, but in a few instances it has been found impossible to do this, as only the most meager details of the lives of some of the men included in the list have been handed down to posterity.

A careful review of the names selected will show that the list is not above criticism. There are several eminent electrical scientists whose names might well be honored by a place on the building, but which are conspicuous by their absence. It will be noticed that a large proportion of the men named are inventors who had something to do with the early development of the electric telegraph, while the names of many investigators of renown, who devoted themselves to the study and development of the science of electricity, have been omitted.

It is interesting to note how the honors have been distributed among different nations. England heads the list with fifteen names: Gilbert, Gray, Priestley, Cavendish, Davy, Ronalds, Faraday, Maxwell, Sturgeon, Bain, Daniell, Joule, Cooke, Wheatstone and Varley. Germany comes next with eight: Guericke, Sömmerring, Ohm, Weber, Gauss, Jacobi, Steinheil and Siemens. The United States has Franklin, Coxe, Henry, Morse, Vail, Davenport and Page, while to France should be credited Coulomb, Laplace, Ampère and Arago. Other nations are represented as follows: Italy, Volta and Galvani, Switzerland, Saussure and De la Rive; Denmark, Oersted; Spain, Don Silva; Greece, Thales. Jacobi, in the German list, may, however, be counted as a representative of Russia, as most of his inventions were made while in that country, and Siemens (Sir William) may be taken as a representative of England, as he became naturalized in England and obtained his fame while a British subject.

Following are the biographical sketches, arranged in chronological order:

THALES of Miletus.—One of the seven "wise men" of Greece (640–548 B. C.); discovered the electrical attraction of amber (Greek γλεκτρον, electron), from which, 2000 years after, electricity received its name.

GILBERT (Dr. William) of Colchester.—Physician and protege of Queen Elizabeth (1540–1603); discriminated between the properties of the magnet and amber, and closes his famous work (1600), "Tractatus sive Physiologia nova de Magnete Magnetisque Corporibus et de Magno Magnete Tellure," with the famous words: "Vim illam electricam nobis placet appellare." ("That power we propose to call the 'electrical.'") Ever since his time the name electricity has been employed. He discovered magnetic reaction; that the earth is a magnet; that heat destroys magnetism; the straw electroscope; magnetic figures, etc.

GUERICKE, Otto von.—Burgomaster of Magdeburg, previously engineer in the Swedish service (1602–1686). The famous contemporary and friend of Galileo; was inventor of the first frictional electric machine (sulphur Ball), with which he conducted many interesting experiments which are fully described in the books on physics of the seventeenth and eighteenth centuries. He discovered electric repulsion and observed electric sparks.

GRAY, Stephen.—English physicist; born about 1680; died in 1736 at London; discovered the conducting and insulating properties of various metals and other bodies; inventor of the "isolating stool." Gray intimated that the lightning flash and the thunder clap were due to electrical discharges.

FRANKLIN, Benjamin.—Born Jan. 17, 1706, at Boston; died in Philadelphia, April 17, 1790. Prominent among the most eminent writers, diplomatists, statesmen and philosophers of his time. Demonstrated the identity between lightning and electricity. "He sent up a kite during the passing of a storm, and found the wetted string to conduct electricity to the earth. He drew sparks from a key tied to the string, a silk ribbon being interposed between his hand and the key for safety." He discovered the action of points, the cascade arrangement of Leyden jars, electric chimes and electric portraits; invented lightning conductors; killed a turkey by electric shock; advanced the one fluid theory and the theory of the aurora.

PRIESTLEY, Joseph.—Born March 13, 1733, at Fieldhead; died Feb. 6, 1804, at Northumberland. English scientist. He published (1767, London) his famous "History and Present State of Electricity." He discovered the influence of electric discharges on a metallic plate, which show the characteristic "Priestley rings;" also the electrostatic law and the melting of metals.

VOLTA, Count Alessandro.—Born at Como, Feb. 18, 1745; died in the same city, March 6, 1827. Famous Italian physicist. Inventor of the electrophorus condenser, straw electrometer, contact series, crown of cups, Voltaic pile. He proved that electricity arose not from the muscle or nerve of the frog's leg, as Galvani imagined, but from the contact of the dissimilar metals.

GALVANI, Luigi Aloisio.—Italian physician, professor of anatomy; born Sept. 9, 1737, at Bologna; died in the same city Dec. 4, 1798. He observed the movement of frogs' legs when two dissimilar metals were placed in contact with a nerve and muscle, respectively; hence his theory of "animal electricity."

CAVENDISH, Henry.—English scientist; born at Nice, Oct. 10, 1731; died at London, Feb. 24, 1810. Discovered and measured specific inductive capacity (1775) of glass, beeswax and other substances. He showed that nitric acid is produced by electric sparks passing through moist air, due to the chemical union of the nitrogen and oxygen of the air. He investigated Coulomb's balance.

COULOMB, Charles Augustin. Born at Angoulême, June 14, 1736, and died at Paris, Aug. 23, 1806. Famous military engineer. Inventor of the torsion balance (1777); discovered the laws of inverse squares, distribution of charge and surface density.

LAPLACE, Pierre Simon, Marquis de.—Born at Beaumont-en-Auge, March 28, 1749; died at Paris, March 5, 1827. Famous French mathematician. He gave the first mathematical conception of the potential and other electrical questions.

SAUSSURE, Horace Benedict de.—Swiss professor of philosophy. Born at Conches, Feb. 17, 1740; died at Geneva, Jan. 22, 1799. He made investigations and experiments relating to atmospheric electricity, and improved the electrometer. He showed that electricity accompanies the generation of steam.

DAVY, Sir Humphrey.—English scientist. Born at Penzance Dec. 17, 1778; died at Geneva May 29, 1829. Discoverer of the electric arc (1800), of the magnetization of iron and steel by electric currents (independently of Arago's discovery), electrolytic method for obtaining metallic sodium and potassium and the rotation of liquid conductors.

SÖMMERRING, Samuel Thomas.—German physician. Born at Thorn Jan. 28, 1755; died at Frankfort March 2, 1830. Inventor of a telegraph (1808) with 35 (later 27) wires, the signals being obtained by the decomposition of water in 35 little glass tubes. He insulated the different conductors with silk and joined them into a cable. He also devised an alarm bell.

RONALDS, Sir Francis.—Director of the meteorological observatory in Kew. Born in London, Feb. 21, 1788; died at Battle, Sussex, Aug. 8, 1873. Inventor of a system for transmitting signals through wires by observing at one end the divergence of a pair of pith-balls when a charge of frictional electricity was sent in the other end (1816).

AMPÈRE, André Marie.—Born at Lyons Jan. 22, 1775; died at Marseilles June 10, 1836. French professor of physics, chemistry and mathematics. Founder of the science of electro-dynamics. To him is due the theory of molecular currents in explanation of the connection between electricity and magnetism; inventor of the solenoid, "Ampère's rule," laws of currents. He suggested a telegraphic system (1821) by placing a galvanometer at a distant point of an electric circuit.

ARAGO, Dominique Francois Jean.—Born at Estagel Feb. 26, 1786; died at Paris Oct. 2, 1853. French scientist. Discoverer of magnetic field around a wire which carries a current (1820); classification of lightning. Arago discovered, independently of Davy, how to magnetize iron and steel by causing currents of electricity to flow

around them in spiral coils of wire. He also discovered that when a disc of copper is rotated in its own plane under a magnetic needle the latter revolves and follows the disc, or if a magnet is rotated below the disc, the latter follows the magnet.

COXE.—American professor. He proposed (1810) a method for telegraphy similar to Sömmerring's, based on the decomposition of a solution of salts, instead of water, by the electric current.

OERSTED, Hans Christian.—Born at Rudkjobing, Aug 14, 1777; died at Copenhagen, March 9, 1851. Professor of the university at Copenhagen. Discovered (1819) the magetic action of the electric current. He showed that a magnet tends to set itself at right angles to a wire carrying a current. He also found that the position which the needle assumes, right or left, depends upon the direction of the current and the position of the wire. His other acheivements include heating of wire from the passage of electric currents (1817); thermopile (1823); electrometer (1840): improvements in galvanic batteries.

DON SILVA.—Spanish physician. Invented the spark telegraph in 1797.

OHM, Georg Simon.—Born at Erlangen, March 16, 1789; died at Munich, July 17, 1854. Professor of physics. His famous work, published in 1827, was "Die Galvanische Kette Mathematisch Bearbeited." ("The Galvanic Circuit Mathematically Determined.") He announced "Ohm's law."

WEBER, Wilhelm Eduard.—Born at Wittenburg, Oct. 24, 1804; died at Goettingen in June, 1891. Professor of physics. His systems of electro-dynamic, electro-static and electro-magnetic units are well known. Inventor of the electro-dynamometer, mirror scale and tetescope method of reading. He produced experimental evidence establishing Ampère's theory.

GAUSS, Carl Friedrich.—Born at Brunswick, April 30, 1877; died at Goettingen, Feb. 23, 1855. Director of the Goettingen Observatory in 1807. His most famous work is "Intensitas vis Magneticæ Terrestris ad Mensuram Absolutam Revocata" (1832). ("Absolute Measurement; Bifilar Magnetometer and Other Instruments for Observing the Earth's Magnetism.") He established a magnetic observatory and invented an electro-magnetic telegraph.

FARADAY, Michael.—Born at Newington, near London, Sept. 22, 1791; died at Hampton Court, Sussex, Aug. 25, 1867. His famous work, "Experimental Researches in Electricity," was issued in 1831. His name is associated with electrolysis, the law of electro chemical equivalents, voltmeter, diamagnetism; discovered inductive capacity and magneto induction, electromagnetic rotation, extra currents, magnetic lines of force, retardation in cables.

MAXWELL, James Clerk—Born at Edinburgh June 13, 1831; died at Cambridge Nov. 5, 1879. Mathematician and physicist. He advanced theories of electricity, the electromagnetic theory of light, the theory of magnetism; invented methods of electrical and magnetic measurements. He wrote a "Treatise on Electricity and Magnetism."

HENRY, Joseph.—Born at Albany, Dec. 17, 1797; died at Washington, D. C., May 13, 1878. Famous physicist; discovered that the variations in the strength of the secondary currents could induce tertiary currents in a third closed circuit, and that variations in the tertiary current might induce currents of a fourth order, and so on. He invented the "sounder," in which he utilized the audible sounds produced by the movements of the armature of an electromagnet to transmit telegraphic signals; experimented with quantity and "intensity" magnets, electromagnetic engine, relay and receiving magnets; discussed the oscillatory nature of electrical discharge; traced the influence of induction at a distance of over 200 feet.

STURGEON, William.—Born at Whittington, near Lancaster, in 1783; died at Prestwick, near Manchester, Dec. 8 1850. English scientist. He was the first to use the term "electromagnet." He applied the discoveries of Davy and Arago to the construction of electromagnets far more powerful than any magnets previously made. He utilized the amalgamation of tin plates for galvanic batteries, replaced the solid iron core of the induction coil with a bundle of iron wires.

MORSE, Samuel Finley Breese.—Born at Charlestown, Mass., April 27, 1791; died at New York, April 2, 1872. Inventor of the electromagnetic recording telegraph; petition for patent Sept. 28, 1837; telegraphed from Baltimore to Washington May 24, 1844; local circuit operated by a main line relay April 11, 1846.

VAIL, Alfred.—American inventor. For a time Morse's partner. Inventor of first electro magnetic printing telegraph.

BAIN, Alexander.—British inventor, born in Edinburgh; died Jan. 2, 1877. Inventor of electro chemical writing telegraph in 1843. The short and long currents transmitted over a wire are recorded in colored marks on a strip of chemically prepared paper, drawn along by clockwork under the terminal of the positive wire. Inventor of the electromagnetic clock, 1835. Discovered that small currents travsering a coil in strong magnetic field produced great mechanical effects, used in measuring instruments and telegraphy as a magnifier.

DAVENPORT, Thomas.—American inventor, of Brandon, Vt. On June 6, 1837, granted an English patent for electromotor. Inventor of a form of solenoid and plunger electromagnet.

DANIELL, John Frederick.—Born in London, March 12, 1790; died in London, March 13, 1845. Professor chemistry at King's College, 1831; inventor of the Daniell (sulphate of copper) battery; investigated heat and electricity.

JACOBI, Moritz Hermann von.—Born at Potsdam, Sept. 21, 1801; died at St. Petersburg, March 10, 1874. Invented electrotyping, 1837; propelled a boat on the river Neva at St. Petersburg by means of a galvanic battery and an electromotor, 1839; theory of electromotors, practical units of resistance and current; electric telegraph in St. Petersburg. His principal work is "Die Galvanoplastik," 1840.

JOULE, James Prescott.—Born at Salford, near Manchester, Dec. 24, 1818; died at Sale, near Manchester, Oct. 11, 1889. Famous English scientist; devoted much attention to thermodynamics; announced "Joule's law," that the quantity of heat developed by an electric current in a conductor is directly proportional to the resistance of the conductor and to the square of current strength and to the time that current lasts.

PAGE, Charles G.—Professor, Salem, Mass. Noted for having made a trip in an electromagnetic locomotive from Washington to Bladensburg and return, April 24, 1891; highest speed, nineteen miles per hour; discovered magnetic sounds; made an electromagnetic engine of the solenoid and plunger type, 1834; drove with it circular saw and lathe, 1852.

STEINHEIL, Carl August.—Born at Ribeaupierie, Alsace Oct. 12, 1801; died at Munich, Sept. 14, 1870. Bavarian professor. Improved electric telegraph, 1837; telegraphed over line 38,000 feet long, using the earth as return, 1838; electric control of a number of clocks from one standard clock, 1839.

COOKE, Fothergill.—English scientist. He invented a telegraph (1836) in which an alphabet was worked out by the single and combined movement of three needles. Subsequently, in conjunction with Wheatstone, he introduced another form containing five vertical index needles. Two needles were acted upon at the same time, and the letter at the point of intersection of the direction of the indexes was read. This telegraph required six wires and was later abandoned for the single needle instrument. This invention is still of great importance in in struments for submarine cable telegraphy. Cooke inclosed conductors in lead pipes formed around them by hydraulic pressure.

WHEATSTONE, Sir Charles.—Born at Gloucester in 1802; died in Paris, Oct. 18, 1875. He invented the "rotating mirror" for determining velocity; he found by its means that the brush discharge is really a series of successive partial sparks at rapid intervals, He devised "Wheatstone's bridge or balance" for measuring resistances. On Feb. 14, 1867, he explained the dynamo electric principle before the Royal Society, his suggestion being made independently but later than that of Werner Siemens. Cooke and Wheatstone brought into practical application the first form of their needle telegraph in London in 1837.

SIEMENS, Carl Wilhelm. (Sir William).—Born at Lenthe, Hanover, April 4, 1823; died in London, Nov. 19, 1883. Originator of a number of valuable inventions, including Siemens' electric furnace, in which the hot atmosphere of the electric arc between carbon points melts refractory metals. Inventor of an electro thermometer, a pyrometer and attraction meter and a bathometer. He was the author of a large number of valuable papers.

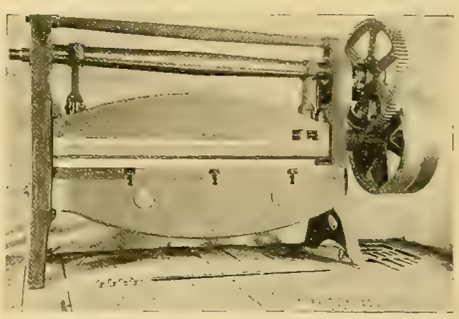
VARLEY, Cromwell Fleetwood.—English inventor. Son of Cornelius Varley, the scientist and artist. He and his three brothers (Frederick Henry, S. Alfred and Octavius) were identified with electrical science. He constructed the first testing apparatus employed in the continuous ship-to-shore testing of the Atlantic cable in 1865; provisional specification for a machine having electromagnets only in 1866, and suggested rotating brushes in the form of metal disks. In 1856 he described a form of induction coil having a laminated and closed magnetic circuit, closely resembling some of the modern forms of transformers.

DE LA RIVE, Auguste Arthur.—Born at Geneva, Oct. 9, 1801; died at Marseilles, Nov. 29, 1873. Swiss professor of physics. One of the founders of the electrochemical theory of galvanism; devised a floating battery, and wrote on diamagnetism, the aurora borealis, transit resistance, the heating effect of the current, etc. His works are mostly included in "Traité D'électricité Théorique et Pratique," 1854-1858.

Mammoth Cutting Press.

The press shown in the accompanying illustration was built for the Edison General Electric company by the Ferracute Machine company of Bridgeton, N. J., from the designs of President Oberlin Smith. This machine is especially adapted for making sections of disc for very large laminated armatures, cutting them complete from the sheet at one operation, and at the same time perforating them. The press will take in sheets up to a diameter of nearly 8 feet, the width in the clear between the columns from right to left being 100 inches. The Ferracute company claims that this machine is the largest ever built for work of this kind. It is of the same general design as are a large number of other sizes built by the same makers. The size is its distinctive feature.

It will be noticed that the bed and the ram are heavily trussed to obtain great rigidity, and also that the columns and connections are of handsome and massive design. The shaft is of forged steel; the clutch and other parts subjected to greatest wear are of hardened steel, and all bolts, nuts, etc., are case-hardened. The gearing is cut from solid metal and is practically noiseless, while the fly whee



MAMMOTH CUTTING PRESS.

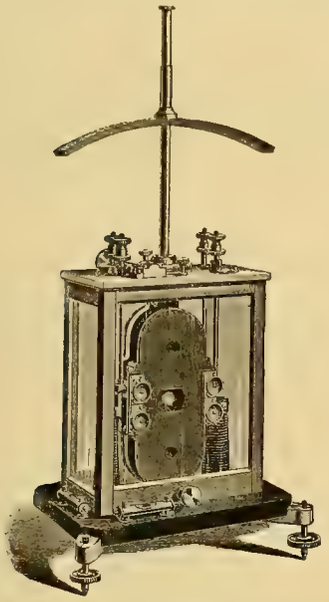
and loose pulley are wide and large enough for ample belt power, being 44 inches in diameter by 7 inches face and weighing about 1200 pounds. The slides of the ram, of unusual length, are furnished with an accurate adjustment and are so swiveled that they can easily be kept in alignment. A brake is placed in such a position that it helps to support the extra weight of the gearing upon the right hand end of the shaft, although the clutch is so arranged that the brake can be run quite loosely, so as not to waste power.

Among the particularly novel features of the Ferracute machines of this class are a clutch whose tripping mechanism is adjustable around the axis of the main shaft, through an angle of some 60 degrees, allowing the clutch to be tripped early or late, according to the particular conditions of speed and ram load, thus insuring an automatic action which always stops the shaft exactly at top of stroke; a new worm gear adjustment for height of ram arranged to give 3 inches adjustment; a treadle lock, enabling the press to be run continuously or intermittently as desired, etc. The ram adjustment can be made while the press is in motion. Several safety devices form a part of the machine. There is a guard at the sides of the gear where they are in contact, and a dead stop upon the clutch to prevent a second stroke, should it not be adjusted exactly right. A clutch lock is also provided, by means of which the clutch is prevented from acting if accidentally tripped. This allows the press shaft to be revolved by hand while the fly wheel and gearing are running. The total weight of the machine is about 19,000 pounds; total length, about 12 feet; total height, about 8 feet. The hole through the bed is 90 inches long, from right to left, and 36 inches from front to back. Height from top of bed to bottom of ram, when the latter is up, is 14 inches. Effective height from top of bolster to bottom of ram is 10½ inches, the thickness of bolster where it rests upon bed of press being 3½ inches. Where it spans the hole in bed of press, the bolster is heavily trussed. The ram is provided with flanges containing a number of holes, making it an easy matter to attach upper dies of various sizes and shapes.

Queen & Co.'s New Four Coil Thomson Reflecting Astatic Galvanometer.

In the Thomson reflecting astatic galvanometer with four coils, illustrated herewith, Queen & Co. lay claim to a combination of the best features of construction suggested by theory or embodied in other similar instruments. In designing this galvanometer four objects were held in view as necessary to attain: First, maximum insulation of the strictly electrical portions of the instrument; second, maximum sensibility, third, application to a wide range of use; fourth, convenience in adjustment, and quickness in working.

To attain high insulation the entire framework of the instrument, to which the coils proper are fastened, is supported by two highly polished corrugated rubber pillars, each 3½ inches in height. The corrugations so increase the insulating surface of the pillars as to make each one equivalent to a plain pillar 7 inches high. The method heretofore employed was to attach this frame work directly to the rubber base by brass braces and screws. The terminal binding posts of the coils, also, instead of being screwed directly to the base as is the usual practice, thus giving only about 1⅛ or 2 inches of insulating surface of base between each post, are so arranged that they go directly to the coils themselves without touching the base or outside case of the instrument. To effect this, these posts are attached to the ends of four long rods about 3-16 inch in diameter. These rods pass down through holes in the top of the case to brass lugs attached to the coil frames proper. Into these lugs, which form the terminals of the coils, the four rods screw. The holes in the top of the case through which the rods pass are somewhat larger than the rods themselves; a small hard rubber collar fits over the rods, and slips down over them so as to fill the holes when the instrument is not in use, thus keeping the dust out. When the instrument is to be used these collars are slipped up, thus leaving the binding post rods entirely insulated from the case by an air space.



THOMSON REFLECTING ASTATIC GALVANOMETER.

To secure maximum sensibility the upper and lower sets of coils have been separated a little more than usual, and the mirror placed between the coils. This arrangement allows the conical space, usually left in the upper coil to allow the reflected ray to go to one side or another of the normal, to be completely filled with wire. To secure even greater sensibility the bounding surfaces of the coils have been carefully calculated, and the wire "graded."

This galvanometer is made so that the coils can be easily and quickly taken off, and replaced by others of a lower or higher resistance. To do this it is not necessary to touch a single wire as the terminals of the coils are attached to small insulated plates forming a part of the coil frames. These frames, two in number, slip into place, and are held each by four milled head nuts, which when in place complete the circuits.

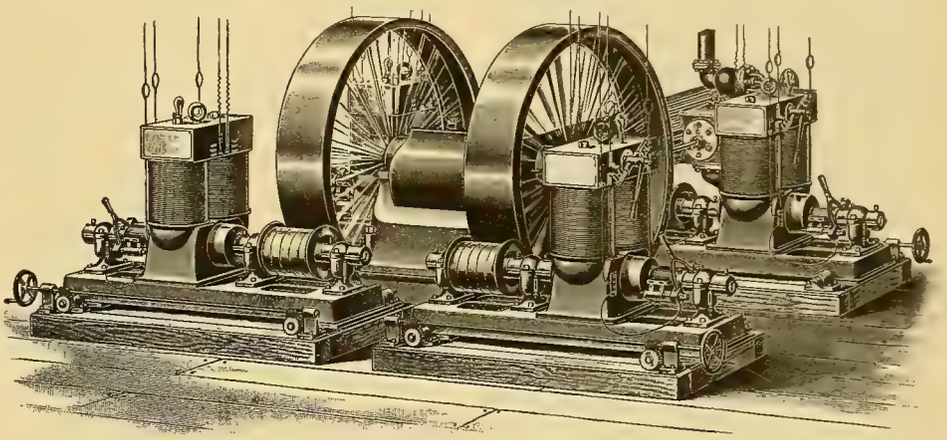
The old box levels, usually employed, have been discarded; on account of the fact that they cannot be made to hold their contents, and require to be refilled from time to time. In place of the box levels are two hermetically sealed and brass incased spirit levels set at right angles to one another.

Other portions of the instrument are much the same as in the usual patterns. A control magnet is arranged to slip up or down the tube, and has a delicate tangent screw by which it may be rotated about the central axis of the instrument.

Queen & Co. also have a new and improved tripod galvanometer, recently made and now testing, which will be placed on the market very shortly.

Dynamos Driven by Friction Pulleys.

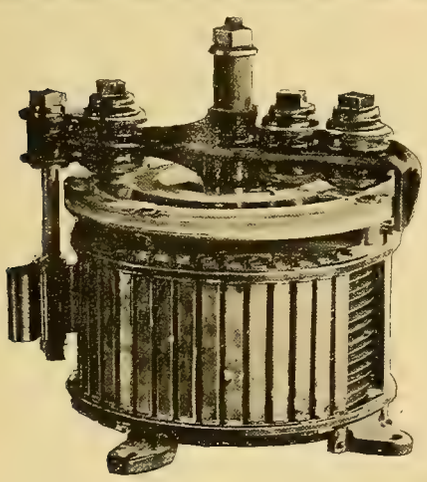
That there is a demand for a more compact system of transmitting power from engine to dynamo than is afforded by shafting and belting is shown by the many devices to accomplish this end that have been brought to the attention of the public. Among the most promising of these space spacing appliances are the friction pulleys and cones of the Evans Friction Cone company of Boston. A recent successful installation of this character is shown in the cut, which represents the lighting plant in the Weeks building, Boston. Four Edison dynamos are driven by the Evans system, power being furnished by a 200 horse power McIntosh & Seymour engine. The plant is said to be working satisfactorily. The compactness and convenience of this arrangement are obvious.



DYNAMOS DRIVEN BY FRICTION PULLEYS.

Edison Elevator Controller.

The Edison General Electric company has recently introduced a new controlling rheostat for use with electric motors running elevators, hoists, and in other places where the conditions require that the motor be started, stopped and reversed continually. The controller consists of a resistance box of special form as shown in the cut. By the movement of a lever, resistance can be gradually thrown in or out of the motor circuit as required, thus increasing or diminishing the speed of the motor. The lever also carries the contacts required for reversing the motor. This controller can be employed with either shunt or series wound motors, and possesses the great advantage of an arrangement whereby, before the motor can be reversed, the whole resistance is thrown into the armature circuit. By this means the possibility of burning out the armature by too sudden reversal of the motor is prevented, and fluctuations in the voltage of the line wires, by too swift an accession of power, reduced to a minimum. The controller is constructed to carry continuous currents of 15 amperes with all the resistance in circuits, but currents up to 60 amperes can be passed through it without injury for a short time, when starting the motor. The contact lever can be worked by handle or a pulley wheel, as conditions require. For elevator work, it is fitted with a pulley, around which passes the steel rope which, in the hands of the elevator man, controls the movement of the elevator.



EDISON ELEVATOR CONTROLLER.

The resistance consists of a continuous series of sheet iron convolutions, with mica insulation between the convolutions, divided into sections, each of which is connected to a vertical brass bar arranged around the iron convolutions, so that a special contact shoe on the lever arm makes a perfect frictional and flexible contact with the brass bars. The lever operating this contact shoe works over a slate table fitted with brass rings for the main and armature connections. Carbon contacts are used on these rings. As iron, brass and mica are the principal materials used in the construction of the controller, it is able to withstand a very high degree of heat, without risk of destruction. A space two feet two inches square and one foot ten inches high is required for the controller.

The World's Fair and the Association.

Members of the National Electric Light association have evinced a laudable interest in all that pertains to the World's Fair, and they have repeatedly signified their willingness to co-operate with the electrical department in advancing the interests of the exposition. At the Buffalo meeting it is quite probable that the association will decide to hold its next convention at Chicago in 1893 during the World's Fair. B. E. Sunny of Chicago, who is chairman of the association committee on World's Fair matters, is a member of the board of directors of the exposition and also a member of the electrical committee. It will be seen, therefore, that the association is acting in harmony with the exposition, and the interests of the organization and its members will be carefully guarded. An interesting report from Chairman Sunny on World's Fair matters is anticipated.

Proposed Technological Institute for Chicago.

The Chicago Electric club committee on the proposed Institute of Technology held another meeting last week, at which the following named gentlemen were present: President Harper and Secretary Goodspeed, University of Chicago; W. L. B. Jenney and D. Adler, Chicago Architectural club; C. T. Purdy and John F. Wallace, Western Society of Engineers; R. C. McLean, *Inland Architect*, and Messrs. Besley, Terry, Parker, and Kreidler. It was decided to bring the matter before the architectural and engineering associations with a view of securing the co operation of these bodies. A general discussion of the lines upon which it is proposed to establish the institute followed, and all the gentlemen present expressed a lively interest in the proposed institute.

Electric Street Lighting in Chicago.

The demand for electric lights in many of the districts of Chicago not reached by the city's stations has become so pressing that the subject of renting lights has been taken up by the city council. At a recent meeting of the committee on gas, oil, and electric lights it was decided by a unanimous vote to recommend that a contract be made with the Chicago Arc Light & Power company to light the streets and alleys of the Fifth and Sixth wards. The Archer Electric Light company put in a bid, but the company has no franchise, and its proposal was therefore ignored.

The committee reported to the council meeting later, and the report was laid over and published. It is proposed to erect 220 lights in the two wards and to do away entirely with the use of gas for street lighting.

CORRESPONDENCE.

New York Notes.

NEW YORK, February 20.—Rumor says that Elihu Thomson will take first place under the reorganization of the Thomson-Houston and Edison companies. It is said that the officials of the Edison company, and even Mr. Edison himself, feel somewhat aggrieved at the turn affairs have taken. There is no complaint on the part of the Edison people on account of the financial arrangements of the consolidation, but a soreness arises from the fact that in the reorganization of the company it is possible and even probable that Mr. Edison will be supplanted as general director of the policy and conduct of affairs by Prof. Elihu Thomson.

The rumor says further that there is a decided difference between Mr. Edison and Mr. Villard, the former claiming that Villard in engineering the consolidation of the two companies was not sufficiently zealous in the protection of Mr. Edison's interests. It has even been stated that Mr. Edison will possibly withdraw from the new consolidation altogether and establish a rival electrical establishment.

Mr. Edison was seen recently in Orange, but he refused to give for publication any information bearing upon the advantages or disadvantages which have fallen to his portion in the consolidation. The officials of the Edison company on Broad street profess ignorance of any intention on the part of Mr. Edison to form a new company.

The fire which broke out on Saturday evening last in the five-story building on the southwest corner of Broadway and Eighteenth street and wrecked the exchange office of the Metropolitan Telephone & Telegraph company, which was on the fifth floor, was not so serious as was at first supposed. As far as could be determined by rough tests the $75,000 switch-board was not injured to any extent. The damage to the instruments of the exchange was estimated at $5,000, and that to the room itself, its desks, floor, furniture, etc., at $3,000. W. F. O.

Milwaukee, Wis.

MILWAUKEE, February 20.—A distinguished party of German electricians visited this city last week. It consisted of Arnold von Siemens, son of the famous electrician of Berlin; C. Vogel, chief of the mechanical department of Siemens & Halske's, Berlin establishment; Alexander Henschell, engineer of the Atlantic cable, and Dr. Berliner. They visited the E. P. Allis iron works and other mechanical establishments.

All of the down-town bridges and the important bridges in other parts of the city will be moved by electricity. Most of them, it is probable, will be equipped with the necessary appliances during the coming season. The Milwaukee Street Railway company is under contract to furnish the necessary power free of charge, and will be asked to extend wires to bridges over which none of its lines run at present. Grand avenue bridge is turned by electricity now, and Michigan street bridge by steam. The Board of Public Works has had time to test both systems, and is of opinion that electricity is the cheapest and most efficient. The use of steam requires an extra man, and in the aggregate the city will save quite a sum of money by the use of electricity. At least twelve bridges, it is expected, will be furnished with the electrical apparatus in the summer.

Chief Foley and the Board of Public Works, have been authorized to purchase $7,130 worth of fire alarm boxes, engine house gongs, etc., and $3,300 worth of fire alarm supplies without the intervention of a formal contract.

The annual meeting of the Milwaukee & Whitefish Bay railroad company, which is now the property of the Villard syndicate, was held Saturday last. Charles F. Pfister, Fred. Vogel, Jr , C. Landsee, Richard Burke, D. S. Wegg, Henry C Payne, W L. Mason, E. C. Wall and George O Wheatcroft were elected directors. Manager Lynn of the Cream City line, who has charge of the Whitefish Bay system, will run three trains to the bay next season, and will reduce the time of the trip from the Kirby house to the popular resort to half an hour. The necessary sidetracks are now being put in.

The annual meeting of the Milwaukee Rapid Transit company was held last Tuesday. Three directors, whose terms had expired were re-elected, the full board consisting of Capt. Pabst, Charles Stickney, E. D. Hoyt, Paul Bechtner, Julius Wechselberg, H. B. Hunter, R. M. Brown, E. S. Elliott and August Richter, Jr. The old officers were re elected. They are: President, Charles Stickney; Vice-president, Julius Wechselberg; Secretary and Treasurer, Gustav Pabst; General Manager, E. D. Hoyt. At the meeting it was reported that the roadbed had been completed at a cost of $50,000, and that bids had been received for equipping the road. The equipment, it was estimated, would cost from $30,000 to $40,000. Three new boilers had been bought, and contracts had been let for two new engines.

At the annual meeting of the Wisconsin Telephone company Secretary McLeod reported that the company was operating 6,783 telephones, of which 2,492 were located in Milwaukee and the remainder in the state at large. During the year the company put in 1,318 new instruments, and lost 881 old subscribers, a net gain of 437. On the first day of the year the company had in operation 6,219 miles of wire, of which 3,773 were strung on poles, and in aerial cables, 66 miles on buildings, 215 miles in submarine cables, and 2,165 in underground conduits in Milwaukee. A city ordinance requires that the entire Milwaukee line shall be placed underground, and the work must be completed before the end of next year. The cost of the work, it is estimated, will be $230,000. Much has already been done. The old plant will not be worth more than $5,000, it is thought, although the cost was $200,000. The wires will be practically useless, but the poles can be cut down and used in the country. Metallic circuits are to be generally introduced in the city. The electric railway and electric light wires have played havoc with the telephone system, and metallic circuits have become absolutely necessary. It was decided at the annual meeting to charge subscribers $20 more per year in case they use the metallic circuit, or $40 more per year when they use full desk sets and modern long distance instruments, besides the metallic circuit. Those subscribers who do not ask for metallic circuits will be charged the old rates, but very few, indeed, will fail to ask for the improved service, as they can hardly get along without it now, and the trouble from induction is steadily growing worse. The company has a metallic circuit between this city and Appleton, erected at an expense of $40,000 that gives perfect satisfaction. When the subway work in Milwaukee is completed the company will have 70,000 feet of conduits, each containing six cables. There will be 115,000 feet of cable. In each cable are from 60 to 100 pairs of wires, so that the total underground system will amount to 8,578,210 feet of single copper wire. Secretary McLeod reported that the annual wear and tear of telephone lines had been found to be between 12½ and 15 per cent. The company was ten years old, and its Milwaukee lines had been entirely rebuilt three times. During last year the total number of toll messages handled by the company was 170,785, a daily average of 546. The company employed 107 day operators and 51 night operators, mostly young women. The total number of employes was 407, of whom 31 were under bonds. The company elected the following directors: Henry C. Payne, Frank G. Bigelow, B. K. Miller, Charles Ray, C. G. Stark, Fred Vogel, Jr , and Arthur G. Fuller. Henry C. Payne was elected president; Frank G. Bigelow, vice-president and treasurer, and J. D. McLeod, secretary. In the vice-presidency Mr. Bigelow succeeded C. H. Haskins, resigned, who has permanently located in New York. C.

Spokane, Wash.

SPOKANE, February 20.—The Spokane Street Railway company recently purchased the City Park Transit company's franchise covering East Sprague street, Third street, Hatch street, part of Monroe street and Pine street. This purchase gives the Spokane Street Railway company access to the east end of town on the south side of the river. The purchase includes the tracks, lines and construction equipment. The City Park company still retains the line to Lidgerwood Park via Sprague, Division and Victoria streets.

The Spokane Street Railway company recently made application to the city council for a franchise to build, equip and operate a single track street railway system for the transportation of freight in single cars along the water front of Spokane, connecting the steam railroads in the city, with the manufacturing center around the water power; but owing to the opposition of the property owners along the streets in question, the company was forced to withdraw the application. The trackage problem to the mills of this city has long been a matter of serious consideration, and this proposed franchise endeavored to give relief in this direction. In their protest against the franchise the property owners did not give any reasons for their objections. Their property is at present lying vacant, and it is difficult to understand why they should have objected to the building of warehouses, etc. for wholesale houses along the front. The company proposed to operate this freight franchise by electricity between midnight and 6 A. M. The application drew forth considerable discussion, and now many of the property owners who opposed it regret their action. A committee has now been organized by the Chamber of Commerce on the question of trackage to the mills, and it is in communication with the various railroad companies on the question of the formation of a terminal company to give transportation and side tracks to the manufacturing industries of the city.

Yesterday the Spokane Street Railway company purchased a majority interest in the stock of the Ross Park Street Railway company. The Ross Park line begins at the corner of Main and Post streets and runs out to the east of the city on the north side of the river, giving service to Ross Park, a beautiful suburb. It is equipped with the Thomson-Houston apparatus, and is one of the finest lines in the Northwest. The road will now be managed by the Spokane Street Railway company, and several extensions eastward will be made at an early date by that company.

The company has completed the car barn, and the system is now in first-class working shape. Fred Bruch, the former superintendent of the company, has taken a position in San Francisco, and O. De Camp, the former superintendent of the Ross Park road, has been appointed superintendent. The company is pleased with the Thomson-Houston snow-plow which it is operating.

There will be a great mining development this year in this section, and several electrical installations are being talked about. J. M.

Denver, Colo.

DENVER, February 20.—Colorado will go into the quarrying of marble for commercial and monumental purposes about the middle of the year, and in the fall Denver companies will be shipping immense blocks of beautifully variegated stone to the markets of the East. This will necessitate the building of several feeders connecting with the Colorado Midland and the Denver and Rio Grande railways, as these companies have signified no intention of building stub lines to several important deposits of coal, granite and marble. The Colorado Marble & Mining company has contracted however, for nine miles of electric road that will rank as the pioneer mountain railroad to be operated by electricity.

Orders for motors, rails and cars have been placed and as soon as snow leaves the ground three gangs of laborers will be placed in the field. Sixty days is regarded as an outside limit to place the road in running order, and then shipments will begin, as there is sufficient marble taken out now to supply the entire demand of the United States.

The officers of the Colorado Marble & Mining company are: Joseph Creswell, president; W. F. Johnson, vice-president; W. H. Morrill, secretary; M. M. Van Fleet, treasurer; S. W. Keene, general manager; W. P. Macon, attorney; directors, M. J. MacNamara, J. M. Berkey, W. T. Johnson, Joseph Cresswell, S. W. Keene, W. H. Morrill and W. P. Macon. G. M. P.

PERSONAL.

President W. R. Mason of the Electric Merchandise company, Chicago, started for New York Saturday, February 20, to make a business trip of about ten days.

President J. B. McDonald of the Illinois Anglo-American Storage Battery company, Chicago, left for the City of Mexico a few days ago, to be absent a month.

C. E. Stump of the *Street Railway Journal*, New York, has been seriously ill at the Wellington hotel in Chicago. Mr. Stump came West on business, but was prostrated by an actute cerebral attack due to overwork. He was confined to his room for several days last week, but recovered sufficiently to return to New York. Fortunately Mr. Stump was accompanied by his wife and little daughter, and he received the best of care. Many members of the electrical fraternity in Chicago called to express their sympathy.

NEW INCORPORATIONS.

American Elevator company, Milwaukee, Wis.; capital stock, $500,000; manufacturing and selling hydraulic, steam and electric engines and elevators; S. R. Miller, Milwaukee, Wis.

Diamond Incandescent Lamp company, Denver, Col , capital stock, $50.000; manufacturing and selling incandescent electric lamps and brackets manufacturing all kinds of electrical appliances, etc.

Land & River Improvement company of New Alexandria, Fairfax, Va.; capital stock, $1,000,000; improvements, factories and merchandise, telephone, telegraph and electric works, etc.

Chicago Insulated Wire company, Charles City, Ia.; capital stock, $300,000; buying, selling and dealing in all kinds of metal used for electric lighting, electric supplies and fixtures; Chicago Insulated Wire company, Room 140, Rialto building, Chicago.

Duwamish Construction company, Seattle, Wash.; capital stock, $200,000; to build, operate and maintain street railways in Seattle and state of Washington; operate and maintain electric light and power plants; deal in necessary real estate, operate and deal in steamboats, ferry boats, wharves, warehouses, docks, and lay out town sites and

erect buildings; operate waterworks, etc.; Hugh L. Thomas, Seattle, Wash.

Hubinger & Pool company, New Haven, Conn.; capital stock, $50,000; to manufacture, buy, sell, and deal in dynamos, motors and electrical apparatus, etc.; Oliver S. White, New Haven, Conn.

Black Hills Electric Railway company, Hot Springs, S. D.; capital stock, $250,000; to construct, maintain and operate a railroad from Hot Springs to Cascade in Fall River county, S. D., a distance of 8 miles; W. M. Lenhart, 6423 Wright street, Englewood, Ill.

Deer Lodge Electric company, Deer Lodge, Mont.; capital stock, $25,000; to construct and operate ditches, canals and dams for conveying and utilizing water for power, transportation, irrigation and other useful purposes, purchase, operate, use electric plants on electric railways; supply and furnish electric lights to Deer Lodge and vicinity.

Knightstown Electric Light company, Knightstown, Ind.; capital stock, $10,000; to operate and maintain an electric light plant in and about said town, and to furnish the motive power to carry on such business, and to do any and all things necessary in operating, maintaining and transacting the business incident to such business; G. W. Williams, Knightstown, Ind.

ELECTRIC LIGHTING.

A $100,000 stock company is being organized at Fredericksburg, Va., to erect an electric light and power plant.

The city of Wayneboro, Va, will hold an election on the 25th inst. to pass upon the issuance of $25,000 of bonds for an electric light plant and waterworks.

The People's Electric Light and Power company of Birmingham, Ala., has been reorganized and the capital stock increased $40,000. Additional machinery will be put in.

A bill in equity has been filed asking for the appointment of a receiver for the McKeesport, Pa., Light company. The plaintiffs are stockholders in the company. The company, they state, has a capital stock of $100,000, divided into 2,000 shares at $50 per share. General mismanagement is alleged.

ELECTRIC RAILWAYS.

John W. Munson has secured a franchise to build an electric street railway in Kenosha, Wis.

Work has been commenced on an electric road to connect North Yakima and Yakima City, Wash.

A $100,000 stock company is being organized at Fredericksburg, Va., to build an electric railroad.

The Collins Park & Belt Railroad company proposes to build an electric railroad from Marietta to Bolton, Ga.

The Amsterdam, N. Y., Electric Railroad company will make an effort in the spring to extend its line to Rockton.

The contract has been let to the Thomson-Houston company for the construction of the Rome, Ga., electric street railroad.

J. H. Wilson and G. C. Rogan will apply to the city council for a franchise to build an electrical railroad in Mobile, Ala.

Several citizens of Montgomery, Ala., have petitioned the city council for a franchise to construct an electric street railroad.

The Rivermont Electric Railway company of Lynchburg, Va., contemplates the extension of its railroad to a point somewhere in Diamond Hill.

The Baltimore Union Passenger Railway company has applied to the legislature for authority to use the cable or electrical system to operate its street railway.

Paul W. Smith and others of Montgomery, Ala, who have obtained a franchise to construct an electric railroad, state that they intend to build and operate from 10 to 15 miles of road.

The city council of Salt Lake City, Utah, has laid over for the second time the franchise of the Saltair Railway company. This road is to connect the city with the bathing resorts on the lake, and it is to be equipped with electricity.

John W. Hoyt of New York and others contemplate constructing a rapid transit street railway in Austin, Tex., and they have applied to the city council for authority to do so. It is believed that the road will be built to be operated by dummy, and later by electricity.

It is proposed to build an electric railway through Piatt county, Ill., which will connect the cities of Monticello, Bement, Deland and Atwood, making a line of road thirty miles in length, with accommodations for passenger and freight cars sufficient so that farmers can bring their grain and products to market, the electric plants at Monticello and Bement to furnish the motive power.

ELECTRIC MINING.

The Copper Queen Copper Mining company of Bisbee, Ari, has an electric light plant consisting of three Edison 150-light dynamos. The first was put in six years ago.

The Gladstone Mine, in Shasta county, Cal., is provided with a new electric drill. Mr. Clark, manager of the mine states that it works as well or better than any drill they have ever used, and the cost is much less. He is using a three-drill machine. He changes the drills every seven minutes, finding that that gives the best results.

The Idlewild Mining company, operating the Taylor mine, located near Garden Valley, El Dorado county, Cal., is putting in electric pumps, lights and drills. This mine has been worked very successfully.

The Bain Electric Manufacturing company, Chicago, has recently completed a 15 horse power generator that has some novel features, and is to be used in connection with a mining plant. The generator is slow speed, 165 revolutions, 225 volts, and weighs only 750 pounds. It was wound to run at such slow speed so that it could be coupled up direct, the light weight making it possible to move it easily from one location to another. This company has aso just completed a generator, 50 volts, 400 amperes, constant potential, to be used in an experimental smelting plant.

"One of the greatest factors in mining matters in the future promises to be electricity," says the Salt Lake *Stock Exchange Journal*. "Electricity is already used extensively in lighting mines and as a motive power for drills and other machinery, and in time we expect to see it employed successfully in the reduction of ores. When reduction by this system is perfected the ore deposits of the Cottonwood mines of Utah should be worked and treated at a trifling cost. Water wheels placed in the Big Cottonwood stream would generate enough electricity to supply all of the mines in that country with power, light and for the reduction of ores, and all this at but a moderate cost, as electrical conductors from the wheel to the mine would annihilate distance and save the hauling of coal, etc., over rough roads, made necessary where steam is used as a motive power. Electricity promises to revolutionize the mining business in this country, and we look for its introduction at an early day."

TELEPHONE.

A line of telephone thirty miles long the first to unite two Italian cities, has been opened between Milan and Pavia.

The new system of telephone numbering recently described in this paper has been put into effect by the Chicago Telephone company. It is generally commended.

The National Telephone company, Glasgow, says the London *Electrical Review*, has just completed the fitting up of an elaborate telephonic arrangement in Woodside Established Church, whereby the subscribers are enabled to hear the entire service with the utmost distinctness and ease.

The chamber of commerce of Haarlem, Holland, has sent a petition to the government in favor of an early introduction of state telephones. The petitioners point out the many defects in the existing system, which seems to combine defective communication with high charges, which they ascribe to the fact that the Dutch Bell Telephone company virtually enjoys a monopoly. The government supervision, the petitioners declare, has no value in practice, and subscribers possess no guarantee against the betrayal of their telephone secrets.

TELEGRAPH.

The Dutch government has admitted that underground telegraph lines have become a pressing necessity, but as the laying of them would mean an expense of about $1,700,000 even if merely confined to the leading cities, it does not feel justified in incurring the expense.

The newly organized California & Oregon Telegraph company of Susanville, Cal., proposes to build telegraph lines in Nevada, California and Oregon, the main line to be between Reno, through Lassen and Modoc counties, to Lakeview, in Lake county. The principal place of business is Susanville, and the capital stock $50,000.

It has been decided by the navy department to make another line of soundings before definitely deciding upon the route of the proposed submarine cable between San Francisco and the Hawaiian Islands. This conclusion has been reached after an examination of the report of the survey of the two lines recently completed by the steamer Albatross. Many irregularities, ranging from normal to submarine mountains two and a half miles in height, were found in these two lines. Orders have been telegraphed to Lieutenant Commander Tanner of the Albatross at San Francisco to get his vessel ready at once for making the new survey. The new line will be run on the great circle, starting at or near Point Conception, Cal., to the island of Hawaii. The experts of the hydrographic office, who have kept careful record of all the soundings made, expect a more level line on the great circle which it is now proposed to run.

An Ottawa dispatch says: "There has long been an effort made to induce the government to take over and operate the various lines of telegraph of the Dominion. F. N. Gisborne, superintendent of the government telegraphs, has prepared an elaborate paper on the subject, which will be presented to the House of Commons at its coming session, when it is probable that legislation will be introduced to effect the transfer of the lines of the various companies to the federal government. Mr. Gisborne advocates strongly that for the purposes of trade it will be advisable that all the telegraph lines should be put immediately under the control of the postoffice department, as they are in England. He says there are thousands of letters transmitted from one part of the Dominion to another which, if the government had control of the wires, would be exchanged by telegraph. The revenue from 500,000 messages at 25 cents a hundred words, less three cents for delivery, would be $110,000, plus the press news income.'

MISCELLANEOUS.

A company has been formed in Berlin to work the Thomson-Houston patents, with a capital stock of $375,000.

The Thomson-Houston Electric company has an exhibit at the Crystal Palace electrical exhibition, in charge of its London agents.

An insulated holder for fire hose has been invented to obviate any danger that might arise to firemen in case a stream of water struck a heavily charged wire.

Dr. Leon Danion of Paris, claims to have discovered a method of introducing medicines into the bodies of men and animals, through the mucous membrane, by means of electricity.

The report of the French naval attache in Italy states that an Italian inspector, Signor Pullini has devised a launch driven by electricity, which has been adopted by the Italian navy, and the construction of which is to be begun immediately at the works at Spezzia.

At the recent annual meeting of the California Electrical society the following named officers were elected for the ensuing year: President, George P. Low; vice-president, C. O. Poole; treasurer, O. Brooks; secretary, W. I. Crossett; executive committee, E. A. Roe, C. T. Ryland, Jr., R. B. Elder.

Judd Green lives down in Salem, Ill., and has distinguished himself by inventing an air-ship somewhat resembling that of the renowned Pennington, but with the advantage of being without the weak points of the latter. Electricity is to supply the motive power. Mr. Green is described as "always jolly and sociable, full of antics, and a general lover of sport."

It is proposed that as the science of electricity has no name of its own it shall be called "electrics." The pair of words electrics and electrician would thus be in analogy with optics and optician, mechanics and mechanician, mathematics and mathematician, and many others. At present the word electricity performs two functions similar to those which are separated in the case of light and optics, heat and thermatics, sound and acoustics.

The Chicago Writing Telegraph company has been organized and has introduced an ordinance in the common council giving it the right to lay wires on Lake street, Wells street, Ashland avenue south to Sixteenth street, Armour avenue and Thirty-first and Thirty-fifth streets. The wires are to be placed in tunnels and over the roofs of houses, providing the consent of the property owners is obtained. After five years all wires shall be underground. Seventy-five dollars a year will be charged for each instrument. As an indemnity for the use of the streets the city will be furnished instruments free. The ordinance was referred to the judiciary committee.

In referring to the crowded condition of the Thomson-Houston factory the *Lynn Press* says: The company has purchased a large tract of land on the marshes between Western avenue and the Boston & Maine railroad and is already perfecting its plans for a great iron foundry, which shall eclipse anything that has been seen of its kind in these parts. As the land fronts on the Saugus river it is expected that all the company's supplies of iron and coal can be freighted to the spot by water. As soon as the foundry is running work will be begun on a mammoth power house. The company has advocated the transmission of power for long distances, and will now use the system for itself. It will be cheaper and more convenient in every way to generate the power for the factory at the place where the coal is received. It is not yet definitely known what will be the capacity of this power house, but from 1,800 to 2,000 horse power will be necessary from the first. The generators used will be the company's multipolar machines of 500 horse power each.

TRADE NEWS.

W. H. Weston & Co., of Philadelphia, will exhibit a new style of switch at Buffalo.

The Star Electrix company, Philadelphia, has recently contracted for a large amount of new machinery.

The Imperial Porcelain Works, Trenton, N. J., will be represented at the Buffalo convention by F. R. Duggan.

The Crescent Insulated Wire & Cable company, Trenton, N. J., is at work upon two large orders for export.

Pepper & Register, electrical engineers, Philadelphia, have recently taken two large contracts for construction work in the West.

H. T. Paiste, Philadelphia, recently returned from a trip to Boston, and he reports the prospects as being exceedingly bright for the spring trade in the supply line.

The Priestman Engine company, Philadelphia, recently made a number of successful tests of its engine on electrical work. The fuel used in the Priestman engine is atomized kerosene.

F. A. LaRoche, Philadelphia, Pa., is making a trip through the South and will visit Cuba before his return. Mr. LaRoche's vacation was necessitated by overwork. The LaRoche Electric Works will be represented at Buffalo during the convention.

The Detroit Electrical Works are building a large addition to their already extensive factory, which will very nearly triple its capacity. In the trial given the improved needle annunciator the results obtained were very satisfactory. The company is making extensive preparations to fill orders with the utmost dispatch.

The Weston & Wells Manufacturing company, Phila-

delphia, is offering a new braided wire guard for incandescent lamps. This guard, made especially strong for use in mills and factories, is furnished in two sizes, six and seven inches.

E. W. Wilkins of Partrick & Carter, Philadelphia, is receiving the congratulations of his many friends. It is hinted that he is very proud of a recent arrival, and some one even went so far as to state that he has already begun to instruct it as to the merits of pneumatic annunciators.

Secretary Benjamin Tingley of the Heisler Electric company, Philadelphia, had a smiling countenance last week. His good humor was occasioned by the formal acceptance of a plant recently installed at Toronto, Ont., and the closing of four of the largest contracts the company has ever taken.

The Ball Engine company of Erie, Pa., reports several shipments during the week. The company has also recently closed contracts for furnishing engines for several electric plants at Lockport, N. Y., Kittanning, Pa., Vancouver, B. C., and other points. The company is doing an excellent business in this line.

General Agent W. H. Eckert and Superintendent W. R. Brixey of the Kerite factory, Conn., have been spending a few days in Chicago in the interests of the Kerite wire. They have completed the transfer of the agency to F. W. Cushing, and he is now well equipped for business at his new headquarters, 225 Dearborn street.

President Elias E. Ries of the Ries Electric Specialty company, Baltimore, Md., will make his headquarters at the Iroquois hotel during the Buffalo convention, and an opportunity will then be offered to the central station men to see the Ries regulating socket in practical operation. Mr. Ries will fully explain the details and advantages of the Ries socket for alternating current service.

A. H. Englund, formerly secretary and treasurer of the Electric Merchandise company, Chicago, has opened an office at 435 The Rookery, as secretary and treasurer of the International Register company. This company has purchased the Pratt patents on conductors' fare registers, and has equipped a very complete factory for manufacturing these machines in both portable and stationary forms. Mr. Englund's long and practical experience in the street railway supply trade has made him a host of friends, and the success of his new enterprise is assured.

The Electrical Supply company, Chicago, has received many letters expressing satisfaction with the use of the Wirt improved dynamo brush. These are from engineers, station superintendents and isolated plants. The company is also sending out a large number of Wirt volt and ampere indicators. In a circular recently issued they direct attention to several features of these indicators not usually found in instruments of this kind. They are made entirely of metal and are not influenced by proximity to dynamos or generators, and can be connected in circuit and left so without regard to direction of current. The scales are so arranged that they can be read from a considerable distance.

The Crocker-Wheeler Electric company, New York, has just shown a full line of motors, etc., at the Crystal Palace Exposition, London, through its agent, the General Electric company, limited, and has come out as usual with flying colors. It has been the policy in times past for English manufacturers of motors to decry machines of American manufacture, but it is now stated that the General Electric company has in writing from Messrs. Crompton & Co. among the largest dynamo and motor manufacturers in England, that its various attempts at making small motors have been failures when compared with the machines put upon the market by the Crocker-Wheeler Electric company. Arrangements have been made with the General Electric company to publish a list of Crompton & Crocker-Wheeler motors. One portion of the list will deal entirely with the Crocker-Wheeler motors, and on the frontispiece it will be stated that the sale of these machines has been taken up by special arrangement with the General Electric company, which is the sole representative of the Crocker-Wheeler Electric company in London. This is quite a victory for goods of American manufacture.

The Electric Secret Service company, 45 Broadway, New York, is now pushing its locking cut-out, by means of which any single light or motor, or group may be cut out or cut in from the central station, without affecting the other lamps or motors on the same circuit. The cut-out consists of two parts: At the central station there is a signal dial carrying the numbers of lights or motors to be controlled, and in connection with this is a transmitter which has as many disks as there are numbers on the dial. At each light or motor, or loop containing several machines, one of the locking cut-outs is placed. The latter consists of an "E. S. S. combination lock" working an automatic cut-out. The appliance is operated by means of a small subsidiary wire. When it is desired to cut out or cut in any light or group, on a given circuit, a turn on the dial in the dynamo room and a touch of the button on the transmitter do the work. The signal destined for the lock selected passes over the line, operates that particular lock, and throws its light out or in as the case may be. The lock at each class of lights or group is set to a different combination, and the electric signals pass freely through all the other locks in the same circuit, except the ones selected, without operating them. The locking cut-out may be applied to any existing circuit with as little trouble as would be necessary to insert an ordinary cut-out. By looping a number of lights of the same class together, one apparatus may be made to control them all; but the aim of the Electric Secret Service company also is to furnish a service which will allow the application of its system to individual lights wherever desirable. To thoroughly appreciate the advantages of this system one must look into the details of operation and through correspondence with the company a great deal of information may be obtained.

BUSINESS.

The Central Electric company, in preparation for the coming spring business has laid in a large stock of all classes of supplies, such as hard rubber tubing, Banner weatherproof wire, Bryant sockets, switches and cut-outs, expanding wire guards, Swan lamps and Washington carbons. The company announce that it is well equipped to handle all orders for carbons of all the standard sizes, having a large stock of moulded pencils, both plain and coated, made by the Washington Carbon company.

The C. & C. Electric Motor company has opened a branch establishment in Portland, Ore., with offices at 53 and 55 North Front street. The Oregon branch will carry in stock all sizes of the C. & C. motors and dynamos, and extra parts for worn or broken machines. The Portland office will doubtless be a great convenience, as there the same careful attention and satisfactory service will be given the wants of customers as would be the case in the New York headquarters.

The Boston Braid Manufacturing company, 28 Beach street, Boston, states that braided silk has been manufactured in this country about seven years. The first work here in this line was very crude, and to within three years there has been constant experimenting and consequent improvement. But it is now considered one of the most satisfactory filaments for incandescent lamps. According to the above mentioned company its advantages are: First, its firmness of texture, combined with pliability, in handling before and after carbonization; second, with silk braid as a filament, and a proper vacuum, the bulb will remain free from discoloration longer than with any other filament now in use. And lastly, the light from it is stronger, and its life is very much lengthened.

The Syracuse Tube company has increased its capacity for the manufacture of iron poles for railway purposes. Its sales agent, the Engineering Equipment company, 143 Liberty street, New York, and 126 Pearl street, Boston, recently sent in an order for a sample pole, which was filled in manner illustrative of the great promptitude with which this house fills orders. The manufacture of the pole necessitated the drawing of certain sizes of pipe, the making of the joints, putting them together, and, finally, painting and putting the pole on the cars ready for shipment. All of this work was accomplished before noon of the day it was started. Under the circumstances this may be considered quick work, and serves well to illustrate the facilities of the Syracuse Tube Works for the filling of hurried orders. According to General Manager Perine, when pushed, the company's capacity can be made as high as seven or eight hundred finished poles a week, or over a hundred a day.

The electrical industry is of comparatively recent growth, yet it is interesting to note that a few of the leading companies engaged in it were well established before electricity claimed the public mind to any considerable extent. Prominent among such concerns is Queen & Co., Philadelphia. This firm for nearly 40 years has been one of the leading scientific instrument concerns in this country. The business is divided into eight distinct departments, each one of which is conducted by a separate management, like so many different firms doing business under one roof. The branches are as follows: Department 1, optical instruments; department 2, engineering, surveying and drawding instruments; department 3, microscopes and accessories; department 4, philosophical and electric instruments; department 5, astronomical and projection apparatus; department 6, meteorological instruments; department 7, photographic apparatus; department 8, chemical apparatus. The firm's offices, showrooms and warehouse have been removed to 1010 Chestnut street, where a much larger building has been secured. The electrical department is located on the second floor. Queen & Co. have made a great specialty of equipping college laboratories with scientific apparatus. Many such installations have comprised electrical engineering outfits of the most complete proportions. The factory in which the scientific apparatus is made is at 819 Filbert street, near the main building. Here seventy-five skilled mechanics are employed. A foundry is part of the establishment. In connection with the electrical department a new testing laboratory has recently been located at Ardmore a few miles from the city. No expense has been spared in fitting up this testing department. High-class apparatus has been installed and is in charge of men trained specially for testing work. In consideration of all the important changes made in the establishment of Queen & Co. it is very easy to see how a house so successful in whatever it has undertaken will continue at the front. The electrical department is being conducted with special vigor, and the run of orders, both large and small, for instruments for testing purposes, speaks conclusively of a continuance of the present high standing of this house.

ELECTRICAL PATENTS.

Issued Feb. 16, 1892.

468,779. Trolley for Electric Cars. John W. Beebe, Waterloo, N. Y.

468,787. Signal for Electric Railway Systems. Frederick A. Cheney, Elmira, N. Y.

468,807. Magnetic Lock. Alcuin E. Kintner, Painesville, O.

This invention relates to a lock having a series of iron or steel tumblers therein, which are attracted by a magnetic key, thereby admitting the easy opening of the lock.

468,818. Multiple Switch-Board. Walker Moseley, London, England.

This invention relates to that class of telephone exchange systems in which the different lines are provided each with several terminals, these terminals being grouped upon different boards, and so arranged that any two lines of the exchange may be connected upon either of the switch-boards.

468,880. Electrolytic Cell. Ernest A. Le Sueur, Ottawa, Canada.

468,887. Electrolyte or Depolarizing Solution for Galvanic Batteries. Samuel Miller, London, England.

468,903. Electric Elevator. Rudolph C. Smith, Yonkers, N. Y.

468,912. Turn Table Connection for Electric Railways. Rudolph M. Hunter, Philadelphia, Pa.

468,917. Electric Brake Mechanism for Elevators. Charles E. Moore, Boston, Mass.

468,938. System of Distribution of Electrical Heating Currents. George D. Burton, Boston, Mass.

468,948. Electrically Propelled Car. Harry E. Dey, Brooklyn, N. Y.

468,949. Converter System for Electric Railways. Thomas A. Edison, Llewellyn Park, N. J.

468,950. Commutator Brush for Electric Motors and Dynamos. Thomas A. Edison, Llewellyn Park, N. J.

468,953. Field Magnet for Dynamos and Motors. Robert Lundell, New York, N. Y.

The principal object of this invention is to provide a multipolar motor for general use, which shall be efficient at low speed, and shall occupy only a small space, especially in a vertical direction.

468,955. Coin Freed Machine for Giving Electric Shocks. Joseph Mason, London, England.

468,959. Electric Railway. Frank J. Sprague and Patrick F. O'Shaughnessy, New York, N. Y.

This invention relates to switch plates which are attached to overhead conductors in electric railway systems at the junctions of branching conductors. Such switch plates are at present mainly used at turnouts in single track roads. They are, however, useful in any case where the overhead conductor branches, as to a side track or a branch or cross road.

468,970. Means for Indicating Dicharge from or into Hoppers. Frank H. Briggs, Cleveland, O.

468,974. Matrix Making Machine. Casper L. Redfield, Chicago, Ill.

469,041. Electric Arc Lamp. Robert S. Dobbie, Jersey City, N. J.

The third claim reads:
"In combination, in an arc lamp, a conducting feed-disk, starting mechanism provided with an arc-striking magnet or magnets and armature, the said magnet or magnets presenting opposing poles to the opposite faces of the said disk, and the said armature forming a part of the magnetic circuit of such magnets passing through the said disk."

469,048. Suspending Device for Electric Lamps. James J. Renehan, New Britain, Conn.

469,050. Electric Search Light. Nelson Weeks, Jr., Long Island City, N. Y.

469,080. Armature for Dynamo Electric Machines. Marcel Deprez, Paris, France.

The claim is:
"In an armature for a dynamo electric machine, the combination, with a segmental-ring core, of a series of segmental bobbins of refractory insulating material fitting upon the core and an armature coil upon each bobbin."

469,085. Telephone Transmitter. Elwood A. Grissinger and Theodore Grissinger, Mechanicsburg, Pa.

The purpose of this invention is to provide a transmitter which shall be extremely sensitive and susceptible to phonetic vibrations of very low intensity, and also to provide a transmitter having a diaphragm of novel construction connected electrically with the line wire and having a novel mounting, the construction of said diaphragm being such that there is obtained a larger body or mass under pressure and an increased field of electrical saturation in the resistance-offering conductor.

496,093. Electric Arc Lamp. Houghton Sawyer, San Francisco, Cal.

496,129. Storage Battery. Chaimsonovitz P. Elieson, London, England.

469,135. Electric Curling Iron. Alexandre F. Godefroy, St. Louis, Mo.

469,181. Electric Letter Box. Charles A. Pinkham, Wollaston, Mass.

Claim four is:
"The combination, with the electric circuit and an alarm or indicator included therein, of a letter box or other receptacle provided with a self-closing lid or slot-covering plate, a main-circuit closer adapted to be operated to close the said circuit by the movement of said lid or slot-covering plate to actuate the alarm bell or indicator, a branch circuit provided with a push-button or key located in a room or at a distant point, a circuit-closer for connecting said branch circuit with the main circuit, adapted to be actuated by the movement of the lid or slot-covering plate, and means, such as a spring-actuated lever, for returning the branch-circuit closer to its original position to break the branch circuit at the box when the door of the latter is opened to remove its contents."

469,193. Dynamo Electric Machine or Motor. Henry M. Byllesby, St. Paul, Minn.

The third claim reads:
"The combination, with the armature, mounted upon the shaft and having the commutator, of the journal-supports S for said shaft, the drum 18, mounted upon said shaft, the quills rigid upon said supports and inclosing said shaft, the field magnets, concentric with the armature and journaled upon said quills, the drum upon said field magnets, the commutator-brushes carried by said field magnets, the insulated rings carried by said field magnets electrically connected with the respective commutator-brushes, and the brushes respectively bearing upon said rings and connected to the line-wires, substantially as and for the purposes set forth.

469,208. Electrical Conduit. Edwin T. Greenfield, New York, N. Y.

469,220. Electric Cut-Out. Van A. Thomas, Providence R. I.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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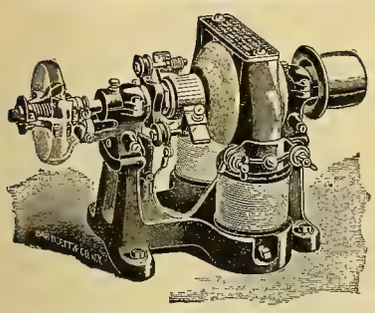

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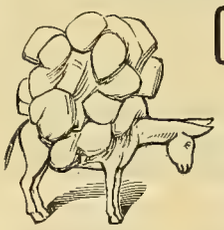

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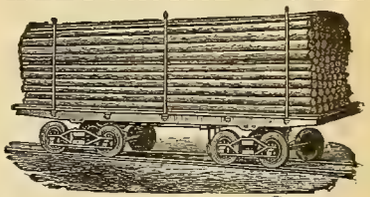

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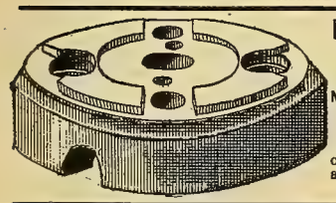

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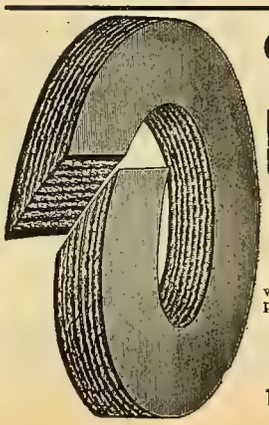

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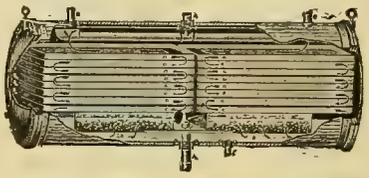

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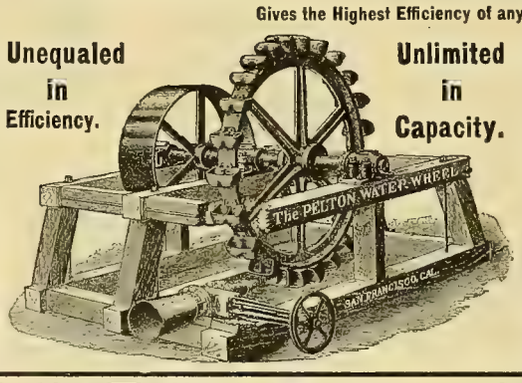

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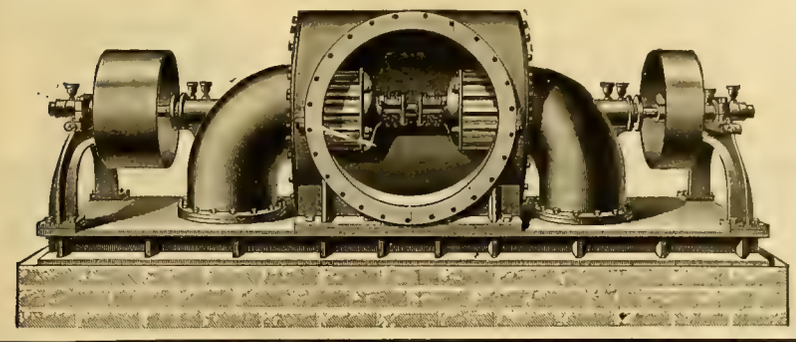

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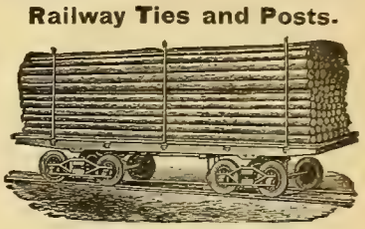

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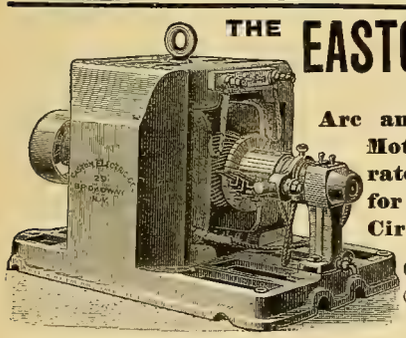

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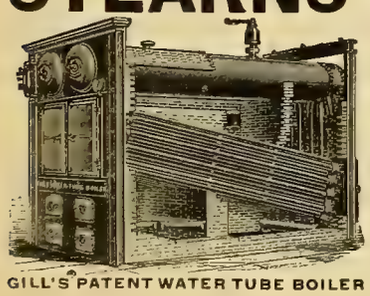

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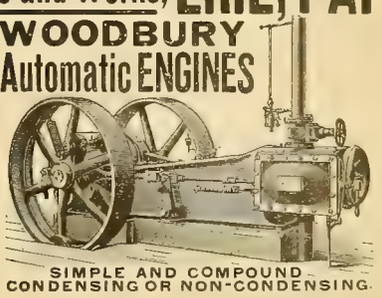

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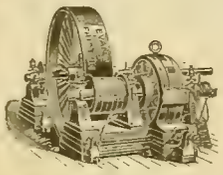

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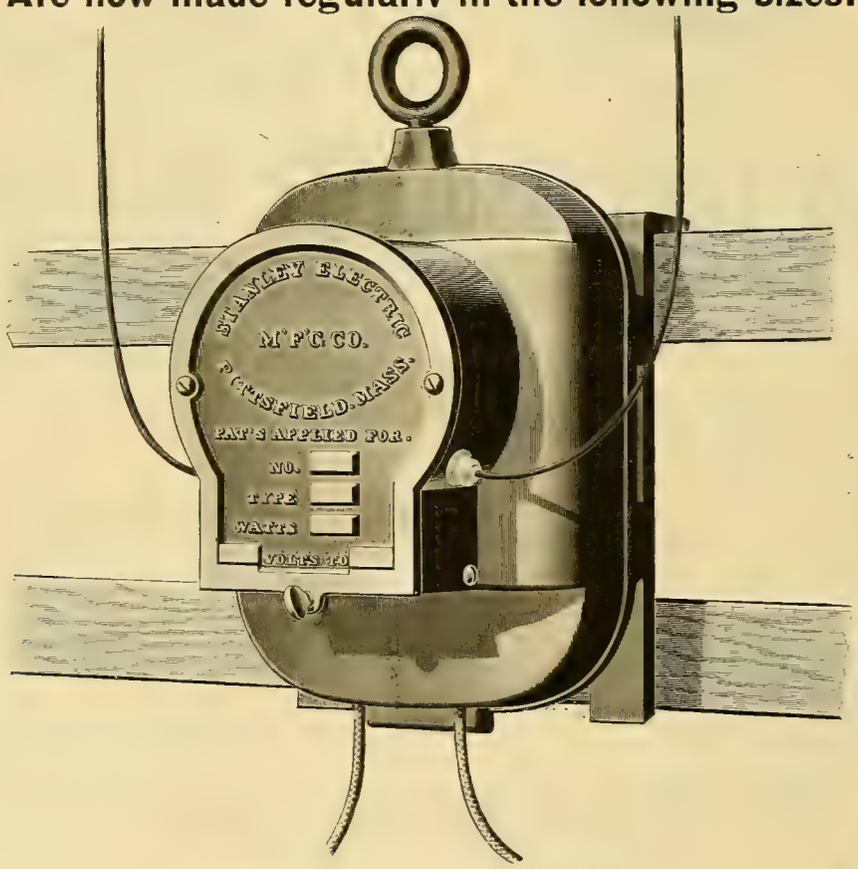

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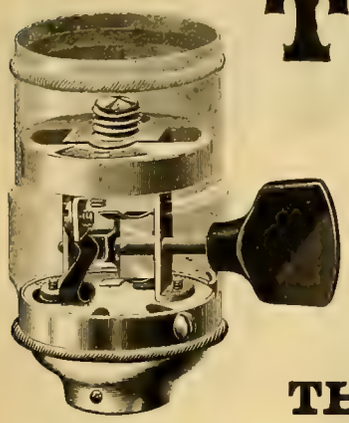

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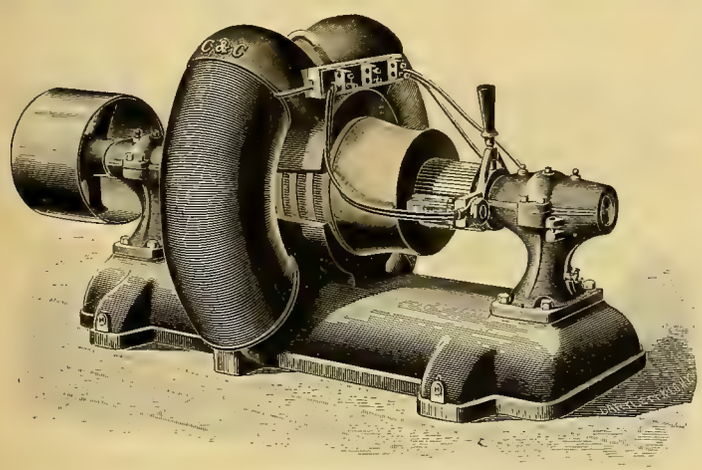

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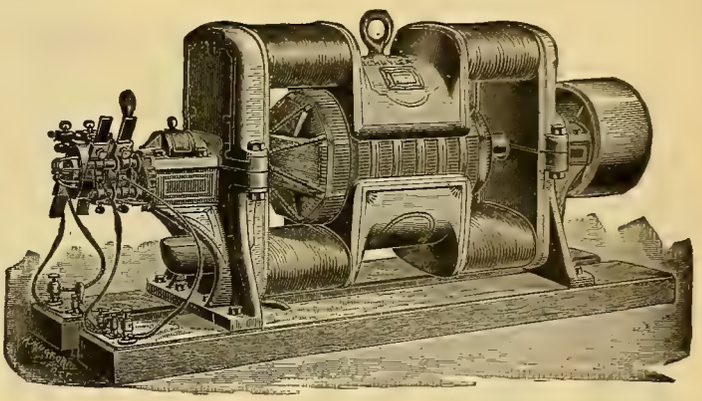

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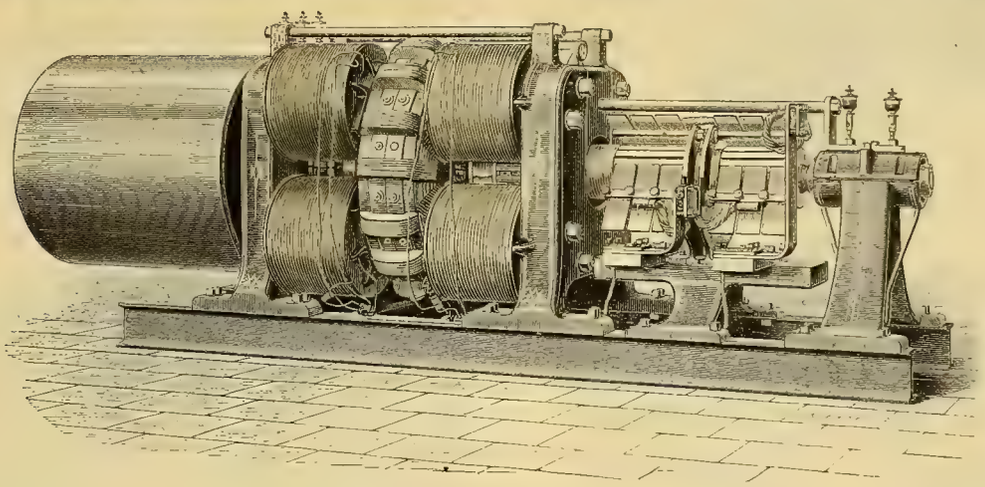

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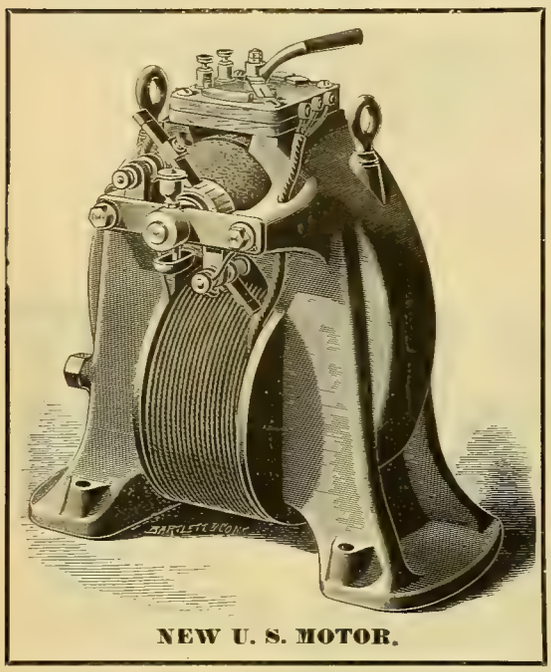

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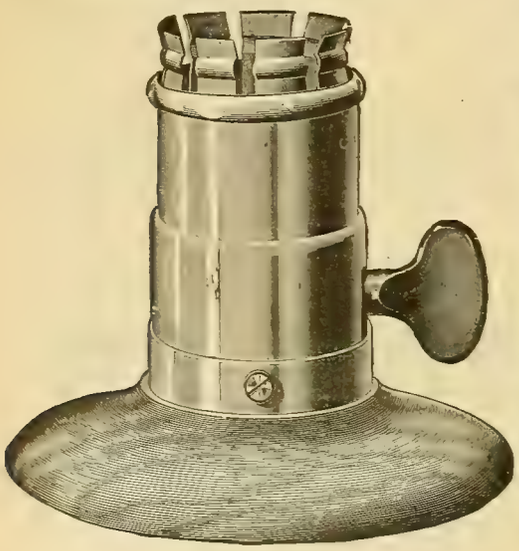

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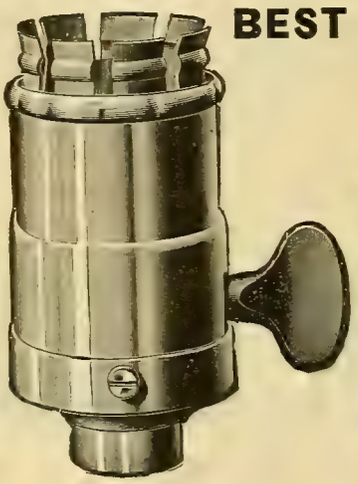

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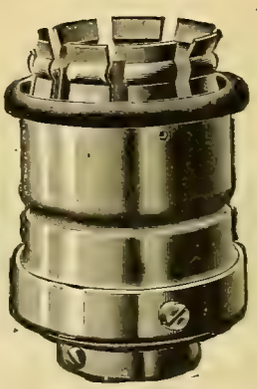

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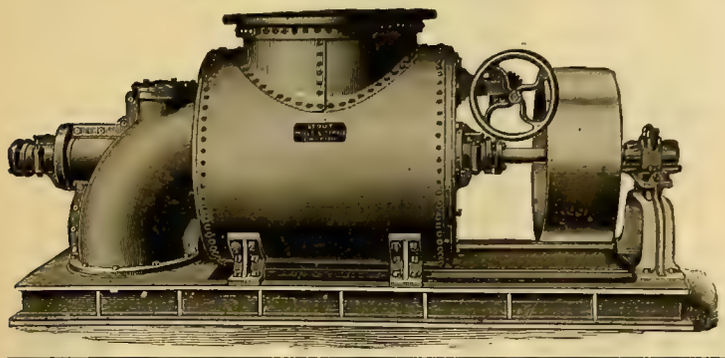

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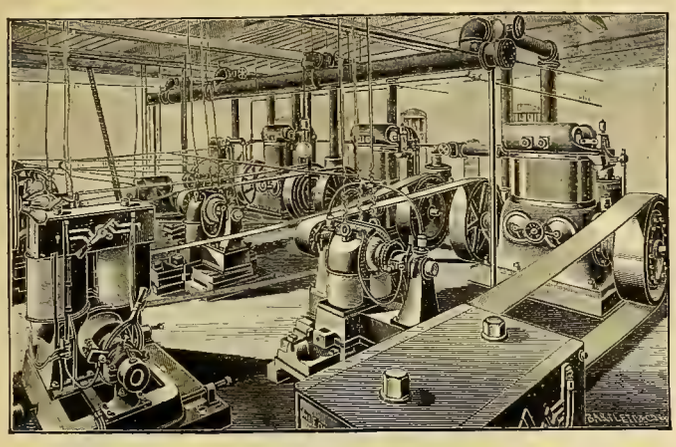

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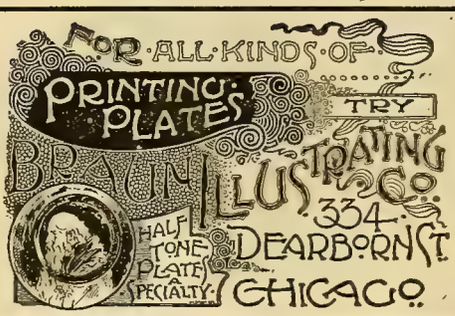

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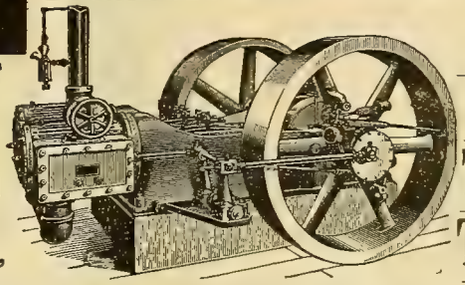

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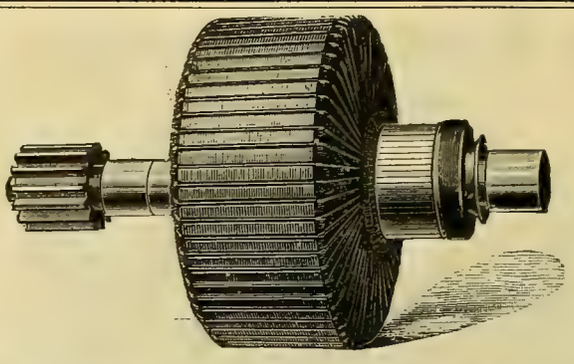

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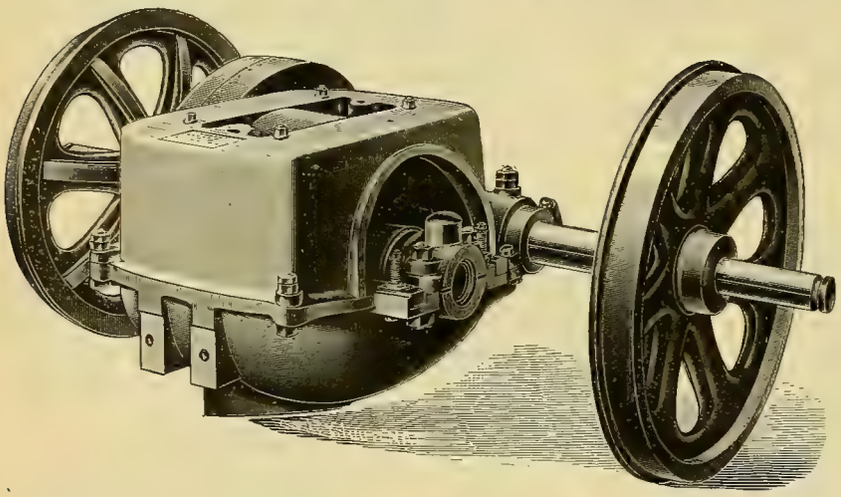

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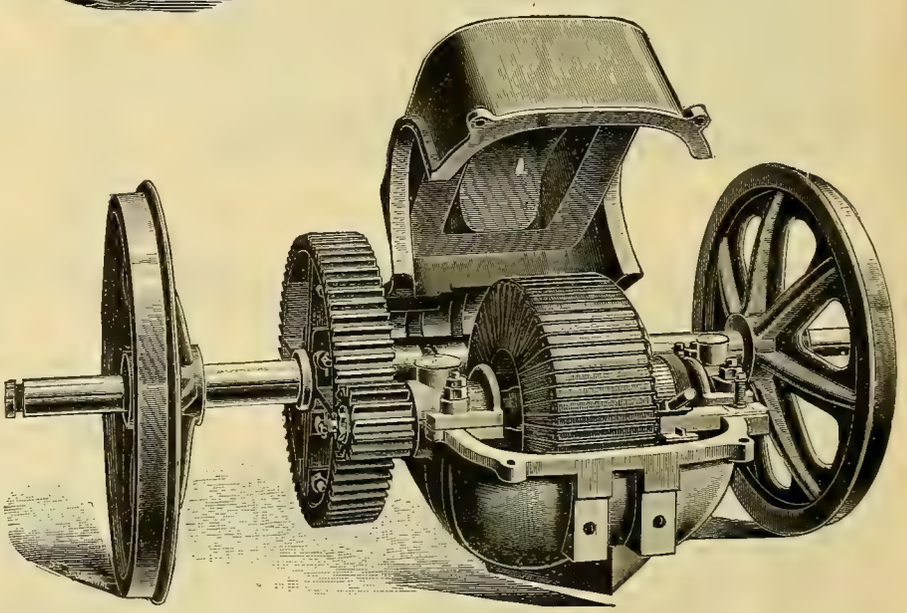

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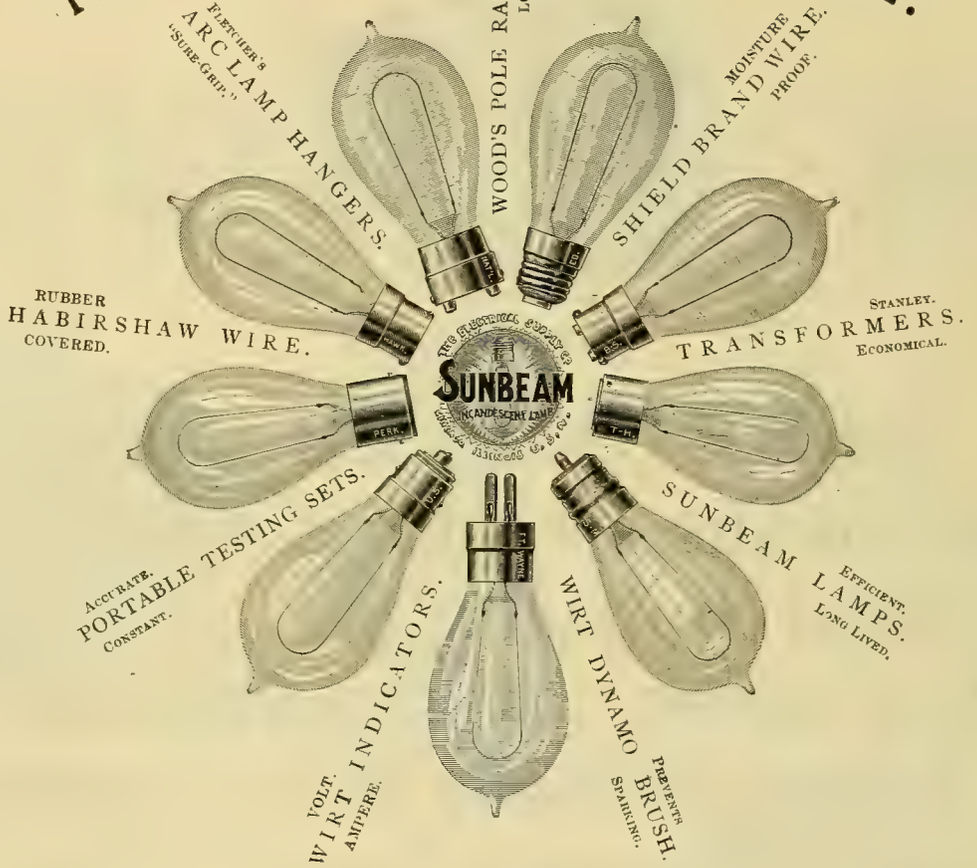

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Turne it which ever way ye will,
It turns for goode, but na' for ill.
There are na' blanks in this roundе wheel,
For he that turns it, turns for weal.

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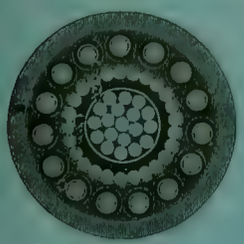
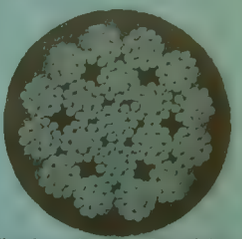

Underground Core.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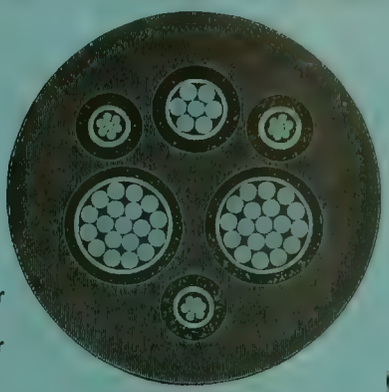
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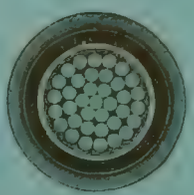
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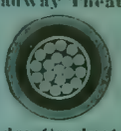
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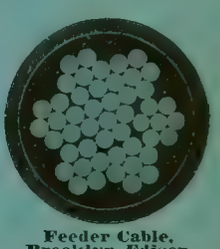
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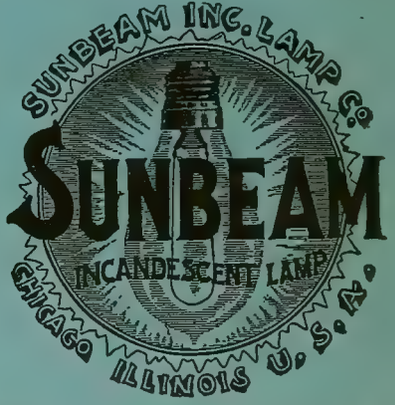

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Yours very respectfully,

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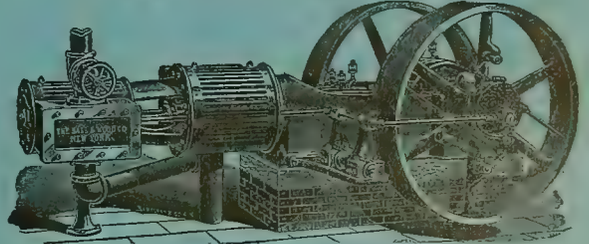

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MANUFACTURERS OF THE HIGHEST QUALITY OF

DYNAMOS, LAMPS

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Central Stations and Isolated Plants,

Arc, Direct Current and Alternating Current Systems,

MOTORS,

POWER GENERATORS.

100,000
Thomson-Houston Arc Lamps,

750,000
Thomson-Houston Incandescent Lamps

In Daily Operation October 1, 1891.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Ave., BOSTON, Mass.

WESTERN OFFICE,
148 Michigan Ave., CHICAGO, ILL

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Partrick & Carter Co.

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Detroit Electrical Works.
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Roeblings Sons Co., J. A.
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Cordage.
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National Carbon Co.
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Dynamos.
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National Electric Manufacturing Co.
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Electroliers and Combination Fixtures.
Baggot, E.
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Knapp Electrical Works.
Roeblings Sons Co., J. A.
Sperry Elec. Mining Machine Co

Short Railway Generators

ARE NO LONGER A NEW TYPE. THEY ARE

STANDARD,

And the record they have made for themselves cannot be surpassed. Inquire in Rochester, Jamestown, Covington, East Liverpool, Muskegon.

The Jamestown Street Railway Company report as follows: JANUARY 6, 1892.

* * * * * * * * * * * * * * * * * *

On Sunday morning last it commenced snowing very hard, and so continued all day Sunday, Sunday night and Monday. We were obliged to put forth every effort to prevent blockading of the road, which we succeeded in doing.

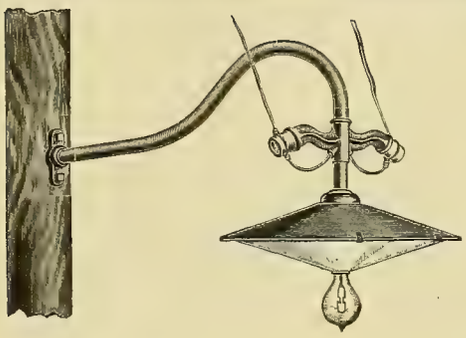
* * * * * * * * * * * * * * * * * *

On Sunday morning we started your Generator No. 2 at 6:30 a. m., and continued to use the same until Tuesday morning at 3:30 a. m., when we shut it down. This Generator was in continuous service during the entire time, and was not even sanded, nor the brushes touched. It did not use to exceed one-half quart of oil. We consider this remarkable because of the hard work the Generator was doing. * * * * * * * *

Yours very respectfully, GEORGE E. MALLBY, Superintendent.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, OHIO.



SERIES INCANDESCENT LAMPS,

FOR

ARC LIGHT CIRCUITS.

For Street and Inside Lighting. Not an Experiment. Thousands in Use.

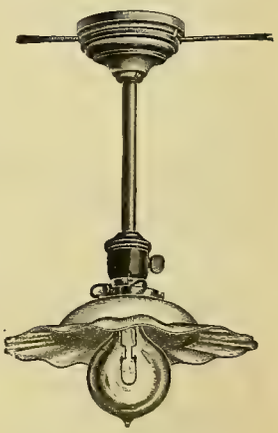
Durable and Attractive Street Fixture.

A Necessity to Every Lighting Company.

Reduction in Price of Series Socket.

SERIES LAMPS FOR ALTERNATING STREET CIRCUITS.

PLACE TRIAL ORDER.



BERNSTEIN ELECTRIC COMPANY,

620 Atlantic Avenue, BOSTON, MASS.

OKONITE TRADE MARK.

WE HAVE

OKONITE TRADE MARK.

C-A-R-L-O-A-D-S

Of moulded carbons, plain or coated.

THOUSANDS

Of Bryant key and keyless sockets, and wall sockets for all standard systems.
Bryant double pole switches. Paiste switches. Main and porcelain branch blocks.
Swan tied and loose filament lamps, all voltages.

MILLIONS

Of feet of Okonite wires, and——*Well, send us your orders, and see how quick WE CAN FILL THEM.*

OKONITE TRADE MARK

CENTRAL ELECTRIC COMPANY,

OKONITE TRADE MARK.

116 and 118 Franklin St.,

CHICAGO.

OKONITE TRADE MARK.

THE "WARD" LAMP

Of the standard type, to run on incandescent circuits, direct current, has been before the electrical trade for a little over two years.

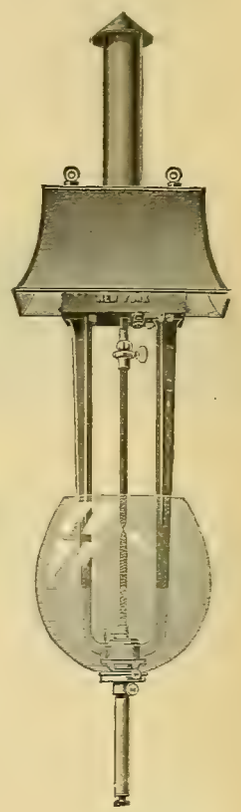
Within that time many thousands of this type have been installed and satisfactorily operated.

It is the only lamp for this purpose, none other having met with even ordinary success.

There are to-day a large number of central stations throughout the United States which are using from one hundred to a thousand "Ward" Lamps each, in connection with their incandescent plant.

The installation of isolated plants on which the "Ward" Lamps are in operation have increased rapidly during the last year, and we are at liberty to refer to many isolated plants, on which there are from fifty to two hundred "Ward" Lamps in operation.

From time to time the Company has brought out and put on the market different styles of lamps to be operated on constant potential circuits, among which styles are the railway lamps to run ten in series on 500 volts, each lamp being provided with an automatic resistance equal to the resistance of the lamp, by which means the resistance in the line is kept constant; the alternating current lamp for use on alternating incandescent circuits, runs in multiple arc on 50 volts; a line of focusing lamps adapted to the different uses of photo-engraving, theatrical side lights, stereopticon work, search lights, etc.



LAMP AND HOOD.

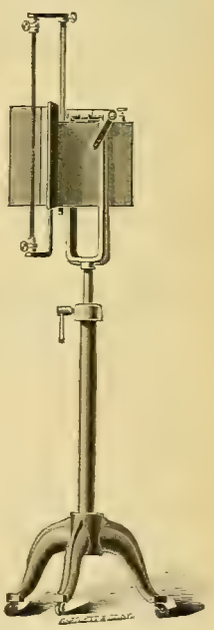


PHOTO-GRAVURE LAMP.

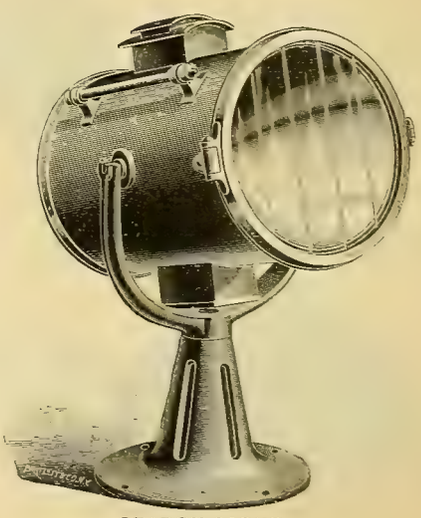
ORGANIZED 1881.
INCORPORATED 1883.

HERBERT TORREY, PRESIDENT.
R. B. COREY, GEN'L MGR.

THE ELECTRIC CONSTRUCTION AND SUPPLY CO.,

MANUFACTURERS OF

ARC LAMPS.



SEARCH LIGHT.

NEW YORK.
TELEPHONE BUILDING.

CHICAGO.
PHENIX BUILDING.

TAKE A GOOD LOOK

AT THIS

TRADE MARK.

It will be to your interest to have it on every coil or reel of high grade insulated wire that you buy in future.

TRY THE NEW KERITE AND YOU WILL BE CONVINCED.

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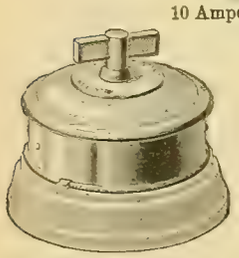
EDISON
PATENT
RATCHET
SWITCHES.

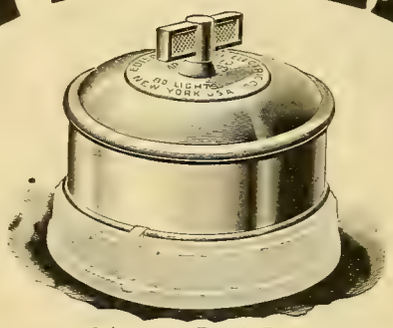
5 Amperes — Single Pole.

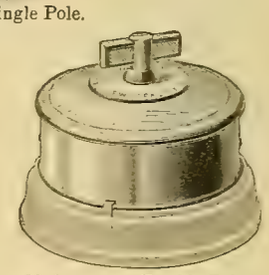
10 Amperes—Single Pole.

10 Amperes—Single Pole.

5 Amperes—Single Pole.


15 Amperes—Double Pole.


40 Amperes—Double Pole.


20 Amperes—Double Pole.

INCOMBUSTIBLE.

25 Amperes—Double Pole.

PORCELAIN BASES.

25 Amperes—Double Pole.

INSTANTANEOUS.

Special attention is drawn to our new style **FIVE** and **TEN** ampere, single pole switches. They are SMALL, NEAT, HANDSOME, and surpass all others of similar capacity on the market.

EDISON GENERAL ELECTRIC COMPANY.

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Sometimes you forget to order

CARBONS

When you should; your supply gets low, and

YOU WANT SOME QUICK.

We are represented by the following concerns.
By ordering from the nearest one, you can

GET THEM QUICKLY.

They carry a large stock on hand.

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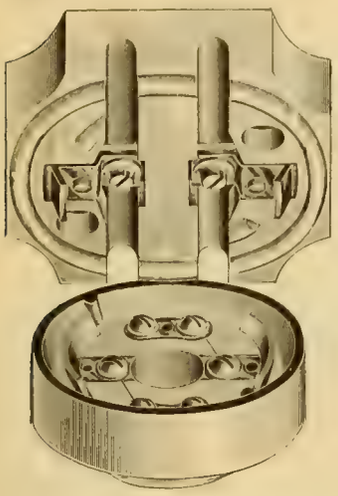
WASHINGTON, PA.

EDISON GENERAL ELECTRIC COMPANY,

— AT —

Boston, Buffalo, Cleveland, Detroit, Cincinnati,
Louisville, Atlanta, Chicago, St. Louis, Milwaukee,
Springfield, Mass., Minneapolis, Denver, San Francisco, Portland, Oregon.

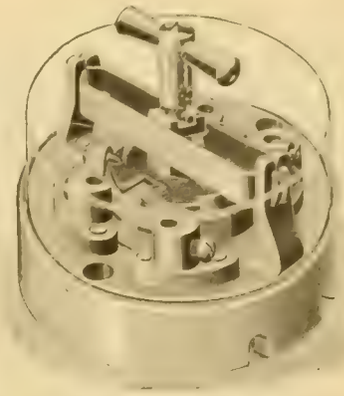
HOLMES, BOOTH & HAYDENS, 25 Park Place, New York.
FRANK S MARR, 641 N. Broad St., Philadelphia, Pa.
ELECTRICAL SUPPLY & CONS. CO., Pittsburg, Penn.
CENTRAL ELECTRIC CO., Chicago, Ill.



THE DOVETAIL CEILING CUT-OUT.

Accidental disjunction impossible. Broad contacts.
The cap is adjusted without the use of screw driver.

No. 101 For C'eat Work.
" 102 For Concea'ed Work.
" 104 For Moulding Work. (Round Base.)
" 106 For Moulding Work. See Cut.



INCANDESCENT SWITCHES.

5 & 10 Amp. Ratchet, Single Pole.
10 to 150 Amp. Double Pole. See Cut.
3 Way Switch. Series Switch.

For Sale by Supply Houses, or by

THE PERKINS ELECTRIC SWITCH MFG. CO.,

P. O. BOX 816. HARTFORD, CONN.

HEISLER ELECTRIC CO.,

DREXEL BUILDING, PHILADELPHIA, PA.,

MANUFACTURERS OF THE ONLY

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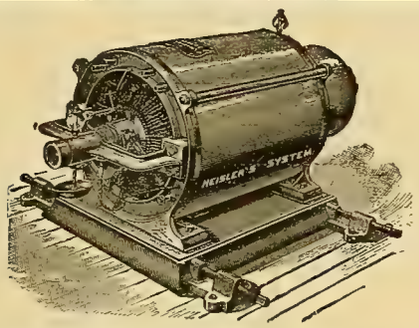
Incandescent Lighting Apparatus



THAT IS SELF-CONTAINED, AND ABSOLUTELY AUTOMATIC IN REGULATION.

Noted for Brilliancy of Light and Great Efficiency.

—ALSO—

Series Sockets and Lamps for Arc Light Circuits.

SEND FOR CIRCULAR.

READ THIS!

IT SPEAKS FOR ITSELF.

ATHAM & BROTHERS

226 & 228 South 5th Street.
Philadelphia, Dec. 30th, 1891

The Standard Paint Company,

2 Liberty Street, New York.

Gentlemen:-

We have for a number of years been using your #2 P.& B. Electrical Compound for coating our lead-encased electric cables, as a protective covering against alkalies and gases detrimental to lead, especially when laid in creosoted wooden conduits. In our experience with your paint we are satisfied that it fills the bill and is the strongest adhering paint we know of. The writer has seen a lead-encased cable, exhumed for the purpose of making a splice, after being buried for three years, that had been coated with your paint and it was apparently as good as the day it was put on. We can highly recommend it as a first-class article for coating metallic surfaces as it does not become brittle and chip off.

Yours respectfully,

TATHAM & BROTHERS.
per R. H. Eagle Electrician.

P. & B. Insulating Compounds, Armature Varnish and Waterproof Tape.

The Standard Paint Co., 2 Liberty St., New York, N.Y.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

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NOTICE.

In view of the decisions in the cases of Western Electric Mfg. Co. vs. Chicago Electric Mfg.Co., reported in 14 Federal Reporter, 691, and Western Electric Co. vs. Electrical Construction Co., et al, reported in the WESTERN ELECTRICIAN of November 21, 1891, and a large number of cases in which injunctions have been granted on the Gray Patent No. 172,993, February 1, 1876, we claim, as owners of said Gray patent, the exclusive right to make, use and sell, or to license others to make, use and sell apparatus covered by the claim of said patent, which is as follows:

"The combination of a movable elevator car, the annunciator attached thereto and moving therewith, circuit closing and breaking signal keys on different floors, and mechanism whereby an electric current is maintained between the signal keys and annunciator without interruption by the movement of the car."

We have agents in all the principal cities who will install apparatus licensed by us, and will guarantee the satisfactory operation of same.

All persons are warned against making, using or selling electric elevator annunciator apparatus not licensed by us.

WESTERN ELECTRIC COMPANY,

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"AN OCTOBER TEMPERATURE IN MIDSUMMER"

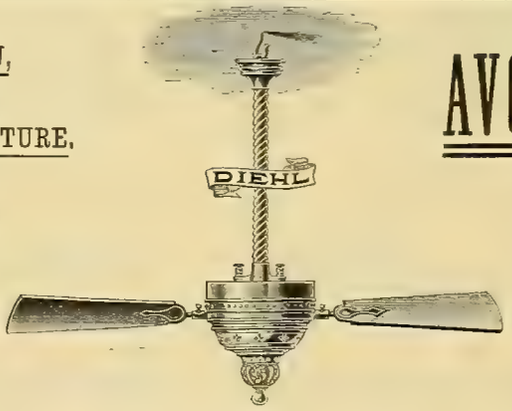
THE DIEHL ELECTRIC MOTOR FANS

INSURE PERFECT VENTILATION, FREEDOM FROM FLIES, DELIGHTFUL TEMPERATURE.

AVOID SHAFTING AND BELTING, ALL ANNOYANCES, DISFIGUREMENT.

PROFITABLE TO HANDLE.

REQUIRE NO ATTENTION.



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CORRESPONDENCE SOLICITED.

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PERRET ELECTRIC MOTORS.

ALL SIZES FOR ALL PURPOSES. **THOUSANDS NOW IN USE.**

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COMPLETE APPARATUS FOR ISOLATED PLANTS.

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THE WORLD'S GREATEST TYPEWRITER.

Official Typewriter of the Convention.

Send for Descriptive Catalogue.

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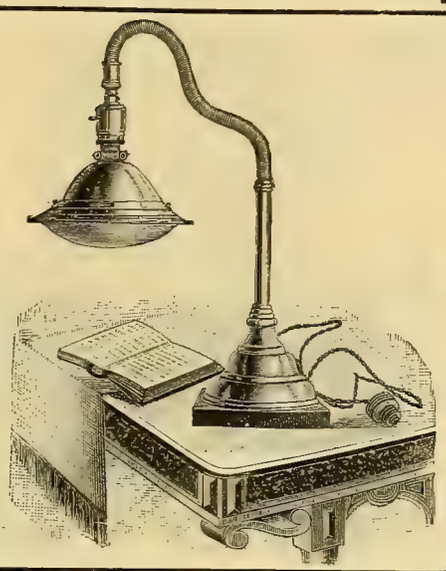
C-S SPECIALTIES.

C-S Reflector Shade.

Made of Aluminum with ground glass diffusion plate. A strong white light exactly where needed, and nowhere else. A soft white light throughout the room. Quadruples the effective light of any lamp

C-S Portable Lamp Stand.

Has flexible arm which holds lamp indefinitely in any position at will. Arm indestructible and may be curved or coiled into an endless variety of graceful shapes.



The Cutter Electrical & Mfg Company,

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RAWHIDE DYNAMO BELTING.

CARRIES NO STATIC ELECTRICITY.

Greatest Adhesive Qualities. Causes Less Friction than any other Belt.

RAWHIDE HYDRAULIC PACKING.

RAWHIDE PINIONS FOR ELECTRIC MOTORS A SPECIALTY.

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Chicago Rawhide Mfg. Co.,

The only Manufacturers in the Country.

Lace Leather Rope and other Rawhide Goods of all kinds by Krueger's Patents.

This Belting and Lace Leather is not affected by steam or dampness; never becomes hard; is stronger, more durable and the most economical Belting made. The Rawhide Rope for Round Belting Transmission is superior to all others.

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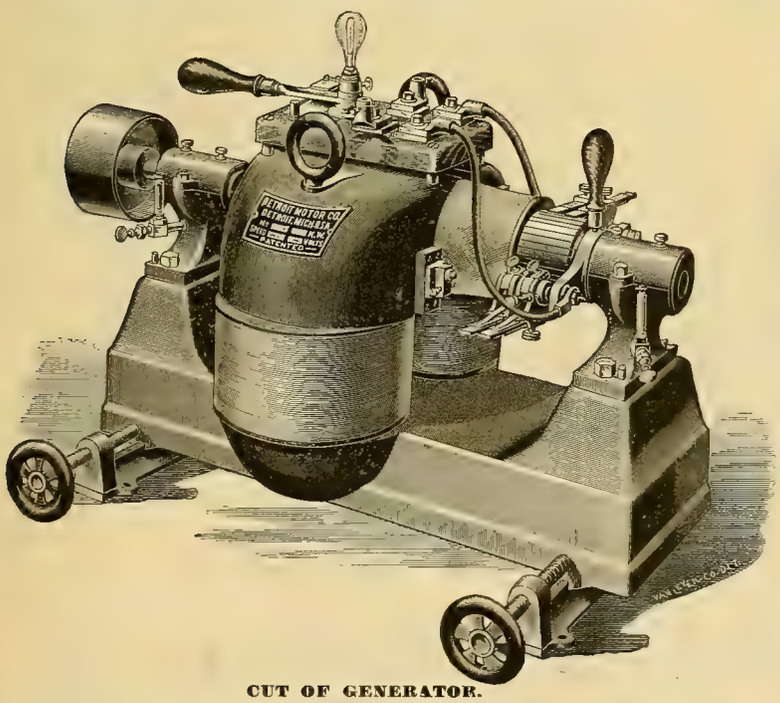
THE DETROIT MOTOR CO.,

MOTORS AND GENERATORS.



CUT OF GENERATOR.

Electrical Features. Armature of very low resistance and the fewest turns without bringing speed too high; symmetrical winding, diametrically opposite sections being of exactly the same length; the winding of the armature sections in parallel turns, thus reducing to a minimum the heat waste and local action that occur in a large inductor; the high resistance of the field circuit —the current expended in the field being 1½ per cent. in some sizes; the great intensity of the field with comparatively low weight of copper, admitting of an armature of small diameter running at the ordinary speed; the large cross-section of the magnet cores and pole pieces, making a magnetic circuit of very low resistance; the use of very soft forged iron field pieces instead of cast iron; the division of the armature into the greatest number of sections, thus eliminating the injurious results from the short circuiting of one section by the brushes; the base neutral and not one pole of machine; the absolute absence of heating, sparking or lead to brushes at full load; the high grade of insulation used in the armature and field coils.

Mechanical Features. Low center of gravity; breadth of base; freedom from vibration; extra large size of shaft of fine steel; perfect balance of armature; self-oiling bearings; bronze boxes of superior design; journals supported in universal ball joint; self-centering pillow blocks; oil gauge cocks showing amount of oil; no end thrust from shaft; brush holders admitting of a wide range of adjustment with the greatest convenience; easily accessible large strong binding posts; switch-board on top of machine; long wearing commutator of extra large size; smooth finish of all iron parts and high finish of all brass work; ease with which all parts may be assembled or separated.

Over 3,000 machines in actual daily operation. Motors from ½ H. P. to 160 H. P. Generators from 1 K. W. to 250 K. W. Electric Hoists, Pumps and Blowers. Machines of any size for any voltage.

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ALTERNATORS FOR CENTRAL STATIONS.
MOTORS FOR ANY CIRCUIT.
DIRECT CURRENT DYNAMOS of all sizes for ISOLATED LIGHTING.

LA ROCHE ELECTRIC WORKS,

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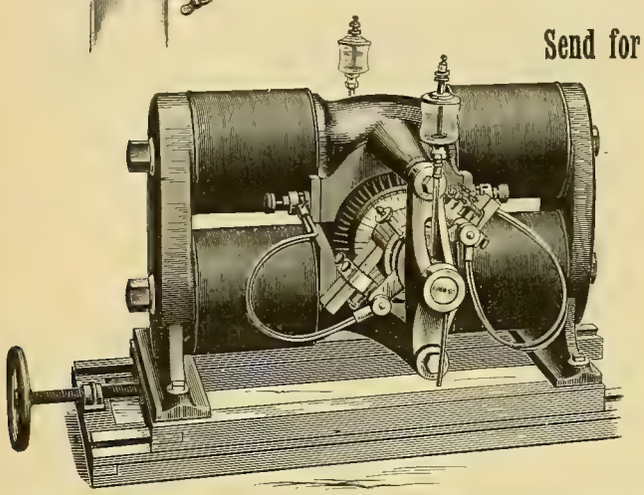
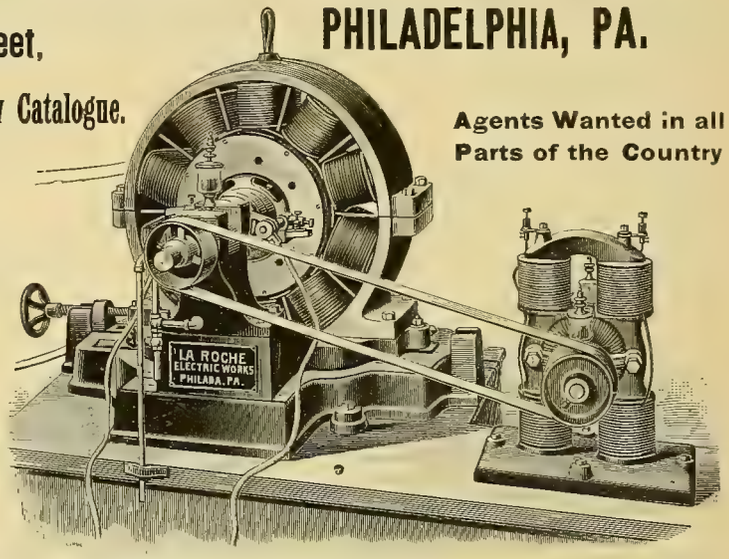
Send for Our New Catalogue.

Agents Wanted in all Parts of the Country





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100 TO 1 AGAINST THE FIELD

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GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

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MOISTURE-PROOF
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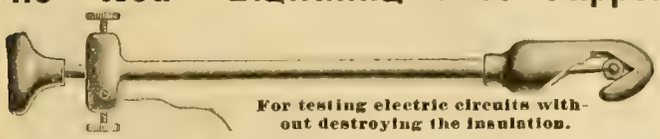
The "Neu" Lightning Wire Tapper.



For testing electric circuits without destroying the insulation.

USE IT ONCE
AND YOU WILL WONDER
How you ever got on without it.

FOR SALE BY ALL ELECTRIC SUPPLY DEALERS, OR BY

G. S. NEU, 110 Centre Street, NEW YORK.

When you are in need of *FIRST-CLASS PORCELAIN FOR ELECTRICAL PURPOSES*, write the

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Modern.

LATEST IN INSULATORS.
PRICES REDUCED.
One-Half Former Quotations.

Write for price and particulars.

SECURITY INSULATOR CO.,
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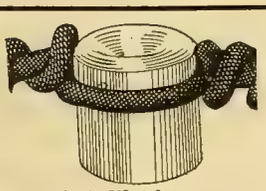

Antediluvian.

FOR SALE CHEAP!!!

Four 400-light, 240 ampere, Thomson-Houston Incandescent Dynamos, 110 volt.
Two 25 light, 2,000 c. p. American Arc Light Dynamos.
One 50-light, 2,000 c. p. Sperry Arc Dynamo.
700 Goose Necks, T.-H. Municipal Sockets, Shades, etc., complete.
45 miles No. 10 Wire, American Electric Co.'s make, used about nine months.
One 10-light Weston Arc Machine, with 8 double lamps, 2,000 c. p., A 1.
Twelve 12-light Knowles 2,000 c. p. Arc Dynamos.
100 2,000 c. p. Schuyler Arc Single Lamps.
Ten 3 h. p. Daft Motors, 220 volt, new.
Ten 1¼ h. p. Daft Motors, 220 volt, new.
Sixty 2,000 c. p. Single American Lamps.
Forty 2,000 c. p. Double American Lamps.

JOHN E. BEGGS MFG. & SUPPLY CO., 74 Cortlandt Street, NEW YORK.

Drop Forgings.

WILCOX & HOWE COMPANY, Birmingham, Conn.,
Solicit orders for light Drop Forgings for Electrical work. *16 years' experience.* Estimates promptly furnished on receipt of samples or drawings.

Locust Brackets,
Oak Brackets,
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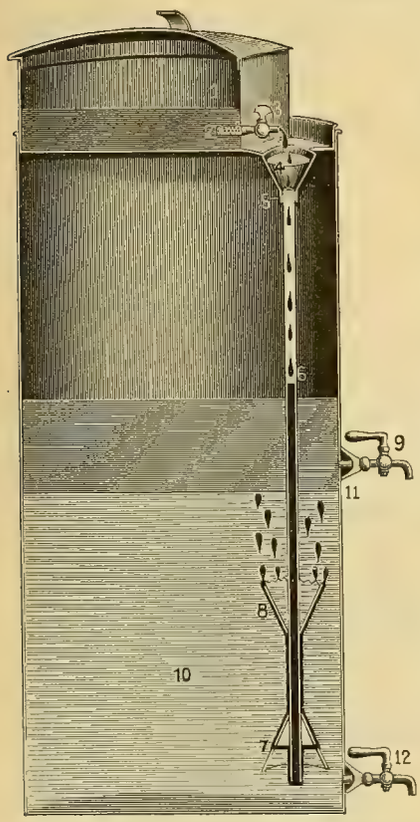
LOCUST PINS.

Try a thousand Locust Pins, and you will order a car load.

PINS ALWAYS IN STOCK. SPECIAL PINS ON SHORT NOTICE.
Send for prices, stating quantity wanted.
SCHINDEL & SCHINDEL, - - HAGERSTOWN, MD.



THE
GRAVITY PURIFIER.

From 75% to 90% Saved in your Oil Bills by using the Gravity Purifier.

TESTIMONIAL:
FORT WAYNE, IND., April 22, 1891.
GRAVITY PURIFIER CO., Decatur, Ind.
GENTLEMEN:—The oil filter sent us on trial some time ago has proven very satisfactory, and we are pleased to indorse its merits. It does everything it is represented to do and is undoubtedly the cheapest and best purifier on the market. Please send us another by first freight and oblige,
Yours very truly,
Jenney Electric Light & Power Co.

Will be sent to responsible parties on 30 days' trial. Write for circulars and prices to

The Gravity Purifier Co.,
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SILK BRAID For Incandescent Lamp Filaments.

The greatest care taken in producing a uniform article. Used by the largest lamp manufacturers in the country. Samples and prices mailed free.

BOSTON BRAID MFG. CO.,
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FINANCIAL AGENTS.

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W-I-R-E-S:

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Hard and Soft Drawn Copper Wire,
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Silk and Cotton Covered Magnet Wire, Incandescent Lamp Cord.

PRICES ON APPLICATION.

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Selling Agents: AMES, EBERT & CO., St. Paul, Minn.
STANDARD ELECTRICAL WORKS, Cincinnati, Ohio.
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CHICAGO, 227 South Clinton Street.
NEW YORK, Cor. Thames and Greenwich Sts.

USE THE **RIES REGULATING SOCKET** ON YOUR ALTERNATING CURRENT CIRCUITS

IT WILL PAY YOU! IT WILL MAKE YOU MANY NEW CUSTOMERS!

THIS INVENTION INTRODUCES A NEW ERA IN THE ART OF

INCANDESCENT LIGHTING.

It Regulates the Light! It Saves the Lamps!! It Saves the Current!!! No Resistance or other Current-Consuming Devices Used.

For Prices and Particulars write to **THE RIES ELECTRIC SPECIALTY COMPANY,**

PATENTEES AND SOLE MANUFACTURERS. Baltimore and Eutaw Streets, BALTIMORE, MD., U. S. A.

TRADE MARK. WIRE AND CABLES.

THE CRESCENT INSULATED WIRE AND CABLE COMPANY,

MANUFACTURERS OF

SEAMLESS RUBBER.

FACTORY AND MAIN OFFICE:
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THE JOHN A. ROEBLING'S SONS' COMPANY,
GENERAL WESTERN AGENTS,
171 and 173 Lake St., CHICAGO, ILL.

Gleason & Bailey Mfg. Co.,
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Manufacturers of, and Dealers in, a line of General

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ALSO ELECTRIC AND COMBINATION FIXTURES AND GLASSWARE.

Rubber Covered Weather-Proof Wires and Lamp Cords.

233 Lake Street, CHICAGO, ILL.

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NEW YORK BELTING & PACKING CO.
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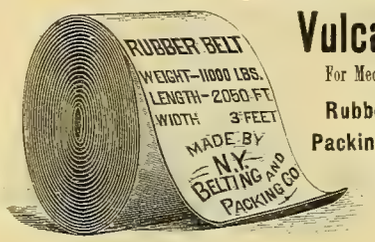
JOHN H. CHEEVER, Manager, 15 Park Row, NEW YORK

Oldest and largest Manufacturers in the United States of

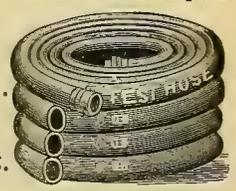


Vulcanized Rubber Fabrics

For Mechanical Purposes,

Rubber Belting, Packing and Hose.

Rubber Cement.

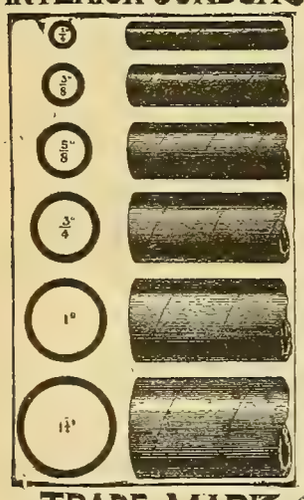


SALESROOMS:
PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601-1611 17th Street.
CHARLESTON, 163 Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 2d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:
SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 16-20 Woodward Ave.
BALTIMORE, 12 North Charles Street.
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

EUROPEAN BRANCH: 98-100 Queen Victoria St., LONDON, ENG.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding
ELECTRIC CONDUCTORS
Wherever and for whatsoever purpose employed, is to be found in the
CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND
CONDUITS
MANUFACTURED BY
INTERIOR CONDUIT AND INSULATION CO.,
WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,
General Offices: 42 & 44 Broad St., New York.

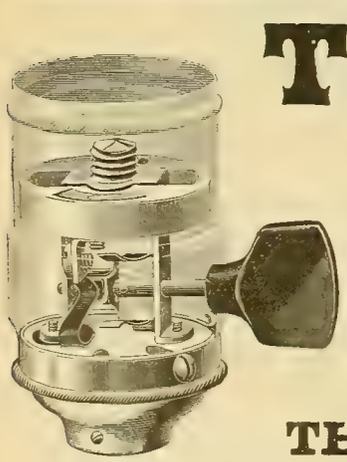
Thos. Day & Co., 222 Sutter St., San Francisco, Cal.
Mountain Electric Co., Denver Colo.
American Elect. Supply Co., 226 Pearl St., Buffalo, N. Y.
Putnam, Gay & Co., 27 E. Main St., Rochester, N. Y.
Glover Elect. Co., 127 W. 8th St., Cincinnati, O.
Chas. Gabriel, Saginaw, Mich.
Southern Electrical Mfg. & Supply Co., 110 Baronne St., New Orleans, La.
Walker & Kepler, 531 Chestnut St., Philadelphia, Pa.
Electrical Supply & Construction Co., Pittsburgh, Pa.
Southern Electric Co., Baltimore, Md.
Central Electric Co., Chicago, Ill.

COMPLETE STOCK OF
ELECTRIC RAILWAY SUPPLIES.

TROLLEY WIRES, SPAN WIRE, FEEDER WIRE, GUARD WIRE, MAGNET WIRE, FUSE WIRE, SWITCHES, CROSS-OVERS, TURN-OUTS, INSULATORS, TROLLEYS, POLES, POLE BRACKETS, PULL-OVERS, POLE RATCHETS, STRAIN CLAMPS, CURVE INSULATORS,

ELECTRIC HEADLIGHTS, GEARS, PINIONS, RAWHIDE PINIONS, RESISTANCE BOXES, STATION EQUIPMENT,

TROLLEY POLES, TROLLEY BASES, TROLLEY WHEELS, TROLLEY HARPS, TROLLEY SPRINGS, TROLLEY CORD, BEARINGS, BUSHINGS, GRAPHITE BUSHINGS, RUBBER BELLS, FEEDER BELLS, CHICAGO CLAMPS, INSULATING TAPE, EYE BOLTS, TURN BUCKLES, PORCELAIN KNOBS, PORCELAIN CLEATS.



THE **SOCKET**

IS THE BEST IN THE MARKET.

No danger of arcing or short-circuits.
Insulations of the BEST Vitrified White Porcelain.
Key and Keyless for all systems.
They are meeting with unprecedented success.

PLACE YOUR ORDERS EARLY.

THE CROWN ELECTRIC MFG. CO.,

H. G. MADDEN, 18 Cortlandt St., NEW YORK. **BRIDGEPORT, CONN.**

Manner of Securing the Center Screw in the T-H. Style.

NOTICE!

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY manufactures and sells at the lowest prices the most perfect line of electrical apparatus on the market for:

INCANDESCENT LIGHTING,
LONG DISTANCE TRANSMISSION AND DISTRIBUTION OF POWER,
GENERATORS,
STATIONARY MOTORS,
STREET RAILWAY MOTORS,
AND DETAILS FOR GENERAL ELECTRICAL PURPOSES.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY does not infringe valid patents owned by other companies or individuals, and it undertakes to defend its customers against suits for infringement, and to hold them harmless with respect to the use of any of its apparatus.

SPECIAL NOTICE.

We are reliably informed that agents and representatives of two large electric lighting companies are attempting to control trade in the street car and lighting lines by stating that the Westinghouse Electric & Manufacturing Company is to be forced, or in some way taken into a huge combination having an enormous capital, and that purchasers should therefore only deal with the representatives of the combination.

We desire to state that the position of this company is independent in every respect, and that it can, by reason of its comparatively small capitalization and its low scale of expenses, sell all competing apparatus at lower prices than can be afforded by any combination having o provide earnings for fifty million dollars capital.

All users of electrical apparatus are warned not to be influenced in the selection of their apparatus by statements made by the agents of other companies concerning this company.

We are in the business, and we propose to stay.

WESTINGHOUSE ELECTRIC & MFG. CO.,

PITTSBURG, PA., Feb. 25, 1892.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

RACINE-HIGH-SPEED AUTOMATIC ENGINES

SUPERIOR REGULATION AND ECONOMY FOR ELECTRIC LIGHTING AND GENERAL PURPOSES

16 SIZES CARRIED IN STOCK

WE TEST EACH ONE OF OUR ENGINES BEFORE SHIPPING

FOR PRICES AND CATALOGUE ADDRESS ENGINE DEPT.

SEND FOR CATALOGUE C.

RACINE HARDWARE M'F'G CO. RACINE WIS.

Write for prices on
Paiste-Switches,
Sockets for all systems,
Sunbeam Lamps,
Porcelain Cut-Outs,
Bells and Batteries,
to
JULIUS ANDRAE,
MILWAUKEE, WIS.

PLATINUM.

JAS. SCHAWEL & CO., 29 JOHN ST., NEW YORK.

Importers and Melters. Sheet and Wire in any Gauge. Scrap Purchased.

MICA.

For all Electric Insulating Purposes East India Mica is the best on the market.

I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

W. F. PERRY. S. F. NOYES.

DEALERS IN ELECTRICAL SECURITIES.

Electrical or Telephone Stocks Bought and Sold.

PERRY & NOYES,

Edison Bldg. - NEW YORK.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

SOLID BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

SAMSON CORDAGE WORKS,

115 CONGRESS STREET, BOSTON.

KARTAVERT

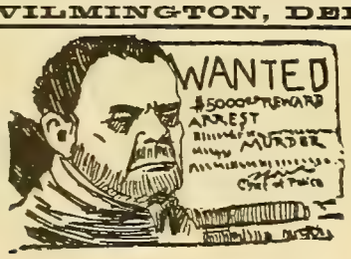
THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.



GOOD INCANDESCENT LIGHTS,

But they are impossible without a good generator. A generator that consumes power only in proportion to the number of lights burning, that does not spark, that is built of the best material, that is simple in construction, and that is self-regulating, is one of the best made and will hold up your lamps. Such generators are made by the

DUPLEX ELECTRIC CO., LTD.,

Who also make ARC DYNAMOS and the "DUPLEX" ARC LAMP,

CORRY, PA.

BUY THE BEST!

The Mosher Arc Lamp.

DIRECT OR ALTERNATING INCANDESCENT CIRCUITS.

READ THE FOLLOWING TESTIMONIAL:

J. M. FISHER, Esq. WINONA, MINN., Nov. 25, 1891.

DEAR SIR:—We have been using the Mosher Arc Lamp on our Edison three wire system since last February and are now using twenty-five. They give good satisfaction to our customers, and are the most economical and profitable lamp for ourselves that we have ever used.

Yours very truly,
WINONA ELECTRIC LIGHT CO.,
J. H. JENKINS, Manager.

Noted for Simplicity and Steadiness.

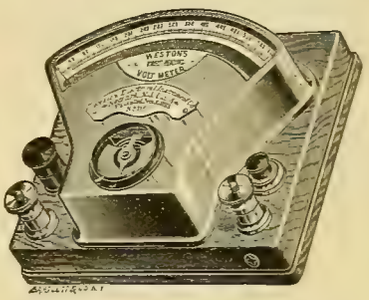
500 to 5,000 candle power, making superior lamp for photo-engraving purposes. Write for price, circular, and sample lamp.

MOSHER ARC LAMP CO., 125 Ontario St., Chicago.

Or to F. P. Little & Co., Buffalo, N. Y.; Creaghead Engineering Co., Cincinnati, O.; Chas. F. Lindner, San Francisco, Cal.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

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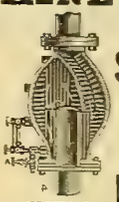
WESTON ELECTRICAL INSTRUMENT CO.,

114—120 William Street, **Newark, N. J.**

HINE'S ELIMINATOR.

THE ACKNOWLEDGED SUPERIOR OF ALL

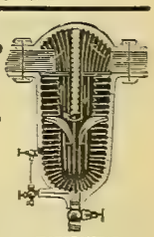
Steam Separators and Oil Extractors.



VERTICAL.

In twelve trials in the "Cornell" Separator test, it averaged 98 7-10 per cent Dry Steam. Outstripping all competitors.

Send for Circular and Cornell test report.



HORIZONTAL.

HINE ELIMINATOR CO., 106 Liberty St., NEW YORK.

This advertisement appears every other week.

SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

Royal Electric Co.,

911 & 913 South Washington St., PEORIA, ILL.,

MANUFACTURERS OF

Alternating and Continuous Current Dynamos and Motors,

AND ELECTRIC MACHINERY.

THE MOST COMPLETE ALTERNATING SYSTEM NOW ON THE MARKET.

Agents Wanted for Exclusive Territory.

Western Electrician.

EVERY SATURDAY.

Vol. X. CHICAGO, MARCH 5, 1892. No. 10

James I. Ayer, President National Electric Light Association.

James I. Ayer of St. Louis, who was elected president of the National Electric Light association at Buffalo and whose portrait is herewith presented, has been a conspicuous figure in the organization for several years.

Mr. Ayer was born in 1854 at Medford, Mass. After finishing his academic education he took an engineering course at Elizabeth, N. J., but before its completion he accepted an engagement to join a railroad surveying party. This work occupied his attention for three years. During the next two years he had charge of several mills in Central Illinois, and from 1877 to 1884 he was engaged in mercantile pursuits. Mr. Ayer first became interested in electrical matters in 1884, when he entered the Jenney Electric company of Indianapolis. He assumed general charge of the company's affairs and his practical business knowledge, together with his experience in mechanical work, proved valuable to the company. Under his direction the stations of the Jenney company were overhauled and remodeled and many changes were made in the arrangement and equipment of the principal plants.

The crowning feature of Mr. Ayer's work was the building and equipment of the Municipal company's plant at St. Louis. When Mr. Ayer severed his connections with the Jenney company he took the management of the Municipal company at St. Louis. The station was constructed and equipped under Mr. Ayer's personal direction and supervision, and it is looked upon as a model plant. There were many interesting novelties introduced in this plant, but the most remarkable thing about the work was the fact that it was completed in an exceptionally short time and was thorough in every detail.

Mr. Ayer took charge of affairs in June, 1889, and he at once notified supply and manufacturing concerns what he would require and the urgency of his demands. The operations were on such a large scale that general attention was directed to the undertaking. The construction work was pushed ahead with vigor and was completed in a remarkably short time. The fact that the work was properly conducted is shown by an early report of the company, which showed that the income from the city lighting was $10,000 and there was a rebate of only $80 for imperfect lighting.

It may be expected that Mr. Ayer will follow the same business methods in the affairs of the association that have marked his commercial enterprises.

JAMES I. AYER.

The Buffalo Convention.

The Buffalo convention of the National Electric Light association, February 23d, 24th and 25th, was the most business-like meeting that the organization has ever held. The sessions were well attended, the papers presented treated of live topics and in many cases excited interesting discussion, and the general tone of the gathering seemed more in keeping with the objects of the association. There was no general exhibit and there were not so many attractions during the hours set apart for meetings to keep the members from the sessions. This was, of course, greatly appreciated by those in charge of the matter. There was plenty of amusement, however, and nobody had occasion to complain. During the meeting the members received several invitations to inspect electrical concerns in and about Buffalo, and many took advantage of the occasion. There was also an excursion to Niagara Falls, which was most enjoyable, and the delegates were recipients of the hospitality of the local company. An inspection of the tunnel proved very interesting, especially to the engineers of the party.

A departure from the course followed at other conventions was received with much favor. There were evening sessions and but one afternoon meeting. The papers of a popular nature were then presented and were received with interest.

In many of the hotel parlors there were special entertainments provided for visitors by members of the electrical companies represented. Some of these were quite pretentious and all were thoroughly enjoyed.

The eastern delegates were entertained en route by the Brush Electric Light company of Rochester. The electric special which reached Buffalo on Monday evening brought about 100 delegates from Boston, New York and other eastern points. It was met at Rochester by a committee from Buffalo composed of Charles R. Huntley, C. L. Abell, George Urban, W. G. Case, F. P. Little, W. A. Fenn, R. T. Goetz, A. A. Berrick, C. M. Morse and H. B. Oatman. The entire party was entertained at the Powers hotel in Rochester by the Brush company, the manager of which, George A. Redman, then accompanied the party to Buffalo. The Buffalo committeemen dispersed themselves among the delegates and on their arrival in Buffalo conducted the visitors to headquarters.

The western delegation did not reach Buffalo until Tuesday morning, and many more followed on Wednesday.

Electricity at the World's Fair.

What are undoubtedly the specifications for the largest incandescent lighting plant ever designed for temporary service have been issued by the World's Columbian Exposition. The specifications are dated February 22d, and proposals will be received by D. H. Burnham, 1143 Rookery, Chicago, until 1 P. M. on April 2d. Thirteen specifications have been issued, which will, of course, allow of an equal number of contracts being awarded. The lighting is grouped as follows:

State and foreign buildings and Midway Plaisance; system of mains and services, only, without inside wiring, 26,500 lights of 16 candle power.

Gallery of fine arts, complete system, including inside wiring, 9,626 16 candle power lamps.

Annexes to gallery of fine arts, complete system, including inside wiring, for 6,616 16 candle power lamps.

Woman's building, complete system, including inside wiring, for 3,000 16 candle power lamps.

Horticultural building, complete system, including inside wiring, 800 16 candle power lamps.

Transportation building complete system, including inside wiring, 2,500 16 candle power lamps.

Mines and mining building, complete system, including inside wiring, 3,000 16 candle power lamps.

Machinery building and annex, complete system, including inside wiring, 4,000 16 candle power lamps.

Administration building, complete system, including inside wiring, 5,000 16 candle power lamps.

Agricultural building and annex, complete system, including inside wiring, 4,000 16 candle power lamps.

Music hall and casino, complete system, including inside wiring, 3,500 16 candle power lamps.

Manufactures and liberal arts building, complete system, including inside wiring, 10,000 16 candle power lamps.

Decorative lights around basin, complete system, 7,000 10 candle power lamps.

These specifications also provide for service connections, without inside wiring, to the following named buildings: United States government building, 5,000 16 candle power lamps, 8-series building, 500 16 candle power lamps; construction and maintenance building, 1,500 16 candle power lamps.

The general conditions forming a part of all specifications provide that the chief of construction be sole arbiter of the plans and specifications and of the changes in compensation involved by the alteration of the plans; that none but citizens of the United States be employed by the contractor; that all damage to person and property in the prosecution of the work be at the contractor's risk; that the chief of construction have the right to remove any particular workman or workmen; that no sub-letting shall be done without the approval of the chief of construction; that work shall be begun immediately on the signing of the contract; that a forfeit of $100 per day shall be exacted if the work is not done at the specified time; that a satisfactory bond with a certified check (varying from $1,000 to $5,000, according to the size of the contract) be given the exposition to insure the faithful performance of the contractor's duties. The machinery and apparatus used may be listed as exhibits at the fair. The generating plant must, of course, be located in the central station at machinery hall. The feeders and distributing mains may be run in main subways and elevated railway structure, if desired, so far as practicable. The remainder of the system must be run underground in ducts, or by using a fixed system of conductors. The exposition will provide all supports for such conductors as may be run in subways, or on the elevated structure, or in the dynamo room, ready to receive pins and insulators, but the contractor must provide all pins and insulators, and all labor for attaching conductors. The contractor must provide all labor and material connected with laying the system of ducts or fixed conductors, except the labor of excavating and re-filling.

The specifications give the requirements in the case of each group. Contractors will be required to furnish all generators and station apparatus, all conductors, lamps and sockets, and all the labor and material of installation and erection. The exposition will furnish all else, including steam power and connections, lamp fixtures and shades. Generators must be erected and in running order not later than Jan. 1, 1893, in the case of most of the buildings, and the contractor must furnish all labor to operate all or any part of the plant, as directed by the chief of construction, at any and all times from 7 A. M., to 11 P. M. daily, from Jan. 1, 1893, to Nov. 1, 1893. The variation in electromotive force at the lamp sockets must not exceed three per cent. If the alternating system is used, the primary wires must not enter the buildings and the converters must be located in fire-proof vaults immediately outside. The installation must comply with the rules for wiring buildings for electric light or power adopted by the National Electro-Insurance Bureau in August, 1891.

The specifications for the administration building require that the plant must be ready for operation from Oct. 1, 1892, until Feb. 1, 1894. In this building the incandescent wiring plan includes provision for eight arc lamps. In the woman's building the plant must be ready for operation from Oct. 1, 1892, until Dec. 1, 1894. The 10 candle power lights around the basin are only to be operated from dusk until 11 P. M. In the music hall and casino the hours are from 5:30 P. M. to 12 P. M.

The number of lamps for the state and foreign buildings group is divided as follows:

Pavilion, 150; Iowa, 200; Montana, 200; New Mexico, 200; Arizona, 200; Wyoming, 200; Nevada, 200; Idaho 200; Utah, 200; Texas, 250; Kansas, 200; North Dakota, 200; South Dakota, 200;

Nebraska, 200; Washington, 200; Oregon, 200; Colorado, 200; California, 600; Indiana, 200; Wisconsin, 200; Michigan, 200; Ohio, 200; Minnesota, 200; Arkansas, 200; Florida, 200; Kentucky, 200; Louisiana, 200; Missouri, 200; Mississippi, 200; Georgia and Tennessee, 200; Pennsylvania, 500; New York, 500; Virginia, 200; West Virginia, 200; South Carolina, 200; North Carolina, 200; Maryland, 200; Delaware, 200; New Jersey, 200; Rhode Island, 200; Massachusetts, 200; Connecticut, 200; New Hampshire, 200; Vermont, 200; Maine 200; Illinois, 2,500; Brazil, 300; Chile, 200; Columbia, 200; Argentine Republic, 200; Japan, 500; Costa Rica 200; Guatamala, 200; Ecuador, 200; Germany, 500; Mexico, 400; Great Britain, 500; Other foreign building not yet located, 3,000; Midway Plaisance, 8,000; total, 26,500.

In the art gallery all lamps for lighting pictures are to be mounted on reflecting screens, and to be eight inches apart between centers. The screens are to be of heavy sheet tin or galvanized iron.

It will be noticed that no bids have been asked for lighting or furnishing power to the electricity building. The plans for this structure are still unsettled.

THE CONVENTION

Of the National Electric Light Association at Buffalo.

The fifteenth annual convention of the National Electric Light association was held at Buffalo, N. Y., February 23d, 24th and 25th. There was a good attendance, and despite the fact there was no general display, the supply men formed a large portion of the visitors. The convention was held in the Buffalo library building, and the sessions were well attended, the evening lectures forming a most interesting feature. Following is a list of members and visitors:

MEMBERS AND GUESTS.

Ackerman, P. C.....New York.
Alberger, Louis R.....New York.
Alexander, P. H.....New York.
Anderson, F. J.....Morristown, N. J.
Armour, Wm. S.....Chicago.
Armstrong, E. A.....Camden, N. J.
Ashton W. H.....Dayton, O.
Ashworth, D.....Pittsburg, Pa.
Atkinson, E. P.....New York.
Atwater, Chas.....Pittsfield, Mass.
Ayer, J. I.....St. Louis, Mo.
Baird, M. E.....Hartford, Conn.
Baker, C. O., Jr., and wife.....Newark, N. J.
Ball, Frank.....New York.
Balsley, A.....Philadelphia.
Barstow, W. F.....Brooklyn, N.Y.
Bartlett, E. E.....New York.
Bauer, A. H.....Chicago.
Beggs, J. I.....Chicago,
Bentley, J. H.....Camden, N. J.
Bibber, C. E.....Boston.
Blake, G. N.....New York.
Bogart, S. S.....New York.
Bostwick, F. H.....Akron, O.
Braddell, Alfred E.....Philadelphia.
Breithaupt, E.....Baltimore, Md.
Brophy, Wm.....Boston.
Brown, A. G.....New York.
Brown, W. S.....Penn Yan, N. Y.
Brown, J. Stanford.....New York.
Brown, A. S.....New York.
Bryant, W. C.....Bridgeport, Conn.
Bulkley, M. J.....Chicago.
Burk, Dr. W. H.....Philadelphia.
Burnett, G. A.....Buffalo, N. Y.
Burrell, E. L.....Chicago.
Butler, C. J.....Akron, O.
Byam, N H.....Pittsburg. Pa.
Caldwell, Edward.....New York.
Carter, E. D.....Erie, Pa.
Chaffee, W. A.....Buffalo, N. Y.
Chase, O. D.....Detroit, Mich.
Chase, S. H.....Boston.
Chesley, C. C.....Boston.
Chinnock, F. R.....New York.
Cleverly, H. A.....Philadelphia,
Coles, Stephen L.....New York.
Collins, L. W.....New York.
Collins, W. F.....Chicago.
Colvin, F. R.....New York.
Corey, R. B.....New York.
Corriveau, A. J.....Montreal.
Coster, M.....Pittsburg, Pa.
Cowles, J. W.....Boston.
Crandall, C. D.....Chicago.
Crossman, T. E.....Brooklyn, N. Y.
Cullen, Wm. F.....New York.
Cunz, W. R.....Medina, N. Y.
Cushing, F. W.....Chicago.
Cutter, H. B.....Philadelphia.
Cutter, Geo.....Chicago.
Darlington, F.....New York.
Daverin, W. A.....Boston.
Davis, A. E.....New York.
Davis, D. L.....Salem, O.
Daniels, A. L.....Erie, Pa.
De Ronde, F. L.....New York
Dickerson, J. W.....Chicago.
Dumoulin, L. S.....Boston.
Edson, Jarvis B.....New York.
Ellicott, Edward.....Chicago.
Fairbanks, H. H.....Worcester, Mass.
Famous, W. N.....Philadelphia.
Faye, C. H.....Brooklyn, N. Y.
Fearly, T. H.....Syracuse, N. Y.
Fenn, W. A.....Buffalo, N. Y.
Fenton, H. J.....Lockport, N. Y.
Ferguson, C. G.....New York.
Ferguson, James, and wife.....Brooklyn, N. Y.
Fessenden R.....Pittsfield, Mass.
Fielder, P. G.....Boston.
Field, C. J.....New York.
Findly, J. H.....Ogdensburg, N.Y.
Fisher, F. E.....Detroit, Mich.
Fisher, G. E.....Detroit, Mich.
Foote, Allen R.....Washington, D.C.
Foster, H. A.....New York.
Francisco, M. J., and wife.....Rutland, Vt.
Francisco, Master Don.....Rutland, Vt.
Frenyear, T. C.....Buffalo, N. Y.
Fulton, H. J.....Lockport, N. Y.
Goble, Chas.....Lockport, N. Y.
Godfrey, J. W.....New York.
Gilbert, G. A.....Sagamon, Mich.
Gray, L. A.....Chicago.
Gray, Elisha.....Chicago.
Griffith, C. B.....Rochester, N. Y.
Gwynn, J.....Steubenville, O.
Hall, A. E.....New York.
Hanna, J. A.....Philadelphia.
Hart, L. H.....New York.
Hayes, C. F.....Syracuse, N. Y.
Heath, Dr. W. H.....Buffalo, N. Y.
Heinrich, R O.....Newark, N. J.
Hering, Carl.....Philadelphia.
Hewlett, O. H.....New York.
Hill, F. T. G.....Waltham, Mass.
Hills, Chas.....Hartford, Conn.
Hine, Henry.....Pittsfield, Mass.
Holmes, W. C.....Newton, Mass.
Houghton, C. W.....Boston.
Hover, P. H.....Chicago.
Hubbard, Wm. A.....Plastas, N. Y.
Hume, S. W.....New York.
Hungerford, D. L.....Waterbury, Conn.
Hunt, W. T.....New York.
Hunt, G. W.....New York.
Huntley, C. R.....Buffalo, N. Y.
Issertel, H. G.....New York.
James, J. N.....Washington, D. C.
Johnston, W. J., and wife.....New York.
Jones, F. P.....Buffalo, N. Y.
Jones, A. J.....New Brunswick, N. J.
Kaelber, J. G.....Chicago.
Kitton, Frank.....Buffalo, N. Y.
Knight, J. C.....New York.
Knudson, A. A.....New York.
Kreidler, W. A.....Chicago.
La Roche, F. A.....Philadelphia.
Laurence, A. B.....New York.
Law, M. D.....Schenectady, N. Y.
Learned, Chas A.....Jersey City, N. J.
Leonard, H. Ward.....New York.
Leonard, S. S.....Cleveland, O.
Leonard, F. H.....Syracuse, N. Y.
Lee, G M.....Little Falls, N.Y.
Little, F. P.....Buffalo, N. Y.
Lockwood, J. E.....Detroit, Mich.
Lovell, M. N.....Erie, Pa.
Lovell, W. N.....Erie, Pa.
Low, W. W.....Chicago.
Lucas, H. P.....Chicago.
Lyman, H. M.....Canton, O.
Lynch, W. A.....Canton, O.
Mackie, C. P.....New York.
Mackie, R.....Cincinnati, O.
Mainwaring, A. H.....Philadelphia.
Manson, Geo. T.....New York.
Martin, T. C.....New York.
Martin, John K.....Philadelphia.
Mason, J. H.....Boston.
McCarthy, Louis.....Boston.
McCoy, D. B.....New York.
McDuff, G. G.....Chicago.
McIntyre, J. D.....Syracuse, N. Y.
McIntire, C. H.....Newark, N. J.
McLaughlin, Wm. R.....New York.
McMann, H.....Buffalo, N. Y.
Mead, Morris W.....Pittsburg, Pa.
Meeker, George H.....Chicago.
Mellville, G. S.....New York.
Metzger, E.....Warren, Ohio.
Minott, F. S.....Buffalo, N. Y.
Montfort, J.....
Morrison, E. W.....Toronto.
Newton, C. E.....Hartford.
Newton, A. D.....Hartford.
Ni holls, Frederic.....Toronto, Ont.
Noble, J. W.....Pittsfield, Mass.
Noll, Augustus.....New York.
Nunn, P. N.....Telluride, Colo.
Oakman, Henry B.....Buffalo, N. Y.
O'Hara, J. B.....Chicago.
O'Hearn, Wm.....Memphis, Tenn.
Olip, B.....Gothenburg, Neb.
Olmsted, J.....Rochester, N. Y.
Osborne, W. F.....New York.
Osgood, J. L.....Buffalo, N. Y.
Paiste, H. T.....Philadelphia.
Pearson, W. B.....Chicago.
Peck, E. H.....New York.
Peck, E. F.....Brooklyn, N. Y.
Perry, Marsden J.....Providence, R. I.
Phelps, Geo. M.....New York.
Phillips, S. S.....Seneca Falls, N.Y.
Pierrez, J. C.....New York.
Platt, F. B.....Chicago.
Pool, H. W.....New York.
Pope, R. W.....New York.
Porter, G. F.....New York.
Possons, N. S.....Erie, Pa.
Post, I. M.....New York.
Powers, E. L.....Chicago.
Powers, H. N.....New York.
Prentiss, J. D.....Cleveland, O.
Price, C. R.....Boston.
Pritchard, F. E.....Niagara Falls.
Purdy, C. J.....Canandaigua, N. Y.
Redman, J. A., and wife.....Rochester, N. Y.
Reed, E. McL.....Pueblo, Colo.
Reynold, J. F.....Buffalo, N. Y.
Rhodes, B.....Niagara Falls.
Rhotehamel, J. H.....St. Louis, Mo.
Richards, H. L.....New York.
Ridlon, Frank, and wife.....Boston.
Ries, Elias E.....Baltimore, Md.
Riker, S. H.....Syracuse, N. Y.
Robbins, H.....Pittsburg, Pa.
Rosenstamm, S.....New York.
Ross, E. L., and wife.....Boston.
Royce, Fred. W.....Washington, D. C.
Schieren, Chas. A., Jr.....New York.
Schieren, C. A.....New York.
Seely, J. A.....New York.
Seymour, E. W.....New York.
Seymour, A. P.....Syracuse, N. Y.
Shain, C. D.....New York.
Sharp, E. P.....Boston.
Shay, J. H.....Chicago.
Sheehy, R. J.....New York.
Sherman, S. S., and wife.....Boston.
Sherwood, R. H.....New York.
Shippy, H. L.....New York.
Smith, J. B.....Boston.
Smith, T. J.....New York.
Smith, H. J.....New York.
Smith, T. J., and wife.....New York.
Sparling, F. H.....New York.
Spicer, W. H.....Detroit, Mich.
Stanley, Wm., Jr.....Pittsfield, Mass.
Star, D. A.....Montreal.
Stephenson, D. J.....Port Huron, Mich.
Stetson, G. R.....Boston.
Stillwell, L. B.....Pittsburg, Pa.
Sturgeon, C. J.....Erie, Pa.
Sullivan, M. J.....Chicago,
Sweeten, F. D.....Wilmington, Del.
Swetland, H. M.....New York.
Taltavall, Thos. R.....New York.
Taltavall, J. B.....New York.
Taylor, S. F.....New York.
Terry, A. C.....Buffalo, N. Y.
Thomson, Elihu.....Lynn, Mass.
Tillinghast, J. W.....Buffalo, N. Y.
Titus, N. V., and wife.....Boston.
Tolles, C. L.....Hartford, Conn.
Townley, C. L.....Pittsburg, Pa.
Vallee, G. W.....Philadelphia.
Van Court, B. R.....Detroit, Mich.
Van Der Weyde, P. H.....New York.
Van Nuis, C. S.....New York.
Van Trump, C. R.....Wilmington, Del.
Walker, W. L.....Boston.
Waugh, C. T.....Chicago.
Weaver, A. B.....Buffalo, N. Y.
Webster, N. D.....New York.
Western, Benj. R.....New York.
Weston, W. H.....Philadelphia.
Wetzler, Jos.....New York.
Wheeler, S. S., and wife.....New York.
Wheels, S. M.....Indiana, Pa.
White, C. A.....Boston.
Whitney, H. C.....New York.
Whitney, W. A.....Pittsfield, Mass.
Whittlesey, W. A.....Pittsfield, Mass.
Wiegand, H. H.....Baltimore, Md.
Wightman, E. T.....Danbury, Conn.
Wiley, G. L.....New York.
Wilkins, E. W.....Philadelphia.
Wilmerding, C. H.....Chicago.
Wilson, E. P.....Buffalo, N. Y.
Wilton, H. L.....Detroit, Mich.
Wiman, Erastus.....New York.
Wolfrom, A. C.....St. Louis, Mo.
Wood, E. E.....New York.
Wood, Wm. H.....New York.
Young, E. P.....Sewickley, Pa.

Tuesday's Proceedings.

The convention was called to order by President C. R. Huntley, who introduced Mayor Bishop of Buffalo. The mayor made the following address of welcome:

MAYOR BISHOP'S ADDRESS.

It might seem as if there were an element of irony in welcoming the representatives of the electric light companies to this city. Judging from the common speech of people here an assembly of gentlemen who are at the head of the electric light companies and also those who is connected with them, especially their managers and attorneys, are not so modest as to require a welcome or an invitation to any place where good things are to be seen or to be had, and it is but fair to infer that electric men coming from other localities have like assurance. I would not have you think that the city of Buffalo is at war with her electric light benefactors. To be sure they do about as they please and they take what they want, but they do it so adroitly, so graciously, and with such abundant good nature that we rather enjoy having our good things taken. Then, too, they will make promises and agreement. which they do not always keep. It affords me great pleasure to have the privilege in behalf of the citizens of Buffalo of extending to you a hearty welcome. You have assembled here for the purpose of transacting

business and passing upon questions which are not only of much importance to yourselves and those whom you represent, but to the entire people.

I trust that your deliberations here and all your actions in this meeting will be successful as the most sanguine of you expect, and I have no doubt of it.

I will conclude by saying that when your labors are here completed and you return to your homes I hope youwill take with you only pleasant memories and a desire to visit us again. Again, ladies and gentlemen, on behalf of the citizens of Buffalo, I extend to you one and all a hearty fraternal welcome and the freedom of the city without reserve.

PRESIDENT HUNTLEY'S ADDRESS.

President Huntley delivered his anuual address, which follows:

In behalf of the National Electric Light association I am glad to welcome to our meeting to-day those who represent the city and public of Buffalo, and as a citizen of Buffalo and president of this body, I am not less happy in adding my own welcome to those which greet the visit of the association to this, the Queen City of the Lakes, a city far enough west to have all the bustle and energy of Chicago, but still far enough east to exhibit the dignity and solidity of New York.

As becomes one who fills this chair, there are certain topics of immediate interest and importance that I will venture to call your attention to, and if I do not touch all the questions that affect our great industry, it is because I made allusion to them in Montreal last September, or expect that you will get enough of them before you go home.

The meeting of this association so near to Niagara seems to afford a fitting opportunity for discussion of the problem which is attaining great importance day by day, namely, the electrical transmission of power, whether we are engaged in the distribution of electric light by arc or incandescent lamps, or in generating current for stationary or railway motors, or for heating, we are essentially engaged in generating, distributing and converting power into its various forms; hence any method by which the initial power can be obtained in a manner or from a source of greater economy deserves our most serious consideration.

The question may, therefore, naturally be asked: What would be the effect of the utilization of Niagara or other large water powers, so far as concerning outlying cities? How far will it be possible to transmit this power, not theoretically, or in an experimental way, but commercially, so as to insure a fair dividend to the investor? At what point does it become cheaper to carry current than to carry coal? Now these are large questions. They are in fact the largest problems in modern engineering. When you come to deal with such an immense and incalculable source of power as Niagara, our previous plans and methods and successes sink into nothing, as indicative of final results and realizations. Our attitude toward such a taming of nature is very much the same as that of the first electrical experimenters when they interrogated her with the help of pith balls and little chips of amber. Even the late demonstration at Frankfort teaches us little, for there we had the utilization of only such a water power as a well-to-do American citizen puts in his back yard for ornamental purposes; and the experiment was tried in summer time, when winds are light and skies are clear. Moreover, that plant was run as an exhibition, with the Emperor of Germany and other dignitaries lending a patriotic hand and subscribing patriotic dollars. Now, gentlemen, when you and I who operate stations come to use such water powers, or distant coal beds, we shall not be able to fall back on kindly emperors for timely donations. Some of our fellow-citizens will be quite ready to help us, but with the instinct that is born in every American, they will want the dollar they pay out to bring another back with it.

Our field of work, in short, with its newness and rawness, is one in which experience must always moderate enthusiasm. To me perhaps more than to many of my fellow members, this question of long distance power transmission is fraught with large possibilities and grave responsibilities. It is imperative that I should know the truth and the facts; and if ever the time comes when I can be humbly instrumental in giving Buffalo a sparkling midnight firmament created by yonder Falls, I shall ask no grander task. I have ventured to make this momentous subject one of the leading topics here, and my call for information has been responded to by some of the most authoritative workers and thinkers in this direction. To them I shall leave the exposition of its details, with the conviction that you will forgive me, if under a sense of duty, I have indicated the practical limitations that must govern every man of affairs.

In this connection I cannot help pointing out again that after all, the cost of coal to operate an electric plant is only one among many items, and frequently a small precentage of the total cost at that. For instance, in electric railway work, the cost of coal comes to about 10 per cent. of the total operating expenses, while in electric lighting it does not probably exceed from 15 to 20 per cent. In these days when municipal plants are the subject of frequent discussion these facts are generally lost sight of, and the cost of electric lights is calculated by reference to the amount of coal burned under the boiler; thus ignoring the fact that firemen, engineers, linemen, trimmers, etc., are required; that carbons require daily renewal, and globes break; that, like all other machinery, engines, boilers, dynamos and lamps are subject to depreciation, require repairs, that the building must be insured, and that a sinking fund must be established for renewals.

Cheap power in itself would therefore influence the cost of electric lighting very little, even if the electric current is distributed in the immediate vicinity where it is generated while its distribution to any considerable distance in large power units on a commercial basis seems to be awaiting its demonstration here rather than in Europe. Hence I would recommend a study of the facts pointed out, which ought to make any community fallen before investing in a municipal plant simply because it may happen to have what is supposed to be a cheap source or power around the corner.

Municipal ownership is, as I have just intimated, a topic that some of you have to deal with directly. This association has always been a forum to which new ideas in the industry might be brought, and our efforts have done not a little in clearing away the haze and confusion on the subject of municipal control and operation. I have made a special effort, as evidence of our impartiality, to get together at this meeting some of those who believe in the abolition of private enterprise and in the surrender of all the ideas that make us crave for a home of our own and the accumulation of a few dollars for a rainy day. If we are wrong in the belief that self-help is the best help, and that ten well-to-do citizens count more for the community than twenty superfluous officeholders, it is time we knew it. Some people want the government to run the railroads and some want it to buy up the telegraphs and telephones. Others want the municipalities to own street railways, gas works and electric light plants. In Boston there is, I am told, a demand that the city shall collect more taxes and put it into public coal yards. I am reminded of my reading as a boy at school, when I learned that the foredoomed population of a great city once sent up a howl for free bread and free tickets to the circus. Now, let me say right here that public franchises are a public trust. In return for them we are to do something or give something, that the community wants. In my humble judgment it has yet to be proved that such a way of introducing improvements and benefits is wrong or foolish. I am a busy man and have been earning a livelihood all my life, but I have had time enough to observe that the whole vast industrial development that has added so enormously to the comfort and happiness of life has come from the investment, under public franchises, of private capital, skill and enterprise. The public has thus been made the partner in all the great works of the age, and has thus gained infinitely more than it could have secured if it had raised an equal amount of money by taxation, and had placed the proceeds in the hands of a vast body of office-holders for the same purposes.

Among the questions that interest us are those that concern the relations between the so-called parent companies and ourselves, the local companies, operating the apparatus that the parent companies sell. I am aware that in some quarters the consolidations that have been effected from time to time are viewed with anxiety, and that in others the cry of bad faith has been raised—not perhaps, without warrant. But consolidations have their hopeful, better side. At one period our reprective territories were practically open ground for thirty or forty competing manufacturers, each of whom had the best system in existence. That fierce and watchful local competition should be engendered under such conditions was inevitable, and even to-day the industry is hampered by the central stations that came into being under this unwholesome outside stimulus. We were, I might say, peaceful farmers whose early and promising crops were an invitation to every raider that could reach us. But at the present time, the situation is clearing. The various consolidations let us see pretty clearly with whom we were dealing, and we know, too, something of the value of the claims made for the apparatus or the patents that protect it. We have also learned that much apparatus essential to good work is free from patent royalties, and that the moment prices go beyond the point of paying a fair manufacturer's profit, a dozen big engineering firms are ready to invest with capital and brains. My esteemed friend and predecessor, Mr. Weeks, has even suggested that we should combine and manufacture for ourselves. But there is no need for that. Dynamo and lamp construction has made a place for itself already as one of the arts, very few fundamental patents are left, and every day brings us nearer to the time when generator building will be as universally practiced as engine building.

Meantime, we who run the stations have been learning hard lessons in the school of experience, and that training is as valuable a part of our enterprise as are the franchises under which we have been induced to put our savings into the business of supplying light and power to our fellow citizens. Unfortunately much of that experience remains a sealed book, and it is with the view of exchanging practical ideas that this association carries on its work. I never meet one of my fellow-workers in this field but he teaches me something; possibly I give him a little in return. Now, apply that principle on a broad scale, and see how beneficial it must be to find out from each of two or three hundred earnest men their best way of doing things. That means progress, prosperity, perfection. But as long as only a few of us get together; as long as a feeling of apathy is allowed to control, our central station practice will fall far short of what it ought to be; it will not be as near standardization as it should be; and we will not make as much money as we ought. My political and social economy teaches me that the greater profit I can get out of any enterprise, with fair service and due satisfaction to the public, the better citizen I am The rewards of society are for those who can increase its wealth and raise its degree of comfort and convenience Now, the central station man who stays home is not doing his share to promote economical operation. I am glad so far as to state that if once a year half the central station men of the country were represented in our gatherings the average dividends would be increased, while not a few stations that now struggle on in dreary debt would reach a basis of solvency. I am very thoroughly in favor of one meeting a year for this association, and of a systematic, energetic effort to get everybody there. Every member should make it his business to interest his neighbors in the work we are doing, especially the smaller stations.

As an inducement to the smaller stations I would be glad to see the dues somewhat reduced, so that they can come in without feeling that they are paying dearly for their whistle. There is no valid reason why the dues should be high, and if cutting them down will bring in the stations most to be benefited, no hesitation should be felt in taking such action. I would like to see our membership ten times larger. As it is, the influence of the association is by no means insignificant, but with larger membership its deliberations would be so much more valuable, and when it approved or disapproved, the matter would be at once settled for the entire industry.

It is important that we should interest ourselves in the World's Fair. I surely do not exaggerate when I say that every patriotic New Yorker wishes Chicago the biggest kind of success in her great undertaking, and admires the genuine American fashion in which the Western metropolis has sailed in to win. It is not only our duty, but it will be a source of great pleasure to contribute to the importance and success of the Exposition. We ought to meet in Chicago next year. We must go there in a body. The Chicago Electric club is ready to take care of us, the whole city has a welcome for us, and the electric exhibit will be the finest the world has ever seen.

We have a good programme of papers for this convention, and I ask you to do the authors the compliment of discussing them exhaustively. If you don't agree with them, tell us why. If you have any local problem, take us into your confidence. You will probably find that others here have laid awake nights worrying over the same matters and have sometimes found a way out. If you have made some improvement in station practice and operation, ask for the floor; and if it is too good for everybody we will go into executive session over it. In these and other ways you will strengthen the hands of the chair, promote the cause we are here to advocate and make this meeting the best we have ever had.

INVITATIONS TO MEMBERS.

The secretary read several communications, including an invitation from the Delaney Forge & Iron company to visit its works. The Postal Telegraph company offered the use of its facilities for the delegates to send social messages free. Free use of all telephone wires in the city and also of the long distance telephone wires to New York and elsewhere were offered. The California Electrical society extended an invitation to hold the next convention in San Francisco.

The committee on underground conduits and conductors presented its report, which follows:

REPORT OF COMMITTEE ON UNDERGROUND CONDUITS AND WIRES.

BY M. J. FRANCISCO.

At the Providence meeting of the association a committee was appointed to investigate underground conduits and conductors, and collect data regarding their working. The committee, in carrying out this work, decided to send out circulars to all central stations and others using underground conduits, asking for information regarding their use and the success obtained. The following circular was printed and mailed:

A committee was appointed at the annual convention of the National Electric Light association, held in Providence, February, 1891, to investigate and collect data relating to underground conduits and conductors. In order to secure the full facts, answers to the following questions are desired: Will you kindly answer and return as soon as possible?

1. Mileage of conduit laid?
2. Cost of conduit per mile?
3. Mileage of conduit in use?
4. Mileage of duct laid?
5. Mileage of duct in use?
6. Average hours per diem same is operated
7. Number of man-holes?
8. Cost of man-holes?
9. Number of hand-holes?
10. Cost of hand-holes?
11. Number of services taken direct from conduit?
12. Cost of maintenance per mile per month?
13. Cost of repairs per mile per month?
14. Average number of burn-outs and grounds per mile and the cause?
15. Have you found the working of your underground system a commercial success?
16. What is the voltage on each conductor?
17. What is the current, in amperes, carried by each conductor?
18. What is the size of the conductors used? (In answering this question give the number and gauge.)
19. What is the thickness of the insulation?
20. Who is the maker of the cables?
21. Are the cables laid in any form of conduit?
22. If so, what kind of conduit is used?
23. Have the cables worked satisfactorily during the entire time of their use?
24. If the cables have failed to work satisfactorily, to what cause do you attribute the difficulty? (Please answer as fully as possible.)
25. Have you abandoned any conduits because they proved failures?

The names of companies or stations will not be made public, but grouped by numbers. We wish this information for the benefit of every member of the National Electric Light association.

It soon became apparent to the committee that it was treading on very dangerous ground, nearly every man addressed at once concluding there was a direct drive being made at him or his business, and the amount of ignorance displayed by those who had used underground cable, and were supposed to know its value and practical working, was rather alarming. Then a plan was adopted to secure from the manufacturers a list of those who had purchased underground cable, with the intention of making personal examination of each plant. Here again the discovery was made, that, with a few exceptions, the manufacturers did

not know to whom they had sold underground cable, and were unable to furnish the list. After these plans had failed, it was decided to investigate personally various plans and systems in use, and the chairman of the committee started out on a voyage of discovery.

The committee found that what had answered the purpose in one city had proved a failure in another, owing to local troubles, such as nature of the soil, gas, steam, and in some cases politics, which had a very peculiar effect upon the conduit itself, as well as the insulation used, and, in one city, we found that a liquid insulation, passed through the conduit in such a way that the officials could personally examine and test its efficiency and quality, was the only conduit or system they would approve or adopt.

In another city the central station company placed about ten miles of underground conductor for an arc line, passing same through an iron pipe, relying upon the insulation of the wires: it utterly failed and they took it out, then tried another make of wire, drawing it into the same iron pipe; this held for a short time and then began to burn out, and sometimes two feet of the wire would be entirely burned out, and when it was drawn out of the pipe you could blow dry powder in clouds from the pipe, showing that it was not moisture that caused the trouble. Another company tried a conduit made of three-inch tarred planks, using underground cable with 5-32 inch insulation that was supposed to be first class; through this they passed a 1000-volt current. As soon as they started they had innumerable burn-outs, grounds and crosses, and finally abandoned it.

One company using 1,100 volts and 50 amperes, tried passing cable through pump logs, with wire of 1-16 insulation and were troubled with grounds and burn-outs, and found the insulation was too thin and had to be abandoned. Another company tried conduit made of asphalt, with several makes of wire, using 1,500 volts and 10 amperes, but did not work successfully on account of burn-outs, grounds and crosses, and abandoned the entire outfit.

In the course of this voyage a gang of men were discovered trying to locate a burn out; as this was directly in line of our business we decided to anchor and devote sufficient time to the case for an examination. The plan adopted was to dig up the pavement and disconnect the iron pipe containing the wires and then test in each direction; this was repeated until fifteen openings had been made in the street at various points and the section burned out discovered, and it was found that, not only had the wires been burned off, but the iron pipe for nearly two feet had been melted, destroying the whole line. This pipe was removed and a new one inserted and connected.

Of course, in many cities where concrete or asphalt pavements were used, it would be impossible to obtain permission to tear up the street in fifteen places to replace one burn-out, to say nothing about the expense. There are five men employed upon this line, and they informed us that their entire time was spent in tracing and repairing burn-outs in their beat, covering about two wards.

In a municipal plant of one city, where the Dorsett system was used, also iron pipe with cement lining and other styles of conduit, it was stated that the underground conduit and wiring was perfection and could not be improved upon. A little private investigation developed the fact that one underground circuit had been in trouble for six months previous to our visit and at that time the trouble had not been located, also that the voltage of the lamps varied from 25 to 55 volts; but as it cost nothing to run a municipal plant, this condition of lines and lamps was not considered of any importance.

Various plans were tried for lighting the Hoosac Tunnel. They used 1,000 volts, but the insulation was too thin and would not stand and they had constant trouble, as the tunnel is very wet and in many places wire was covered with water. They then tried another style of wire, using 1,000 volts, alternating current, lamps in series, twenty in each set, 1,250 lamps in all. Since this plan was adopted they have had no trouble and the same wire has been in use three years, running twenty-four hours per day.

The Electric Bureau of Philadelphia has about fifteen miles of duct in use for electric lights; it is using 2,500 volts and 9½ amperes. It reports six grounds from Jan. 1, 1890, to Nov. 13, 1891, and all, except one, from too thin insulation.

In one case the cable was damaged before drawing into the duct. They used the creosoted wood conduit; the cost of this kind of conduit is about $4,500 per mile, including manholes. As they have only been in use about two years, it is impossible to judge of their durability.

In Washington the terra cotta conduit is used. This is a trough, 3½ by 8 inches each made of glazed terra cotta, laid with a proper cover about two feet below the surface. These are connected by bracket shaped pieces, which hold the joints in position and all laid in a heavy bed of cement. Each duct is calculated to hold three 2 inch cables, but the size can be varied. The Electric Lighting company tried conduits of wood, asphalt and iron, but they all failed; they then used the terra cotta and have found it very satisfactory and reasonable in price, but the cable to be used must be first class.

In New York city the electric companies could have made a success of the underground conduit work, were it not for the exorbitant prices charged as rental for use of conduits, which has been $1,000 per mile per annum for 3 inch distributing duct; $900 for 3 inch trunk, $800 for 2½ inch trunk. To this must be added the heavy cost of cables, joints, labor, etc., with an expenditure of about $24 per mile to maintain them. The companies are then asked by the city officials to furnish all night lights for about $75 per year. This would leave a very peculiar looking balance sheet at the close of the year, and, if repeated for a few years, would require the services of an assignee to adjust.

In England many plans have been adopted, with varying success. Through the courtesy of the London chamber of commerce and prominent English electricians, we have obtained some information regarding the practical working of various systems. Ferranti uses for his high tension 10,000-volt current his concentric cable, composed of a thick copper tube, upon which is wound a number of layers of paper saturated with an insulating wax; over this is slipped a thin outer tube of copper for the return current and drawn down close; then he covers the outer tube with insulation and puts a lead tube covering over that and places same in the ground; wherever there is traffic he adds an iron pipe. Notwithstanding all these precautions he has had innumerable troubles from grounds, induction, etc.

In Liverpool the mains are laid in cast-iron troughs, then filled in around them with bitumen and covered over with Portland cement. These have answered perfectly for the low tension, but they have not used high tension currents long enough to test their efficiency of durability.

In Bath, England, they use a conduit consisting of an iron trough, with iron cover, in which cables with one-half inch insulation are laid on wooden bridges about two feet apart, and after cables are placed in position the whole is filled solid with bitumen and then the iron cover fastened down. On cables laid in this way they have carried for two years an arc current of 2,500 volts and an alternating of 2,000 volts successfully, only one ground having occurred.

After a careful and extensive examination of nearly all underground work in this country, the fact has been developed that, with very few exceptions, the system and plans heretofore adopted have proved a failure; in some cases this was caused by improper materials, insufficient insulation, in many cases carelessness in laying the conduit or drawing in the cable, and, in a large majority of cases, from using cable with too thin an insulation. High tension currents can be carried in conduits successfully, if the conduits are properly built and cables thoroughly insulated and carefully drawn in, but it is absolutely necessary that all work and materials should be first-class—no half way business or effort to scrimp and save expense by thinly insulated cables or poor construction.

Investigation plainly shows that a large number of the troubles on underground cable have been caused by workmen in the manholes, as the employes of all companies have access to them. Employes of one company have been extremely careless while working over the cables of a competing company and trouble has followed. This shows conclusively that each company should own and control exclusively the conduit in which its wires are placed. The plan of renting conduits is not productive of good results, unless the legislatures of the various states pass a law regulating the charges made for rental: and it should be the aim of the National association to see that laws properly controlling the price charged for rental and use of conduits are passed in all the states where they are used.

A serious trouble in underground work has been caused by drawing in the cables. This is a very important part of the business, and should be intrusted to reliable and experienced men, as the least injury to the insulation, while it is being placed in the duct, will surely develop and cause trouble; and many of the burn-outs have been caused in this way. No matter how good an insulation you may have, if it is cut or injured while passing it into the duct, you can depend upon it that this special place will give you notice before long, and in a way that will severely test your ability to obey one of the ten commandments.

Some substance must be used for the conduit that will withstand the action of the gases, soil, etc., and also resist the affectionate embrace of the workman's pick, used in excavating and repairing streets. Iron is not desirable, as, under certain conditions and places, it will be destroyed in a few months, leaving your cable exposed; cement alone cannot be relied upon; wooden conduit soon decays, beside absorbing large quantities of moisture. It would seem that glazed terra cotta, or like substance, set in concrete, was the most reliable, and with a cable first insulated with not less than one-fourth inch of pure rubber, this covered with a heavy braid well insulated, over this a covering of lead and then a heavy and substantial braid, saturated with a good compound, will give satisfactory results and can be used with high tension currents successfully and without being troubled with burn-outs or grounds. But this entails a large outlay for conduit and cables.

There is one feature of the business upon which all examinations and reports agree; that is, that the underground plan has been in use for so short a time that it is impossible to give a fair comparison of the cost of maintaining aerial and underground circuits, but it is conceded that the expense of maintaining underground cables is far greater than aerial, also that the durability of conduits and cables, in many cases, is mere conjecture, as they have not been used long enough to test their ability to stand the action of acids, gases and various other requirements, which can only be determined after a sufficient time has elapsed.

In cities of less than 200,000 inhabitants, compelling companies to place their wires underground will practically prohibit the use of electricity for lights, and leave the inhabitants of those cities to meander through its streets, guided by the sickly rays of the kerosene lamp or the feeble flutter of the gas burner, as no electric lighting company can afford the expense that this would incur, unless they could obtain double the prices now paid for lights.

The expense of conduits and underground cables is so heavy that they can only be adopted in a few of the larger cities, thickly settled, and then the electric lighting companies adopting them must be paid a higher price for service, or eventually their company will be bankrupted by the expense and loss entailed. Therefore the taxpayers in any city who demand that wires should be placed underground want to realize the fact that this move means increased cost for lights and larger taxes to pay for them. From data obtained it is evident that nearly all the cities could be served with aerial lines for the high tension current in a more acceptable manner and at less expense than with underground conduits, and they could be so arranged as to be perfectly secure and not in any way endanger the public or mar the general appearance of the streets. But as this committee was appointed to investigate underground and not aerial circuits, it has not considered it within its province to describe or recommend a plan for aerial lines.

Discussion.

Mr. Nichols: It is said that a creosoted wood conduit costs $4,500 per mile. Is that the price per duct, or if that was the whole conduit, how many ducts in the conduit?

Mr. Francisco: That is for two ducts in the conduit.

Mr. Hering: I believe no mention was made of the system in use in London and Paris, in which bare wires are run in conduits on glass insulators, a system which seems to work satisfactorily, and seems to solve the problem of insulated coating. The wires are perfectly bare, and supported on glass insulators under the sidewalk. They are easily accessible, as they are covered with flagstones a few inches below the surface of the ground.

Mr. Francisco: In the course of correspondence, I was told that in Paris nearly all the lines are in the sewers on glass conductors. Such a method is impracticable in this country, and I paid no attention to it.

Mr. Hering: I believe that is an error. I was there, and they told me that no electric light wires were allowed in sewers, on account of the telegraph and telephone wires. At the time I was there, they were laying the electric light wires under sidewalks in special conduits made for them. It was a concrete conduit of rectangular cross section; the insulators were on iron rods extending across from one side of the conduit to the other.

Mr. Wilmerding: I think Mr. Francisco takes a rather pessimistic view of the underground system of distribution. We think that we have succeeded in Chicago in transmitting currents underground without any trouble. The reason that there are so many failures in places where they are just beginning to do that work, is because they do not do it properly. They try to do it at too small an investment. In order to economize in the first cost of construction, people will put in a wire that is too lightly insulated. There are systems of conduit in the market which are recommended as being insulated, but I do not take any stock in them. The iron pipe for conduits is just as good as a non conductor, except from the fact that it will rust out and become useless in four or five years. The main point to be considered in the conduit is to get a certain strength and elasticity, so as to prevent the conduit from cracking with the action of frost and other causes, and yet be easily repaired. I believe that wood is one of the best substances for conduits we have. In Chicago we have had very satisfactory results with it. We began the work about four years ago, and I had occasion to open the street a short time ago at a place where this first wood conduit was laid, and I found it in perfect condition, although the weather had been dry for a long while; aside from that, the wood was thoroughly moist. It bends and takes up any irregularities in use; it maintains its moisture; it affords a very smooth surface for drawing in cables, and I think it is a good thing. It has the further advantage of being very cheap.

In regard to the reliability of the cable, I think I have the right cable, and with sufficient insulation it will carry a reasonable potential for a considerable length of time. I have forty miles at present of a certain cable, with an insulation in thickness of 5-32 of an inch, which is carrying a potential of 500 volts on a constant potential motor service, an alternating service of 1,000 volts and from 2 500 to 3,000 volts in arc lighting service, and which has been in service for over two years, and I have not had a single case of grounding, burn-out, or anything of the kind, on 40 miles of conduit. This shows that the conduit system can be maintained with perfect satisfaction, if you put it in in the right way in the beginning.

Mr. Francisco: I would like to ask Mr. Hering if the underground wire is for low potential?

Mr. Hering: Yes, sir; it is.

Mr. Francisco: The continuous current was referred to us and we paid no attention to low tension current.

Mr. Hering: The system seems equally applicable to high and low tension. It is an aerial line running in the conduit underground. At the California exhibition this summer, there was an underground cable, in which an alternating current of 20,000 volts was carried for a distance of about a mile.

Mr. Francisco: In regard to Mr. Wilmerding's remarks about wood, I would say that the entire thing depends on the locality. I can show you a case of wood conduit that has lasted less than nine months, and I can show you other cases where they have been running for 20 years. It depends on the locality and the soil. In some soils you can lay a conduit and have it work all right; in other soils, you would have nothing but a wood pulp that you can

crack in your fingers. I would like to ask if they have not had trouble in Chicago with the conduit?

MR. WILMERDING: I think that is the fact in regard to the city plant. I was told by one of the employes who had charge of the underground circuit that they had trouble on one of the underground circuits for about six months, and had not been able to locate it.

MR. STANLEY: When a high potential continuous current is placed in an underground cable there is a great strain on the insulating material, and this strain is all in one direction. As the result of that continued pressure in one direction the constitution of the insulator changes, and after six months in some cases, I believe, in London, in even less time than that - the entire structure of the insulator changes, so that while the cable had a high specific resistance to start off with, that rapidly fell off in the same cable. In the case of alternating currents in these conductors this deterioration does not take place; but in this case the current reverses rapidly, and the work done by the current passing in one direction is quickly undone by the next wave passing in the opposite direction; and thus the effects are neutralized. The effects of the alternating current are more like those of water flowing through a pipe. If we had a long pipe, filled with water, and suddenly turned it on end, the water would rush to the far end, and strike a hard blow, and there would be a water hammer effect. The longer the cable is underground, and the longer the distance, the greater is this condenser effect; and it was so great in the case of the Ferranti main that it raised the pressure at London a great many volts higher than at Deptford, where the other end of the cable was. I think it can be generally stated that those insulations made from oil-compounds are unfit for a continuous current strain, while they are exceedingly good for alternating currents. In some cases in underground work we found that the cables did not have the capacity they were figured for; the capacity being always reduced. The resistance of the cables for alternating currents was considerably higher than it ought to be—in some cases ten per cent. higher -and we were worried a great deal about it. We found that the external resistance of this cable was due mainly to the work that was done in the iron pipe which inclosed the cable, the resistance function being outside of the wire, and not inside, and also that the current in the wire was not evenly distributed, a result which had been predicted long ago by Sir William Thomson. These difficulties were overcome by adopting a certain small standard size of conductors and putting in more cables.

M. J. PERRY: To the suggestion that aerial lines be run underground, there are several objections. In the first place, streets as laid out in this country, with very few exceptions, are winding and irregular in character, both as to direction and width, such as in Boston, Providence and other cities. It is utterly impossible to occupy the space directly under the sidewalk; in many instances these are controlled by the abutting property owners; they have possession, and they are using it for vaults and other purposes. To attempt to obtain the right by legal proceedings, by eminent domain or condemnation, would entail tremendous expense, if at all feasible. In addition, we have a great variety of pavements for our sidewalks. It runs from a simple bed of concrete in some places to great granite blocks, so as to be in harmony with the material and style of architecture of the building. The proposition to place wires underground, in the broad sense, I think is admitted as practicable, by all our best electricians, provided you are prepared to put a sufficient amount of money in it. To be able to put that money in it, it is necessary to offer some inducement to the investor for the use of his funds. I assume that probably the main line of the Buffalo company is from twenty-five to forty per cent. of its capitalization. You must first absolutely shrink that and throw it away, and that would be an enormous strain on any corporation; secondly, you must put in three or four times as much money as you have now invested for distributing purposes; and to secure that investment, you must make it plain to the investor—more plain than you can now do with the isolated instances we have of the workings of underground systems—that he can safely put his money in it and realize a profit. Up to two years ago at least, the gentlemen from Chicago were not prepared to recommend to investors. They may have worked the problem out; but you cannot get any more American capital on the showing made there: American dollars do not go that way; and they do not grow that way.

If we could see the books of the Buffalo electric light companies, I will warrant you that they would not show that they were making extravagant profits. They may possibly be earning dividends—a fair return on the investment—which a man who invests his money is entitled to. This proposition to place wires underground, if consummated, would necessitate earning a dividend on at least double the present capital. We will say you have based your prices on a capital stock; that you have an investment which requires that you should earn one hundred dollars per lamp; but you cannot raise your prices. The tendency in prices, in all business transactions, is steadily downward, and you have got to be busily at work to determine and introduce economies that shall take care of that gradual pressure downward; and yet you propose to pay double; and it will be impossible to get higher prices, even though an increased investment should be made.

These are the points that must be very seriously considered. This instance of the Buffalo electric lighting company is being considered, when an attempt is made to force it at once to lay its wires underground. It may be that sufficient pressure may be brought, it may be sent to bankruptcy, and it may be that those who come in on the second deal may reap a rich reward. I do not believe, however, that that is the province of any city government, and I do not believe that it is the intention of any intelligent public to do this, if they have been fairly and squarely confronted with the question.

Mr. Francisco's paper was carefully prepared and well digested. He brought out certain things that have transpired to my own personal knowledge; one of which was that wood will work in certain kinds of soil and not in others. I question, however, whether underground work up to this time has been a success, even where conduit companies that have gone into cities and have laid down conduits have been a success. No such success has come to my knowledge, and I have watched the matter carefully.

MR. WILMERDING: I do not want to be understood as recommending underground conduits for investors. Mr. Perry rather misunderstood me about that. When you discuss this matter as a financial question, it assumes a very different aspect, of course. As to the question of the practicability of having currents underground, I must say it is practicable. We know it is. When it comes to a matter of investment, it is impossible, with a given rate for service based on overhead construction, to furnish underground circuits at the same rate. When Mr. Perry assumes that it may cost two or three hundred dollars per lamp for underground construction, he is too low; we cannot do it for less than four or five hundred dollars for a complete plant. Of course, we had a different experience in Chicago from what the Buffalo company would be subjected to. We never had an overhead construction; never had to throw our overhead construction away. We started in to put wires underground, when we began business. After many experiments we managed to make a success of the matter, and our stockholders are not entirely neglected. I do not think it is possible for any company which is operating by the overhead system to afford to do the lighting at the same price by the underground. It certainly cannot be done under any circumstances in a city of small population — two hundred thousand or less—it is practically impossible.

AFTERNOON SESSION.

Mr. Stillwell read the report of the committee on the relation of size and efficiency in transformers.

THE RELATION OF SIZE AND EFFICIENCY IN TRANSFORMERS.

BY L. B. STILLWELL.

It is not intended in this paper to present an elaborate discussion of the relations of size and efficiency in transformers treated from a theoretical standpoint. If we were to select a certain type and, preserving for all sizes the same general proportions, agree upon a certain limiting temperature which all may be allowed to attain under working conditions, such a discussion would of itself be of interest, as pointing out the relations which exist between radiating surfaces and the amount of energy unavoidably lost in a transformer, but a thorough discussion upon such lines would involve a more or less elaborate comparison of the several factors which go to make up the sum of this loss, and for our purpose the possibilities of allowing greater loss in copper and less in iron, or greater in iron and less in copper, which are presented to the designer, are of less interest than a brief and necessarily general study of the effect of varying size upon the commercial efficiency of transformers as they are now offered by the manufacturer to the central station manager. Treatment upon these lines will also naturally call attention to other considerations of great practical importance, as regulation, insulation and weight. The variation in difference of potential at secondary terminals when the transformer is without load and when it is loaded to its full rated capacity should be a minimum, the insulation should be such as to practically prevent the possibility of electrical connection of primary and secondary coils, and the weight should not be so excessive as to cause serious inconvenience in handling.

The designer of a transformer has presented to him alternative paths. He may easily design with reference to a very small loss of energy and relatively high efficiency at light loads, if he is willing to sacrifice regulation. He may design a transformer of little weight and large output, if he is content to work at a very high temperature, which may perhaps endanger the lasting qualities of his insulation. The best transformer is not necessarily that which has the lowest leakage or magnetizing current; nor that which regulates most closely; nor that which is lightest and most easily handled; nor yet that which will carry its full load indefinitely with the least increase of temperature; but it is that transformer which best combines as much of each of these desirable properties as is practicable. In comparing various types, therefore, it is necessary to begin with a realizing sense of the fact that the same laws govern all types as to design and performance, and that, under the general laws of physics which have to do with this class of work; extraordinary excellence in one respect is necessarily obtained at the price of sacrificing excellence with respect to other properties equally important.

A glance at the files of the technical journals or an examination of the records of the patent office for the past five years will show that a very large number of transformers alleged to embody certain new and useful improvements have been suggested, or, as their respective sponsors would say, invented. Fortunately we are not called upon to discuss all of these. Five years in the development of electrical apparatus is a long time, and while it may not yet be said of transformers in commercial use that only the fittest survive, it is noteworthy, as it is for our purpose fortunate, that there is a general similarity of type prevalent in America, and the more general relations of size and efficiency obtaining in a line of transformers, as furnished by one manufacturer, obtain in all. I propose, therefore, without venturing farther upon the domain of theory than is absolutely necessary, to glance at what may be called the geometrical relations of transformers of various sizes, and so invite the attention of owners and operators of central station plants to a subject of very considerable practical importance to them.

Let us take, as a starting point, a very small transformer; for example, one of five lights' capacity, the primary terminals of which are connected to an alternating current circuit of 1,000 volts potential. We will suppose that the lamps which are connected to the secondary circuit are all turned off. Under these conditions a small current, called magnetizing current, or leakage, flows in the primary coil. This current magnetizes the iron, and as a result, we have in the primary what is called a counter electromotive force. Every transformer, small as well as large, which is connected to this dynamo circuit, must develop a counter electromotive force approximately equal to that delivered to it from the dynamo. This counter electromotive force depends upon the alternating magnetization of a certain amount of iron, and the magnetization of this iron means the expenditure of energy. The amount of iron required and the expenditure of energy necessary will naturally be less in a transformer of small capacity than in one of large capacity, but there must be some iron magnetized and some energy expended in holding back the electromotive force of the dynamo. It is safe to say that a commercial transformer, by which I mean a transformer that can be manufactured at a cost that will make it a commercial or salable article, cannot be so designed as to have a loss of less than 20 watts, due to the magnetization of the iron. A transformer twice as large—that is, of 10 lights capacity—is called upon to do precisely the same work and no more in developing counter electromotive force to oppose that of the dynamo, and may quite as easily be designed to work with an iron loss of 25 watts. If the rated capacity of the five light transformer is 250 watts and of the 10 light transformer 500 watts, the loss in the former will be eight per cent. and in the latter five per cent. A 20 light transformer may as easily be designed to work with an iron loss of 30 watts, and a 40 light transformer with an iron loss of 45 watts; the percentage of loss in these cases being, respectively, three per cent. and 2 25 per cent.

One 10 light substituted for two five light transformers will reduce the amount of energy lost in magnetizing the iron from eight per cent. to five per cent. a saving of three per cent. One 40 light substituted for two 20 light transformers will reduce iron loss from three per cent. to 2 5 per cent., a saving of one-half of one per cent. About the same percentage of saving can be effected by again doubling the size, and 100 light transformers can be furnished in which the iron loss does not exceed 1.7 per cent. Beyond this figure it is easily seen that improvement is difficult and even were it possible, by employing a very large transformer, say one of 500 lights capacity, to reduce iron loss to one per cent., the improvement in efficiency resulting from the substitution of one of this size for five of the 100 light size would be but a fraction of one per cent., and, in view of the necessarily greater weight and the obvious objections to putting a large number of eggs in one basket, the advisability of such substitution would be doubtful.

Thus far we have considered only the loss in iron when no current flows in the secondary circuit, and it will be sufficiently accurate for our purpose to assume that this iron loss remains constant under varying loads of the transformer. The loss of energy due to the resistance of the copper when no current flows in the secondary is negligible, since the magnetizing current in the primary is very small, but this loss increases as the load on the transformer is increased, and the increase varies as the square of the current flowing; that is to say, the copper loss is four times as great when two amperes flow in the secondary circuit as when one ampere flows in that circuit. In the transformer without load we have a certain loss of energy designated iron loss, while in the transformer fully loaded we have this same iron loss plus the maximum copper loss. For intermediate loads we have approximately the same iron loss with varying copper losses dependent upon the amount of the load.

The loss due to the resistance of copper is generally about two per cent. This does not vary materially with a variation in size of the transformer, certain considerations having to do with regulation being largely accountable for this fact. If we assume that the loss in copper at full load for every size is two per cent., and that the iron loss is constant, irrespective of the load, the following table will, with sufficient accuracy, indicate iron and copper losses and efficiencies at full load. The table does not represent actual measurements of selected transformers, but is intended to fairly represent the proportionality of losses in transformers of various sizes. Actual tests will show results as good as, or even better than, the figures given in the table.

Capacity in 16 C. P. Lamps.	Loss in Iron.	Loss in Cop'r.	Efficiency at full load.
5	8 per cent.	2 per cent.	90 per cent.
10	5 per cent.	2 per cent.	93 per cent.
20	3 per cent.	2 per cent.	95 per cent.
30	2.5 per cent.	2 per cent.	95.5 per cent.
40	2.3 per cent.	2 per cent.	95.7 per cent.
60	2.1 per cent.	2 per cent.	95 9 per cent.
80	1.9 per cent.	2 per cent.	96.1 per cent.
100	1.7 per cent.	2 per cent.	96.3 per cent.
300	1.5 per cent.	2 per cent.	96.5 per cent.

It will be seen that for sizes of less than 20 lights capac-

ity the falling off in efficiency as we go down the scale of sizes is very rapid, while, on the other hand, the gain in efficiency of transformers larger than that of 20 lights' capacity is much less marked. The exact significance of the table will, perhaps, be better shown by putting it in another form. Let us compare the losses at no load and at full load in 1,200 lights capacity of converters of each of the several sizes, and let us express the loss in each case in terms of the number of 16 candle power lamps, which the energy so lost would be sufficient to supply. We then have the following:

Transformers used.		Loss at no load.	Loss at full load.
240	5 Light Capacity.	96 Lamps.	120 Lamps.
120	10 "	60 "	80 "
60	20 "	36 "	60 "
40	30 "	30 "	54 "
30	40 "	$27\frac{6}{10}$ "	$51\frac{6}{10}$ "
20	60 "	$25\frac{2}{10}$ "	$49\frac{2}{10}$ "
15	80 "	$22\frac{8}{10}$ "	$46\frac{8}{10}$ "
12	100 "	$20\frac{1}{10}$ "	$44\frac{1}{10}$ "
4	300 "	18 "	42 "

These figures plainly show that to supply any number of lamps up to 100 it is desirable, on the score of efficiency, to use a single transformer of the required size rather than two or more of less capacity.

For sizes of a capacity above 100 lights the improvement in efficiency is necessarily little, and although the argument on the score of efficiency is still in favor of the use of the large sizes, that argument is by no means as strong as it was before we passed the 100 light limit.

This properly finishes the discussion on the relation of size and efficiency in transformers as they are to be purchased in the market to-day, but there are certain other considerations very closely connected with the subject which will naturally influence a central station manager. I have left myself no space for a discussion of these points, but they are, for the most part, of a very obvious character, and it will be sufficient to simply mention them.

In favor of the use of large sizes is the very practical argument of reduced cost per lamp capacity. In giving proper weight to this consideration the purchaser should assure himself that the manufacturer has not effected a reduction in cost at the price of an excessively high limiting temperature, which may endanger the lasting qualities of the insulation.

Transformers of 300 or 500 lights capacity are naturally large and difficult to handle; or if they are not very large it will be well to again note the temperature.

An investment in a 500 light transformer is large as compared with an investment in one of 100 lights capacity and the chances of accident, such as may be caused by lightning, are quite as great in the case of the former as in the case of the latter.

It is extremely improbable that a static discharge from the line caused by lightning will damage more than one of a group of five transformers which may be connected together in multiple arc, while a discharge which may break down the insulation of one of these will be quite as likely to damage a 500 light transformer.

Discussion.

Wm. Stanley, Jr.: Mr. Stillwell has assumed that a non-heating transformer is what we desire. Now, as a matter of fact, the most efficient transformer that could be made, I believe, would be the hottest transformer. Mr. Stillwell qualifies his statement by saying that it should not be so hot as to endanger its life. The problem of building a transformer is to build a coil of wire and get as much iron in it as you can; that is, to surround a given amount of iron with as many turns of wire as you can; or, to surround a given size or coil of wire with as much iron as you can. I think the table that Mr. Stillwell has given as to the efficiency of the several sizes very good. We have had occasion lately, to design transformers of very high voltage, as high as 15,000 volts. We find no difficulty in keeping the temperature of these transformers within reasonable limits. They will get hotter than a small transformer; it is better that they should. But I do not believe any well insulated transformer is in danger of breaking down. It depends on the kind of insulation. If you put in mica or if you put in paper, or any stratifying insulation, and subject it to a high potential, it will most certainly break down with that potential by either a dynamic current or static charge or stroke of lightning; but if you fit it with a homogeneous insulator, such as oil or some solid insulating compound, you can use any potential you want, provided the discharges do not take place that occur in stratified insulation. I think the heat has very little to do with the breaking down of a properly insulated transformer.

Prof. Thomson: I do not exactly agree with Mr. Stanley in the statement that a transformer is better when it is hot. I would rather modify that statement in this way, that a transformer would run best if the iron would run hot and the copper as cool as possible; that is, the hysterisis losses of the iron would be diminished by the heat, and the resistance losses in the copper would be lessened by keeping it cool. If we could insulate the core of the transformer so as to prevent the escape of heat, and keep the copper as cool as possible by ventilating it thoroughly, we should then have the ideal transformer. I hardly agree with the statement of Mr. Stanley that the insulation would not be injured by being hot. It is our experience that you cannot have a machine, a dynamo or any other electric apparatus run too cool, as regards the preservation of its insulation, provided it does not run so cool as to gather moisture from the atmosphere. The absolute resistance, the dielectric resistance, is highest when the substance is cool; that is, the tendency to puncture insulation is much less if you can keep your insulation cool. If you allow the insulation to heat up, its power of resisting puncture certainly decreases. The matter may be briefly stated in this way: if you take a good conductor like copper and run the temperature down its resistance almost disapears at very low temperatures; hundreds of degrees below zero copper is almost a perfect conductor. If you heat it up it becomes more and more resisting. Let us take glass—a good insulator—or any insulating material, and run its temperature up, it loses its insulating power, and if we run it up until it gets to red heat it approaches a conductor, so that all substances are conductors when they are hot enough.

Mr. Stanley: I did not mean to imply that it would not injure the insulation of a transformer if you had it too hot. What I did wish to say was, that so far as the efficiency of the apparatus went, it would rather, on the whole, be improved by heating it. I think Prof. Thomson agreed with me. Of course, we can heat a transformer up so high that it will get on fire; but there ought not be anything to burn. I question if the transformer of the future will have cotton or other inflammable material in it. We are making transformers in which, if the coil is cut in two, the copper wires will be found imbedded in a solid dielectric, and the section would resemble the section of a well constructed cable; there is nothing to burn there. A temperature change of 30 or 40 degrees would hardly affect the dielectric strength, while it would materially affect the efficiency of the apparatus.

Mr. Stillwell: While it may be a theoretical possibility to make a transformer in which only such insulating materials as are not affected by heat are used, I do not think that any transformer is now offered in the market which will be found to embody that kind of insulation. If you use only mica or something of the kind which is not affected by heat materially, then, in general, I should agree with Mr. Stanley, that it is well for efficiency to let the transformer run at high temperature. As it is, however, nearly every transformer, so far as I have examined them, does use insulating tape, or an insulating substance resembling tape, in one form or another. It may not be necessary, perhaps, to be guided to any extent by foreign practice in these matters; but in so far as the foreign practice is found to be in line with correct theory, I think it is of some use to us; and it is very noticeable that in the specifications of foreign engineers, they limit both in machines and in transformers to a comparatively low temperature. Anything that is done in the direction of reducing the temperature, either in generators or in transformers, by the manufacturing companies is a direct gain to the purchaser; because I do not think it will be disputed that, taking the apparatus as it is built, such a policy tends to prolong the life of the apparatus.

Mr. Perry: In behalf of the central station men I wish to move a vote of thanks to the gentleman who presented this paper, and to those who took part in discussion. I will venture to say that we central station men have learned more in this paper, concise and clear as it is, and in this quiet discussion, brief as it has been, than we would have been able to learn about transformers from the itinerant representatives of the transformer builders in a half dozen years.

The motion extending a vote of thanks was carried.

Amendments to Wiring Rules.

The committee on Safe Wiring, by M. D. Law, chairman, then reported the following proposed amendments to the rules on that subject, which were adopted:

Inside Wiring. Art. 7. Inside conductors must not be laid in plaster, cement, or similar finish, without an exterior metallic protection.

Special Wiring. In rooms where inflammable gases exist, the incandescent lamp and socket must be inclosed in a vapor tight globe. This is not understood to include rooms where illuminating gases are used in the ordinary manner.

Art. 2. The word "water-proof" change to "moisture-proof," so that the article will read: "Provided with a durable moisture-proof covering."

Interior Conduits. Art. 2. Interior conduits must not be of such material or construction that will be injured by plaster or cement or other surrounding material, or that the insulation of the conductor will be ultimately injured or destroyed by the elements of its position.

Accidents Due to Electric Currents.

Allen R. Foote read a report of fires and injuries caused by electric currents during the year 1890, being data obtained from 425 cities in the United States.

Number of members on fire force, regular and volunteer	56,498
Total number of fires for which the force was called out	39,817
Total number of fires caused by electric currents	518
Total number of injuries received while on duty	1,719
Total number of injuries received while on duty at fires caused by electric currents	35
Total number of injuries caused by electric currents, while on duty	31
Total number of fatal injuries received while on duty	60
Total number of fatal injuries caused by electric currents while on duty	1

In the case of the single fatal injury caused by electric currents it was reported that the man fell from a pole 35 feet high; and as there was no autopsy, it could not be learned what was the exact cause of death.

Lubricating Oils.

Mr. Lane, of Cleveland, O., made an address on the subject of lubricating oils. He said that most people were under the impression that it was necessary to use lubricating oils of high viscosity and low gravity in order to get good lubrication on heavy or high speed machinery. Extended experiments had convinced him that a light oil, light in gravity and low in viscosity, was the oil that would give the best satisfaction in the lubrication of both high speed and heavy machinery. In the case of machinery running at very high speed, an increase of oil will increase the temperature; and unless enough oil is used to absorb the heat, so that the oil will run away taking the heat with it, the heat cannot be reduced by a large amount of oil; that is, if more is used than is really necessary for lubrication, but not enough to carry the heat off with the oil. The oil recommended was an oil of about 32 gravity and 140 vicosity. He instanced the Calumet and Hecla mines, where lard oil was used up to two years ago, but where a mineral oil is now used. Objection was sometimes raised to oi s because they produce a gummy substance; but this is usually a scale making material, which comes from the walls of the cylinder. As a rule, any oil that will produce a gummy substance is a good oil.

The paper on the "Allied Powers" was read:

The Allied Powers.

By D. Ashworth.

Within the memory of the present generation it is well known that the conspicuous figure upon the chess-board (of politics, at least) in all Continental Europe, and its far-reaching connections and dependencies, was the almost omnipotent power of the Allied Powers; that these powers swayed all Christendom, changed the maps of vast and long-established principalities, eventually subjugating the Autocrat of all the Russias.

At this period of the nineteenth century, by reason of an advance in an intellectual sense, such combinations are rare, and the signs of the times point to their entire extinction; but a greater and more powerful factor engrosses our attention, which in the eternal fitness of things, can be called the Allied Powers—that is, the combination of steam and electricity. So powerful are they that I think we may be pardoned for the strength of our language in claiming that they are the foremost powers of all this world. Jointly, their application is universal; in the brilliant palaces of crowned heads, or illuminating the otherwise Plutonian darkness of the village bridge or chasm in the mountain, they emblazon with jewels of light the great city, at the same time cast a soft halo of light over the suburban town.

These joint powers embody the poet's ideal when, by their agencies, we can, in subterranean works, "Dive into the bottom of the deep, and pluck up drowned honor by the locks," or, from the observatory, "Pluck bright honor from the pale-faced moon."

This subtle and all-powerful agent, electricity, this reinforcement and seemingly inseparable handmaiden of the older agent, steam, will be left for those whose lines of thought and action have been concentrated thereon; those among you who have been and are continually developing its hitherto unknown resources and powers; to you is relegated the pleasant duty of presenting its claims to an enlightened and appreciative public while we present to them the older one, that of steam and the steam engine.

Setting aside the many traditions and historical associations which have clustered about its early history, closing the eighteenth and commencing at the dawn of the nineteenth century, that close student and persistent Scotchman, James Watt, announced his patents. Then it became the source and sustaining power of mechanical energy, whose action quickly changed the face of the world.

As expressed by the historian, the advent of the steam engine gave that mighty impetus, which, contributed to by succeeding inventions, to which it was the prime mover, turned the people's thought from war to the fruitful vocations of peace.

In the history of the world never were there greater changes of a civilized people than those which followed the advent of the steam engine. For years the victories that were achieved had been those of war and destruction; now followed the rapid succession of victories of peace. In course of time it completely revolutionized the existing conditions of the mechanical world. Among the Cornish mines enterprises of vast extent, which had been abandoned, and others, operated at a loss almost, were reclaimed and placed in positions of profit beyond the expectations of the most sanguine. The spindles of the United Kingdom were, in a comparatively brief period, humming throughout its borders, bringing from the Indies and the islands of the seas the raw material, which, through the agency of the steam engine, was cheaply woven into textile fabrics for the comfort and luxury of mankind the world over.

There is a very notable feature in the development of the steam engine, as relates to James Watt, to which I invite your attention, and that is that all the principal features so essential to economy of fuel, regulation and benefits to be obtained by expansion, were fully considered by him. He was fully cognizant of the insidious losses by condensation so that, after all, the marvelous progress that has been made in this direction has been in the refining of well-known existing conditions rather than the profundity of philosophical thought bestowed upon it by Watt in its early stages.

The gradual perfection of mechanical appliances in the form of tools, etc., again contributed to the still greater success, until at length it seemed that the acme of excellence had been obtained in workmanship. Then the maritime world began to furl its sails, and the mighty agency of steam became the power on all waters. The minerals and precious deposits were taken, by its agency, from the bowels of the earth, placed in the furnaces, moulded and fashioned for man's use, and thus, in the time of a generation, this steam application became the potent industrial agent of a civilized world.

In the rapidity of this recital we must not lose sight of the fact that a legion of close students, profound thinkers, ingenious and expert mechanics, were constantly observing, noting and experimenting in the face of vast results already attained. The intelligent mechanics and scholars were well aware that the percentage of loss from fuel to results was great, and to reduce this has been the point to

which their efforts have been converging, so that, step by step, this became reduced, and in this direction up to this time, in the language of the poet, "Increase of appetite has grown by what it fed on."

It is not our purpose to enter upon any description of the many devices which ingenious and fertile minds developed during these periods, but it is generally acknowledged that the drop cut off valve, invented by George Sickles, embracing as it does the tripper and dash-pot, giving an instantaneous cut off, gave the key-note for further and more thorough steps in this direction. This was followed by the Corliss system of valve motions, producing results which attracted the attention of not only the engineering world, but the vast body of steam consumers. So thorough were the reforms of steam engineering, so complete were its results in economy and regulation, that the name and fame of Geo. H. Corliss is as familiar as a household word in all nations where the power of steam is used making an epoch in our country's history which, as a grateful people, as well as engineers, we should cherish with pride and patriotism.

The success of this system of automatic valve action, American-like, was quickly followed by others, each and all having their peculiar method or device for accomplishing the needed requirements, embracing the automatic cut-off, so as to give proper steam distribution and regulation. All of these, in a measure, fulfilled the requirements in the largest plants of our country, especially where cotton factories are predominant. In all these departments devoted to textile fabrics, regulation and economy were of the most satisfactory character.

As the step from the conditions of the steam engine with its slide valve to that of the automatic was radical and brought about by the imperative demands of closer regulation for the manufacture of textile fabrics, and economy of fuel from a commercial point of view, so was the evolution of the steam engine to meet the requirements of the introduction of electricity in all its applications, especially that of lighting.

We now come to the period where the merging of the allied powers was imperatively demanded. As at the time of James Watt there were great trials and tribulations, accompanied by a host of disappointments, so in the electrical application. The world at large will never know of the sore trials, failures and disappointments that attended these conditions. The divine poet has said, "As it was in the beginning, it is now, and ever shall be," so will the inventive genius of man rise to the occasion again with a thoroughness and determination.

Again, the world over, did our scientists and ingenious mechanics apply themselves to meet this new and exacting requirement of the steam engine for electric purposes. We now reach a point that may be worthy of attention—at all events, may lead to an idea. How often does the popular mind conceive the idea that the age of steam power is on the decline, and confidently predict that the time is not far distant when electric power will be the sole agency employed? Try to bear in mind, if you please, that since the advent of electric lights and motors the refinements of the steam engine in every respect to meet the requirements have more than surpassed those of the half century preceding.

It may be said, without exaggeration, that during this period the finest intellects have been taxed to their utmost in research of principles to meet the exacting demands of the electrical requirements. Observe, if you please, the magnificent workmanship, far surpassing anything of the kind produced before; indeed, so far has this refinement been extended that special tools were created to produce the perfection desired. Does not this all point to the closer and inseparable union of the two powers, instead of that separation born of the heated imagination?

In this development of the steam engine for this special purpose this great and constantly increasing field has resulted in the bringing forth of a vast number of competitors, each having, or at least claiming to have, some special factor of superiority, all converging to the two important points, regulation and economy, and last (though not always placed last), first cost. Right here is where the most of the troubles between the two powers originate, in that over-zealous desire to capture the contract by a guarantee upon the first two points, so that in the very depths of their silent thoughts they feel that they are straining a point just to barely overlap some one else. A moment's reflection, it would seem, would convince them that the day of reckoning may come, but this is the process of his reasoning: "These parties will never require this, it will never be tested. I will take my chances;" and oh! what a sea of trouble that taking involves; the innumerable disappointments and delays, attended finally with bitter contentions and, perhaps, a long train of litigation. Frequently this taking of chances, by reason of minimum duty devolving upon it at the time of starting, allows it to pass in safety, but eventually the day of reckoning comes. Reputable houses, I believe, make every effort to abstain from this, but it is the over-zealous agent that is generally the factor who enters into this prevailing trouble.

There are two points which, I think, if acted upon by both parties, would do much to eliminate, if not remove it entirely, viz., on the part of the seller, to be careful to promise only that which he is positive can be accomplished with fair conditions and with ease, and upon the part of the purchaser, to reject at once that which upon investigation seems to promise too much. In case your knowledge is limited, employ an expert to sift the matter thoroughly. So clearly is the importance of this matter becoming understood that, in cases of importance, this course is becoming the rule, and is considered first-class practice. Notwithstanding these existing sources of irritation, it is gratifying to know that they are generally the attendants of unhealthy competition, and, with an increase of knowledge by those directly interested, will, in a measure, disappear.

Another feature, prolific of great annoyance and engendering friction at every point between the powers, is the often misplaced confidence of the authorities in placing officers in charge who may, perhaps, be thorough in all that pertains to the electric affairs, yet at the same time utterly lacking in the elements that go to make up the correct requisites for the steam department. Under such conditions, how often do we find upon the threshold of operations a multitude of troubles and almost every point bristling with disappointments and irritations. The writer has in mind a number of such cases, all of which could have been avoided by a more thorough knowledge of the steam requirements.

In the matter of steam or fuel economy, a general survey of the field in this direction reveals results of a marvelous character. Looking back to the period antedating the advent of the electric power, the majority of cases were well content with a result of four or five pounds of coal per horse power per hour. With the advance in the adoption of the compound system, one and a half and two pounds are attained in practice.

An inspection of one of our first-class plants, fully equipped and properly maintained, cannot fail to impress the appreciative mind with the grand results of the efforts of American students, scientists and mechanics. As you look upon these muscles of brass and sinews of steel as they reciprocate to and fro, and listen to the soft whirr of the dynamo, does it not at times suggest to you the vast army of unknown ones that have burned the midnight lamp over the countless problems that have been solved to bring about such an harmonious whole? And more impressive is the fact that still the never ceasing cycle of time continues with the same mastering passion to do more, to do better, ever reaching out for hitherto unseen forces and powers.

As has already been stated, the results in regulation and economy in engine practice to-day would seem to fill the round of desires or expectations at least. There yet remains much to be done in the direction of design with a view to durability, embracing within itself those qualities which, in a machine of continuous operation, would reduce the wear and tear to a minimum or scarcely appreciable amount. The tendency to a multiplicity of parts or movements in valve gear is to be deplored. This evil undoubtedly has been borne with the effort of straining after exceedingly fine points, regardless of the medium introduced for the accomplishment of the object in view. This complication never fails eventually to make itself known by its prolific fruits, in exasperating breakdowns and interruptions, entailing with the same a train of expenses that frequently assume alarming proportions and culminate occasionally in an entire abandonment of the plant.

In the matter of economy in the adoption of early points of cut-off and rates of expansion, it has been conceded that the positions of pure theorists, governed by the laws of thermodynamics, when brought into the actual school of practice and measured by the searching light of commercial conditions, were at variance. A halt upon this important point was the result, and now these theories are rapidly being modified and brought into close relations with accurate and first-class practice by this over-reaching, as it were.

A more rigid and careful investigation was brought about, placing the extreme theorist in close contact with the practical workers and their results, so that to-day these two branches of workers, theoretical and practical, are closer and more perfect in their results than ever was known. By these conditions, the ideal steam engine of the school only has rapidly given way to the hard actual demonstrations of the workshop and the engine-room. The advent of electric requirements in engine-room management has worked an incalculable benefit to aspiring mechanics in creating avenues for advancement and fields of operation, which presented to them, on every hand, unbounded fields of thought; opportunities which drew forth those latent powers which, in time, gave them preeminence in their stations by their invaluable services to their fellow men. We say it without fear or favor, that for all that goes to make the vigilant, enterprising, and ambitious type of American manhood, the engineering staff of these allied powers stands without a peer. The remarkably close attention given by this body of earnest workers encourages us in the belief that as each succeeding year gives its result, so will this condition occupy a still higher plane, well meriting the continued approbation which always accompanies good and faithful work.

With the light of the past exhibiting to us a vast number of improvements which have been applied to these powers, many of which, if suggested a quarter of a century ago, would have been considered by the highest sources, to say the least, chimerical, it should not be inferred by what has been touched upon as to engines, that the fountain head or source of supply has been forgotten, the boiler and its appendages.

It seems but a very brief period since a close observer expressed the idea that of all the adjuncts of the steam engineering departments, that of the prime mover, the boiler, had received the least attention, and as a sequence to this, the progress had been exceedingly tardy, the steam engine seeming to engross the attention of thinking minds, to the exclusion of other important details. We do not have far to go to ascertain the cause. Do we not all recognize the fact that there is an attraction about the steam engine that is indescribable? Whether it be the comparatively miniature high speed, flashing in the light as its piston fairly flies to and fro, or the ponderous beam engine, vibrating gracefully, we are constrained to say—this is the most wondrous work of man—hence it has been regarded almost as a thing of life, and man has applied himself to wrest from it all the points of its action, to increase its power and enlarge its field; by this means the prime mover, to a great extent, has been tardy in its progress. However, it is gratifying to note that during the past ten years there has been greater progress than in the fifty years preceding.

The numerous types and systems of steam generators brought to our notice constantly give ample testimony to the continued interest manifested in this important direction. Strength to resist pressure, durability, facility of access to clean and repair, are imperative. For economic results an abundance of steam capacity is requisite to produce the quantity of steam, and, what is of equal importance, quality of same. The latter is receiving close attention, indeed, so much as to receive favorable commendations from our compeers abroad.

We are prepared to hear it said that these are but common truisms and are like twice told tales. We know it, but at the same time, they are such as will bear repetition. No attempt is made to describe any of the marvelous points of mechanism or to demonstrate with mathematical precision the unerring laws which, when formulated, reveal the very foundations of the principles by which these mighty results are achieved, the object being simply to point out the various causes of friction frequently introduced between these two powers like unto the welding heated surface to join foreign particles prevent a perfect union, our desire being a cementing together, a harmonious working.

Never in the history of scientific progress has the world witnessed such a vast army of active minds as have been engaged and are now working in this sphere. Since the advent of these powers the rapid trend of thought has moved on with an impetus that is amazing to us when we glance at but a brief period of the past, resulting in lifting all up to a higher plane. And as this goes on, so will this field for the two powers expand, until the uttermost recesses of our land will be greeted with the movement of the steam engine, the brilliancy of light, and the gliding of the motor.

Under the present auspices, can we not confidently look for greater, more perfect and startling results, with a closer and more perfect union, so that we can say of these allied powers that, "For all ages yet to come, they will hold sovereign sway and masterdom."

Invitations from the Brush Electric Light company at Niagara Falls to visit the Falls, and from the Buffalo Railway company to inspect its power station and plant, were read.

The meeting then adjourned, and the delegates passed the afternoon at the power house and plant of the Buffalo Railway company.

EVENING SESSION.

The president called the convention to order at 8:20 P. M.

THE PRESIDENT: The nature of the meeting of our association to-night is to listen to papers upon long transmission of power by high tension currents. I need not say to the people of Buffalo that this is an interesting topic, and I trust that before you go away you will learn a good deal as to the possibilities of utilizing the Niagara Falls. You will also listen to demonstration, or illustration, of the Lauffen-Frankfort power transmission.

TRANSMISSION OF POWER WITH SPECIAL REFERENCE TO THE FRANKFORT PLANT.

BY CARL HERING.

A year or two ago the subject of electric railways was the most prominent branch in the later developments in the field of electrical engineering, and the almost phenomenal growth of this branch is well known to all who have given the subject any attention. Just as that was the leading subject during the last year, so the subject of the transmission of power in large quantities over great distances seems likely to be the chief field of development in the near future, a bold beginning having been made in the form of a very successful public experiment made at Frankfort in Germany, on a scale far beyond anything before attempted. I am informed that much attention has been given by promoters of the Niagara Falls power plant to this experiment at Frankfort, and its success will, doubtless, lead to the adoption of the same or somewhat similar system for the Niagara-Buffalo transmission. It may be said, in fact, that, as far as our present knowledge goes, any other system than a high tension alternating current transmission has hardly any chance of adoption for the long distance work in this undertaking.

In order to appreciate more readily that the advantages of electrical transmission over other methods are well founded and are not mere vague claims made by its advocates, let us review briefly the other methods, all of which have been in use much longer than the electrical one and have had a chance to show their limitations. Most of these are almost without a rival in their own narrow fields, but when it comes to transmission over long fields, the electric method stands almost alone.

The most prominent method of transmitting power is by means of shafts and belts, but, although this is one of the best for very short distances, it need not be considered at all for anything over a couple of hundred feet, at the most. In an electric light station in Rochester there is a belt 175 feet long and a shaft 200 feet long, and there are, doubtless, a few other exceptions like it; but it requires peculiar circumstances to make this practicable for even such a limited distance. Even for the short distances in workshops, shafts and belts have already been and are rapidly being replaced in many factories by individual motors, placed in the immediate vicinity of where the power is required and having their power transmitted to them electrically, which shows that, even for such short distances, electrical transmission encroaches on the field heretofore occupied entirely by the shaft and belt transmission. The only modification of the shaft and belt system adapted for longer distances is by wire rope transmission. This is an old, well-exploited system, and its narrow limits are already well known. The poor efficiency, the liability to stoppages, and the great increase of cost with distance are very much against it for long distances. The fact that it takes a two-inch rope, running at a speed of 2,000 feet per minute, to transmit only 36 horse powe is sufficient to show the impracticability of this system fo long distances or large powers. A significant fact is tha

in Switzerland, where this system is used perhaps more than anywhere else, it is already at present being rapidly replaced by electrical transmission. Another fact which is significant is, as I am informed, that rope transmission is not being considered at all by the promoters of the great Niagara Falls plant.

Transmission by water direct is limited to locations which are peculiarly favorable, and is not general enough to be considered here. In Zurich there is a high pressure reservoir, located on a neighboring mountain, the water for which is used for power purposes in the city. There are, doubtless, other similar cases, but they are all limited to peculiarly favorable locations as well as to comparatively short distances. Even in Zurich they are now installing an electrical plant, from which power is to be distributed.

Transmission by steam is of more general application, but the expense of the piping, the attention it requires, and the loss in the condensation, all limit its practicability to within a comparatively small radius probably—within a radius of a mile, at most. It is in successful use in the city of New York, but its introduction does not appear to be making very rapid progress.

Transmission by gas, as a fuel, is in successful operation for very long distances of over 100 miles, but it is limited to localities where natural gas is found, and its supply is, I am told, very uncertain.

Transmission by compressed air is perhaps the chief rival of electrical transmission, with which it shares many advantages over all the others, It is at present used chiefly in mines, where it is still a very successful rival of electricity, but from present appearances it is likely that it will gradually be replaced by the latter method. In Paris there is a large central station for the distribution of compressed air, and it seems to be in successful operation. It does not appear, however, that the advantages over electrical transmission are so great that it will not soon be replaced by electricity. Its introduction is not making the rapid strides that the introduction of electrical transmission is already making. Its efficiency as compared with electricity will be shown very well at the Niagara Falls power plant, where, I understand, a compressed air system is to be introduced in competition with electricity. One of the disadvantages for power purposes is the fact that when the compressed air expands in the engines it generates cold to such an extent as to seriously affect the working and the lubrication of the engine. It appears that fires must sometimes be built to heat the air before it can be used at all in the engines; the advantages over a boiler and a steam engine are thereby greatly reduced. From a paper by Prof. Unwin it appears that the transmission of power by compressed air is practicable to a distance of at least 20 miles. It seems that 10,000 horse power can be transmitted to a distance of 20 miles in a 30 inch main at 123.3 pounds per square inch pressure, with a loss of pressure of only 12 per cent. The efficiency of such a plant is said to be 40 to 50 per cent. if the air is used cold, and 59 to 73 per cent if the air is reheated. Coleman Sellers, one of the Niagara Falls company's advisory committee, states in a recent paper that experiments were made by Mr. Saunders of New York, of heating the compressed air at the receiving end by combustion within the mains. The result, he states, leaves little to be desired, as the product of the combustion is added to the quantity of compressed air, while the heated air and gas also increase the efficiency.

A very good idea of the relative efficiencies of several of these systems may be obtained from the following table of Boringer, giving the percentages of efficiency for different distances:

Distance in miles.	Hydraulic.	Pneumatic.	Wire rope.
1-2	50	55	91
1	49	54	85
3	41	51	61
5	37	50	43
10	26	43	21
13	18	39	11

The most usual and extended method of transmitting power, if so it may be called, is that of transporting the coal itself from the mines to the manufacturing cities. Although this is the system which is by far the one used most exclusively, the objections to it are such as to offer great inducements to other competing systems. Even in Philadelphia, which is not far from the coal regions, the price of a ton of coal is said to be doubled by the cost of its transportation from the mines to the boilers in the city. In engineering terms this means an efficiency of 50 per cent. in the transmission only. An electrical system with such a poor efficiency in the line would scarcely be considered for a moment, and yet strange to say, we are still transporting most of our power on the railroad in the form of coal and utilizing it in small individual boilers and engines, the efficiency of which is so low that even an amateur electric motor builder would be ashamed of his motors if they did not give a better efficiency.

It will be seen, therefore, that with the exception of compressed air and the railroads, the field is quite clear from rivals for electrical transmission, and that most of the disadvantages attending other systems do not apply to electrical transmission. Even in the two excepted cases, there are many advantages in favor of electricity, and it is probably only a question of time when they, too, will be replaced by electricity. Perhaps the most serious objection to electrical transmission is that it is new, an objection that is often a more serious one to overcome than many engineering difficulties. If capitalists were all engineers and were not hampered by prejudices against new departures merely because they are new, what enormous strides engineering would make!

Coming now to electrical transmissions, let us see which of the various methods stand a chance of success for long distances. To be successful at all for long distances requires beyond question the use of very high potentials, as otherwise the cost of the line will make it impracticable. If continuous currents are to be used, they must be generated directly by the dynamo at that high potential, as there are no means at present known for converting a low tension continuous current into one of high tension, without the use of moving machinery; continuous currents would, therefore, require that very high tension currents be produced directly from a dynamo with a commutator. Long experience and frequent attempts have shown that it is not practicable to exceed five or six thousand volts, at the very most, on continuous current dynamos, and even then there are many objections. As this would be a comparatively low voltage for long distance transmission, continuous current systems stand very little chance of being used for more than comparatively short distances. Another disadvantage is that the motors also must be run at this high potential, unless the current be transformed by a motor-dynamo, which is awkward and expensive, as it involves the use of moving machinery requiring attendance. The starting of a motor at such high voltage also introduces difficulties. A point in favor of continuous currents is in the fact that the line is not charged and discharged continuously.

The field is, therefore, left tolerably clear for alternating currents, which owe it to two features, one that the alternating current dynamos require no commutator, and the other that such currents may readily be converted from a low tension to a high rension, and the reverse, with but a small loss of a few per cent. in each transformation. An alternating current dynamo for generating low potential currents is the simplest kind of a dynamo, and a transformer requiring no moving machinery is a very simple thing to take care of, if, indeed, it requires any attention at all. Simplicity alone, therefore, is very much in favor of alternating currents.

The only serious objection to the use of simple alternating currents for the transmission of power is that they are not so suitable for running motors as direct currents are. There is a class of motors called synchronous motors, which are, as a rule, simple alternating current dynamos used as motors, like in the case of direct currents. These must be run at a speed which must synchronize with that of the dynamo as precisely as if coupled to the shaft of the dynamo. They run very well after they are started, but many of them come to a dead stop if overloaded sufficiently to retard their speed below that of synchronism, even if only to a slight amount. Their chief fault, however, is that they cannot be started readily, furthermore, all the load must be taken off before they can be started at all. Various methods are used to start them; but, although they accomplish the object, they can hardly be termed satisfactory solutions of the problem, at least so far as they have come to my notice. This makes them unfit for many purposes, as elevators, street cars, shops, etc. When there is only one large dynamo, which is started, say only twice a day, it can be done by a small, inefficient motor, or by starting both the generator and motor together, or by some other similar means, but when it concerns the distribution of power as distinguished from mere transmission, this disadvantage becomes of great importance. But this objection may not continue to exist very long, because, with the amount of attention given to this subject at present, it is not unlikely that some solution will be found before long, if it has not been found already. Several methods have already been devised for overcoming it, one of which was shown in the Frankfort transmission. Others are being at present worked out, among which may be mentioned that of Mr. Stanley and others; also, that of Leblanc, which, I understand, is being experimented with on a large scale in the interests of the Rothschilds, of Paris. It is therefore likely that before long this problem will also be solved by several methods, so as to leave very few objections to the use of alternating currents.

One of the prominent features of the Frankfort transmission was that this motor problem was solved, as motors were there run, not only with the same ease with which continuous current moters are run, but with additional advantages, which make them far preferable even to the best continuous current motors. The only objection to this system was that three wires had to be used in place of two, an objection which appears to be in many respects small as compared with the advantage gained.

There are, in general, two methods for transmitting to great distances by alternating currents. One is to generate the high tension currents directly at the dynamo; this is the system used at the Ferranti station in Deptford, London. At the distant end these currents are then transformed to low tension currents, suitable for distribution to consumers. The second system is to generate low tension currents at the dynamo, then to transform these at the dynamo station into high tension currents, by means of transformers, which high tension currents are then sent through the line to the distant station, where they are transformed a second time back to low tension currents; this is the method which was used at Frankfort. The advantage of the former is that there is only one transformation; but a disadvantage, which appears to outweigh the objection to an additional transformation, is that the high pressure current must be generated on moving machinery and that it must be controlled by switches and other apparatus, which must be handled by the attendants. The dynamos and switches are thereby rendered very much more complicated, and, as they must be handled, there is a constant source of danger to workmen. This source of danger, and the complications, are overcome almost entirely by the second system. In the one used at Frankfort the dynamo was the ideal of simplicity in its construction, and the high tension circuit contained, with one exception, no switches or any apparatus whatsoever that required to be handled.

To recapitulate, it appears probable that the solution of the problem of long distance transmission will be solved by the use of high tension alternating currents, originally generated at a low voltage, then formed into a high voltage, then sent over the line, and finally transformed back to a low tension; this will, furthermore, be done by some system which will enable motors to be used on the circuit. The system exhibited at Frankfort was such a one, and it appears to have been a perfect success in every way. It seems therefore that the problem has not only been solved, but also demonstrated by a practical illustration on quite a large scale.

Among the transmission of power plants in this country may be mentioned the following: One at the Delmatia Mine in California, in which the power is about 100 horse power, transmitted about one and one half miles at 1,800 volts by direct current. Another is in Virginia City, Nev., in which about 500 horse power is transmitted a distance of about one third of a mile, with an efficiency of 70 per cent. Another at the Calumet and Hecla mines, in which 400 horse power is transmitted about one and one half mile, at about 1,000 volts and at an efficiency of 73 per cent. These are all direct current systems. Another was installed by the Westinghouse company, at Telluride, Colo., in which about 120 horse power is transmitted two and three-quarter miles, at 3,000 volts and at a commercial efficiency of 75 per cent. This is of special interest, because it is an alternating current plant in which the motor and dynamo must run synchronously. The difficulty of starting the motor is overcome by the aid of a small motor of 10 horse power, which is first run to bring the large one up to speed, after which it will remain in synchronism with the generator. The cost of this plant, exclusive of erection and line, is said to have been $10,000, or about $100 per horse power delivered.

A fair idea of the cost of transmission of power plants may be obtained from the following table of figures given by the Oerlikon company, and taken from plants actually installed by it mostly in and about Switzerland. The table was copied from a paper read by Saunders Morris at the Engineers' club of Philadelphia.

		Cost in Dollars.				
Distance in Miles.	H. P. delivered	Generators.	Mot'rs	Line.	Total.[1]	Per H. P. Delivered.
6.25	11	647	540	2350	4,700	42.60
.43	510				33,250	65.30
3.75	220	5190	4700	3135	14,500	66 20
1.56	150	3720	3525	1615	10,020	67.20
.56	71	2155	1960	294	5,100	71.60
1.87	85	3135	2741	2155	9.220	108.50
2.20	51	1761	1567	1469	5,595	109.40
5.00	41	1174	980	1682	5,000	121.10

1. This includes regulating apparatus, instruments, poles, insulators, lightning arresters, erection and supervision.

The Lauffen-Frankfort plant was erected by the joint co-operation of the Allgemeine Elektricitaets Gesellschaft of Berlin and the Oerlikon company of Zurich, the chief engineering features being due to their respective engineers, Mr. Dobrowolsky and Mr. Brown.

The main object of this plant was two-fold; first, to test and demonstrate to the public the feasibility of using very high tension alternating currents on bare overhead lines; secondly, to show the practicability of a modified alternating system especially adapted for running motors. The former feature was due to Mr. Brown and the latter to Mr. Dobrowolsky. It was an experiment in so far as it was at first not known whether such very high potential currents used on overhead lines would develop any new and grave difficulties, which were predicted by some mathematical electricians, involving capacity and induction effects. These fears were not realized however, or in the terse language of Mr. Dobrowolsky, "the losses in the line all followed Ohm's law." The experiment demonstrated that with the use of carefully made and proportioned porcelain insulators containing oil, such high potentials can be used successfully on bare overhead lines. Strange as it may seem, one of the unexpected serious difficulties experienced on a line with similar insulators was that such large white insulators formed tempting targets for the small boys to throw stones at, because a "good shot" from one of the little rascals was awarded by the pleasure of seeing the insulator flying to pieces, ringing like a bell.

The plant consisted in general of a dynamo of exceedingly simple construction generating a large current but of only 50 volts. This was led through the switch-board with all its accessory apparatus and was then transformed by a step-up transformer into a small current of 16,000 volts. This was led through bare overhead wires a distance of 108 miles, where it was again transformed back to a low voltage by step-down transformers. It should be noticed that the currents at the dynamo and switchboard, where they had to be handled, were only 50 volt currents, thereby avoiding all possible danger to the attendant, besides facilitating greatly the construction of the dynamo. In this feature it differed characteristically from the system used by Ferrantt in London, in which the dynamo and switchboard was in the high potential circuit, the dynamo generating the high voltage directly. The Frankfort system was furthermore grounded in such a way that even in the case of a cross with the high tension circuits the voltage at the dynamo or switchboard could never exceed 50 volts above the ground. The second feature of this plant is, that it enables motors to run with the same, and even greater, ease than continuous current motors. It therefore solved the problem of distribution as well as of transmission of power. It should be clearly understood that it was to solve the motor problem that a certain modified alternating current system, known as the three-phase system, was used. This system involves the use of three wires throughout, in place of two. It not only overcomes the difficulty of the distribution of power and the starting of motors, but it goes farther, because such motors are very much easier to run and are simpler in construction than the best continuous current motors—a feature which counterbalances to a great extent the objection to the use of three wires.

Time will not permit a detailed discussion of this three-phase system here. It will suffice to say that it consists of three simple alternating currents, one in each wire, the waves or impulses in the three wires following each other in succession similarly to the relative motions of the three

cranks of a three cylinder steam engine, or the pistons of a three plunger pump. Such a set of currents produces a rotating magnetic field, while the simple alternating current produces merely an oscillating field. The rotating field furthermore has a definite direction of rotation. It is this feature of a rotating magnetic field, as distinguished from an oscillating one, which renders it particularly well adapted to run motors. The ordinary simple alternating current motor may be said to be analogous to a steam engine with one crank, having its slide valve operated by an independent rapidly running engine; it has a dead point from which it will not start, but after it is up to speed it will run very steadily. The rotating field motor on the other hand, is analogous to a three crank engine operating its own valves. There is no dead point, and it can start itself even with a full load.

As to the priority of invention of this rotary field system, I will only say here that Ferraris and Tesla seem to have invented it originally and independently of each other. Just in what respects Dobrowolsky improved it is hard to tell until we know how far Tesla developed it. It will suffice to say here, that as modified by Dobrowolsky the motors appear to be an undeniable success.

In conclusion, the following figures regarding the Lauffen-Frankfort plant may be of interest.

The small town of Lauffen is situated on the river Neckar in the mountains, 108 6 miles south of Frankfort, and not far from the city of Heidelberg. There is a large water power there, 300 horse power of which is to be transmitted electrically to the manufacturing town of Heilbron, at 5000 volts by this system. The turbine and dynamo of this plant were loaned for the Frankfort experiment. The turbine is horizontal, has a speed of 50 revolutions, and can develop 300 horse power. It drives a single dynamo by conical gears. The dynamo is exceedingly simple in mechanical construction, has a speed of only 150 revolutions, and is capable of generating three alternating currents of 50 volts above their common connection and about 1400 amperes each, or a total of about 200 kilowatts. The number of alternations is 40, which is purposely made very low. This current passes through the switch-board and regulating apparatus to a three core transformer of equal capacity. The ratio being 160, it is transformed up to about 12,500 to 15,000 volts measured between any two of the three wires, and down to 4 or 5 amperes; by connecting two of these with their primaries in multiple and their secondaries in series, they will generate 25,000 to 30,000 volts.

An interesting feature about this system is that although the three currents have different phases, they need no separate return leads, because the nature of the currents is such that each acts as a return current for the other two in multiple arc. The three circuits are therefore merely connected together to a common terminal, after they have passed through the dynamos, transformers or lamps. This terminal we will call the neutral point. This neutral point was grounded throughout the system, in the low tension as well as in the high tension circuits, and at both ends of the line. No current, however, will flow through the ground when the plant is working normally.

The line consists of three bare, hard drawn, copper wires, 4 millimeters in diameter (slightly less than a No. 6 B. & S. wire) having a resistence of about 2 ohms per mile. The distance being 108.6 miles, the resistance of each wire is about 217 ohms, which, with 5 amperes makes a loss of about 1,000 volts on each of the three lines. The lines were run on poles with one cross arm 16 feet above the ground, the wires being one meter from one another. There were 3,227 poles, at 200 feet spans; each pole had a skull and cross bones painted on it to indicate the sure fate of any one who could not keep his hands off. There were 3 000 large porcelain insulators, 8 inches in diameter, made in two parts, and with three oil grooves; and 6,500 small ones made in one piece, and with one oil groove. The only apparatus connected with the high tension circuit was the fuse wire and a short circuiting device to replace the switches for opening the circuit. The fuses for each of the three lines consisted of two copper wires in parallel, each .15 millimeter in diameter (between Nos. 34 and 35 B. & S. gauge) and 2 meters in length. They were stretched between two poles outside of the building. They were exploded (one can hardly apply the term "blown") several times to test their effectiveness. Even to an electrician it seems strange to think of several hundred horse power being transmitted through a few wires about the size of a hair! The short-circuiting devices consisted of pieces of bare wire shaped like a V inverted suspended directly over the line of wire. These were placed at very frequent intervals along the line. In case of any danger or interruption, or in case the line must be handled, this wire is lowered by a string, and drops on the line wires, thereby short-circuiting the line, which blows the fuse and opens the circuit. This is a very cheap and effective substitute for a switch, which would be dangerous to handle in a 30,000 volt circuit; furthermore, there is absolutely no possibility of a current being on the line when this device is down.

Both the high tension and the low tension circuits were carefully grounded at both ends at the neutral point, that is, at the common junction of the three wires. This makes the system perfectly safe, for in no case can the voltage on the low tension circuit be greater than the normal low voltage. In case of a ground on the line, or a cross between the high and the low tension circuits, the fuse will blow.

Arriving at the receiving end, at the exhibition at Frankfort, the high tension current was transformed down to about 75 volts measured between any two of the three wires. Some of it was used to illuminate one thousand 16 candle power lamps on the exhibition grounds, consuming 58,000 watts, and some was used to run a 100 horse power motor, which drove a centrifugal pump, the water from which formed an attractive waterfall on the exhibition grounds. The average voltage used on the line was about 16,000 volts, and the greatest amount of power, I am told, was about 150 horse power. This was not because of any failure to be able to transmit more, but merely because that was the full capacity of the bank of lamps and the motor.

The report of the official tests, which I understand is completed, have not yet reached this side, but from careful commercial measurements it was found that the efficiency from the dynamo current at Lauffen to the lamps at Frankfort was 72 per cent. when about 80 horse power was transmitted, which is very satisfactory. It is furthermore probable that accurate measurements will increase rather than decrease this figure. It should be noticed that this was the efficiency for only 80 horse power. From this efficiency must be deducted the loss in the generator and that in the motor in order to get the total. After the exhibition closed, the plant was also run at 30,000 volts; during that test one of the insulators failed. The plant was run in all kinds of weather without apparently any appreciable increase of the loss on the line; it was furthermore found that the predicted heavy losses due to the condenser action did not exist and that for practical purposes these losses follow Ohm's law. It will be remembered that this was one of the uncertain features, the existence or non-existence of which this experiment was to prove. As the distance was far beyond that at which power will in practice be carried, say 30 or 60 miles, this experiment demonstrates that such a transmission is entirely feasible at distances met with in practice.

The Oerlikon company gives the following figures regarding the cost of the plant: Assuming that 300 horse power is developed at Lauffen, and that all the energy received in Frankfort was converted into light, the cost of the lamp per effective horse power measured at the terminals of the lamp will be about $282, of which $236 is for the line alone. These figures appear high, but it must not be forgotten that in this particular plant there were conditions which would not be likely to occur in practice, namely, relatively small power on the one hand, and exceedingly great distance on the other, both of which factors naturally increase the cost per horse power.

It may be of interest to add here that Mr. Dobrowolsky of the Berlin firm states that he would be willing to bid on the contract to transmit 1,000 or 5 000 horse power from Niagara to Chicago, a distance of 500 miles. He proposes to use 40,000 to 50,000 volts and claims that an efficiency of 60 to 75 per cent. could be obtained without difficulty.

Mr. Hering then added: "I received this morning a letter from the Zurich people, the Oerlikon company, which has put in a bid for the transmission of power from Niagara Falls to Buffalo. They propose that the current generated at the Falls is to be such that both motors and lamps are lamps as well as incandescent—shall be used. They say as the rotary current is at present, and will be for a long time to come, the only practical form of current to run large motors of a fair efficiency they will use it. They propose to use 50 periods in place of 40 which were used at Lauffen, because they say that 40 is too low to run arc lamps. Fifty is said to be the lowest at which arc lamps will run satisfactorily. The generating stations would be composed of units of 5,000 horse power each. According to the wishes of the turbine designers the number of revolutions has been fixed at 250 per minute. The diameter of the armatures has been fixed at about 10 feet. The armature is to be drum wound. I suppose that means the drum winding on the surface of the cylinder, that is not across the ends as we usually wind drum armatures here, but wound as they very often do in Europeam multipolar machines. The currents are to be 2,000 amperes in each of the three circuits, and the voltage 600 to 700. It has been found advantageous to revolve the armature instead of the magnetic field, in order to have a minimum weight on the vertical shafts. The weight on one of those shafts, by the way, is something very great. The shafts are 20 feet long, and the weight of the shafts, together with that of the armature and turbine, is very great, and must therefore be considered. The generators will each have 24 poles. They will be separately excited. The efficiency will be in the neighborhood of 96 per cent., that is, the efficiency of the dynamo, including exciting power. There will be two transformers, as it was not found practical to build a single transformer of 5,000 horse power. The transformers will be artificially ventilated, and only the high pressure coils will be placed in oil. These transformers will raise the potential to 25,000 volts."

"This," they say, "is no longer to be looked upon as a venture."

The cost of the line will be about 100,000 francs, that is $20,000, an almost trifling part of the whole.

Mr. Hering continued reading from the letter, with occasional explanations or comments.

"As to the line, we propose not to carry any more than one or two units of 5,000 horse power on one line of poles, for a number of reasons." "Five thousand or 10,000 horse power can be conducted on wooden poles at a very moderate initial cost of plant." "The lines would terminate in one or more step-down transformer stations that would supply current of 1,800 to 2,000 volts for municipal and street lighting in the shape of alternating currents to be transformed down to the suitable lamp voltage, as in the case of the present transformer systems." "The cost of the electrical part of the proposed plant, including the generators, exciters and transformers at both ends of the line, would be about $180,000, for each unit of 5,000 horse power, with an efficiency of 84 per cent. at the low pressure terminals of the secondary transformers." This reduces to $36 per horse power, which is lower than the lowest one in the table that I read to you. The cost of the [illegible] power, which is about 10 per cent. [illegible]

Dr. [illegible]

Prof. Elihu Thomson: In the [illegible] paper to which [illegible] transmission, and Mr. Hering has [illegible] transmission as the coming mean [illegible] of power. We have in the case [illegible] an example of wire rope [illegible] know that there are [illegible] mission unless it is confined within [illegible] limits. It is a common saying that [illegible] larger portion of the power in a cable [illegible] in pulling the cable around and that the [illegible] the loaded cars to the cable makes only a moderate addition to the power required to move the cars. This is certainly true if we have a system in which there are a number of curves. The cable may be turn corners, and I have no doubt the figures given by Mr. Hering relate to cases of cable transmission in which the transmission is practically straight where there is an open country as it were, and the rope transmission can be carried across. If a good many curves or bends are to be made in the system, of course the efficiency runs down very rapidly. But in reality with electrical transmission we may bend our wire as much as we please; we may turn as many corners as we please, and it simply adds a little to the length of the line, which can be made up by adding slightly to the copper used.

He has spoken also of the compressed air system, which is used in Paris. I believe the system was originally introduced there for the operation of clocks and finally extended to the working of compressed air engines. In that system it was found that the engines did not work efficiently unless the air was put through a heater, the reason being that when the air is compressed at the station it losses during the compression a large amount of energy, which is converted into heat, and it has to be thrown away by cooling arrangements, cooling the compressing pumps. It then passes along the distributing points at low temperature—at the ordinary temperature. The moment it reaches the engine and begins to be expanded in the engine it demands to resume its normal condition, that the heat which it lost during compression be put back into it, and of course if it does not get that heat it simply chills, cools, and comes away from the engine very cold. The bad effect of this cooling of the air is, that it not only shrinks the air in volume and therefore relieves the pressure on the piston, on which you rely for the development of power, but it hurts the mechanical working of the engine, so that the practice in Paris is to put up a little stove and pass the air through a coil of pipe in this stove before it reaches the engine, and in that way they get a very fair efficiency out of the compressed air system. But it is by the addition of this extraneous heat, and the consumption of fuel. It is true that the heat that is added to the compressed air as it enters the engine is very efficiently used. It is almost all converted into mechanical power. In fact if we had a supply of compressed air at our disposal at very high pressure, and then were to heat that and allow it to expand down to ordinary temperatures, we would have a very efficient way of using heat and converting it into mechanical power. But the pressure would have to be very high to make that a system that would be useful.

Mr. Hering has also mentioned in his paper a form of transmission which is not ordinarily classed as transmission of power; that is, the carriage of coal from the coal regions down to a city where it is to be used. That is in reality a transmission of power; and if we had a gravity road; if our coal mines were up in the hills, or in the mountains, and we ran the coal down by gravity, starting the cars at one end and allowing them to go down with practically no use of power, carrying back the empty cars only, we should find that we had transmission of a very efficient kind indeed, that we would get, outside of the wear and tear of the road, practically no expense in conveying fuel. That the efficiency of conveyance now is no greater than 50 per cent. is probably due to some manipulation; it seems to me it ought to be higher. It ought to be possible, for example, to get down to Philadelphia from the anthracite coal regions a ton of coal without its costing as much again as the coal costs to mine. However, I do not know that I have investigated that subject sufficiently to pass a proper opinion. Whether the coal will ever be burnt in the mining regions, and the power developed there transmitted electrically, of course is a question to be considered. It depends upon the cost of carriage relatively to the cost of the carriage of electricity. If it should turn out that the plan of conducting the power electrically should give a lessened cost of carriage the electrical plant must, it seems, take the place of the road in carrying coal—not perhaps for the development of heat; we are not likely to burn the coal at the mines and carry the electricity 50 to 100 miles, and then use the electricity for heat—but for power. Heat is a different thing. We need to get a very large fraction of the energy of the fuel in the case of heat, and for power we are content to get 10 or 12 per cent. in the steam engine, and use that.

It has been aptly stated in a paper read to you that the commutator difficulty is the one that stands in the way of the application of direct or continuous currents to power transmission. It is an actual fact that a commutator which is to stand indefinitely 3 000 volts is very expensive in construction. It requires very high insulation, very careful construction, and very numerous segments. It has been found impracticable to raise the electrical pressure existing between two adjoining segments on the commutator

[*Continued on page* 141.]

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CENTRAL station men called upon from time to time to purchase alternating current converters will find some useful hints in L. B. Stillwell's convention paper on "The Relation of Size and Efficiency in Transformers," Mr. Stillwell treats the subject in a practical manner that cannot fail to please busy men who want information but who do not like to wade through columns of mathematics to get it.

QUITE distinct from the usual contributions at electric light conventions was the paper read at Buffalo last week by Charles A. Schieren, who described the progress of belting leather "From the Tannery to the Dynamo." The title, however, does not fully outline its contents, for Mr. Schieren begins at the slaughtering establishments in his description of the manner of making belting, and not the least interesting portions of his paper are those that relate to the processes in the tannery itself. Central station managers cannot be too well posted in relation to the characteristics of any portion of the mechanical equipments of their plants, and consequently practical information like that supplied by the author of this paper is always welcome. Mr. Schieren has written an account of this character that is entertaining and valuable, and which also affords a pleasant relief from the more technical papers presented to the convention.

PROF. ELISHA GRAY'S remarks before the National Electric Light association at Buffalo on the subject of the World's Electrical Congress will attract attention among those who are interested in all departments of electrical engineering. Prof. Gray outlined the course contemplated by the committee having in charge the arrangements for the congress and gave a detailed account of what it was proposed to do. Resolutions were adopted by the association pledging the earnest co-operation of the organization to make the congress successful.

The report of B. E. Sunny on the work already done by the electricity department of the World's Fair and what might be expected in this department was received with attention. The association showed a lively interest in any thing pertaining to the World's Fair, and the Chicago visitors were besieged with anxious inquiries as to the progress already made in the construction of the electricity building.

POETRY and electricity are generally believed to be in certain respects very much like oil and water, but the author of the convention paper, "The Allied Powers," was evidently satisfied that an emulsion could be produced with a strong enough flavor of electricity to tickle the palate of central station men. One reads with interest that these joint powers embody the poet's ideal, when by their agencies one can "Dive into the bottom of the deep, and pluck up drowned honor by the locks," or "Pluck bright honor from the pale-faced moon." Perhaps, though, as the "pale-faced moon" is to be blamed for the moonlight schedule, the plain and practical convention delegate would be more entertained with the thought that the allied powers had "swayed all Christendom, changed the maps of vast and long established principalities, eventually subjugating the Autocrat of all the Russias." These important facts, and the manner in which they were presented to the convention, cannot fail to excite the wonder and admiration of the less fortunate members of the association who were unable to hear this paper read.

A LITTLE sermon might be preached to street railway companies contemplating the introduction of electric motive power, with a text taken from J. B. Craven's convention paper. Speaking of the advisability of burying railway feeders, Mr. Craven says: "It behooves us to meet this popular demand of placing all wires possible below the surface, otherwise we may compelled to put the trolley wire itself there." Mr. Craven, in the above remark, strikes what should be the keynote of the policy of the companies about to adopt or introducing the trolley system. It is the cheap construction that does the most toward exciting the people against the system. The talk about the danger from the overhead conductor sounds now rather absurd in view of the difficulty of making up a list of fatal accidents that have happened through contact with it. The street railroad company that is ambitious of winning the kind words and consequent nickels of what is, after all, a very indulgent public will at the start put up the very best center-pole construction obtainable and bury all feeders. With the symmetry of his street unimpaired and nothing in sight but the two slender wires hung from neat, well-balanced and tastefully designed brackets, perhaps the over-conservative property owner who did all in his power to keep the trolley wires off his street, will say: "There are worse things and slower things than the electric cars."

IT is curious to observe the absurdity of many of the New York papers in criticising the overhead trolley system. Thus the *Evening Sun*, sensible enough in other respects, has this to say: "Viewed in the light of the experience of other comparatively large cities in the United States, the city of Brooklyn must be said to have taken a distinctly retrograde step in permitting the introduction of the trolley system of propelling street cars. Whatever advantages of cheapness this system may have for poor towns sparsely populated, it is inconvenient and cumbersome in a densely populated city. The desirable end in a perfect street car motor is that it should be automatic, without any outside connections, noiseless, quickly stopped and started, and commercially practicable." It is a pity that the *Sun* was not more explicit in its strictures. What "comparatively large cities" are those in which the overhead system has been used and which are held up as a terrible example to Brooklyn? How is the system "inconvenient" and how "cumbersome"? Of course "a perfect street car motor" is desirable, and so, in many respects, are air ships. But the world will have advanced many years farther toward the Millenium before either is attained. In the meantime only a blind, unreasoning prejudice prevents the New York papers from recognizing the advantages of the best street railway system yet devised, which consists of cars propelled by electric power by means of overhead conductors.

THE members of the Chicago Electric club who listened to the paper recently written by William Stanley, Jr., for the club, had, to a certain extent, the advantage of the National Electric Light association, for the main facts in Mr. Stanley's convention paper had been set forth in the club article. Mr. Stanley talks plainly and is firmly convinced that he and J. F. Kelly have solved the alternating current motor problem by the production of what they call the "condenser motor." It is well known that with a practical and reliable means of separating the alternating current into two currents having a certain difference of phase the commercial value of the Tesla motor would be greatly enhanced. Mr. Stanley believes that he and his co-laborer have devised a satisfactory method of producing this much-desired result. But, after reading the long paper presented to the convention, one is very apt to regret, with Mr. Stanley, that he was "unable to disclose the method." The most serious difficulty to overcome was that encountered in the building of a suitable condenser. Mr. Stanley is not the only worker, however, who has sought for a dielectric that will withstand the potentials met with in adapting a condenser to service with the alternating current motor, and on this account Mr. Stanley's method of patenting his dielectric "films," by wisely keeping their composition secret, cannot fail to excite both admiration and curiosity.

THE proceedings of the fifteenth convention of the National Electric Light association are fully reported in this issue, and will no doubt be read with interest by all who are engaged in electrical development. The attendance at the convention was large and included many distinguished inventors as well as those who have been noted for the successful manner in which they have conducted the electrical enterprises. More attention was given the papers and there was much more general discussion than is customary. It was remarked, however, that several papers were presented at a time when it was impossible to discuss them fully. This has frequently been the case at former meetings, and it is to be hoped that at the next convention arrangements will be made to so classify the papers so that the most important can be fully discussed. There are always papers that might be passed over without loss, but these are frequently placed ahead of others of far more importance. It might be well to insist upon all papers being handed in a month in advance, in order that they might be passed upon by the committee. Some of the papers presented at Buffalo did not reach the secretary's hand until after they had been read, and in one case at least the secretary did not get a copy of the paper until his return to New York, as the author carried it away after reading it. If President Ayer will insist upon a change in this direction he will earn the gratitude of the association.

It has been decided to have but one meeting each year hereafter, and in conformity to this rule the convention adjourned until February, 1893. In this connection it may be well to call attention to the suggestion of a central station manager that the meetings hereafter be held in summer instead of in winter. It is claimed that more central stations would be represented in summer, as the superintendents are too busy in mid-winter to leave their business without serious inconvenience. Furthermore, it is claimed that if the meetings were held in the second or third week of the month there would be no interruption of the business occasioned by the absence of the managers of the stations, as they could return in time for the rush at the end of the month.

These suggestions should receive due consideration. It might be well for the association to secure an expression of opinion on these points at the next convention.

[*Continued from page 139.*]

beyond a certain amount. The current is apt to leap the gap between the segments and form short circuits. Therefore, for high voltages, we need to divide the commutator up into very fine divisions. But that involves that the winding be also divided up. It makes it very difficult to wind the armature and connect it to such a commutator.

I think the limitation would naturally be found somewhere between 2,000 and 3,000 volts for actual practical usage; that is, so far as the commutator is concerned, and if we attempt to transfer power at that one potential, reducing it, we do not rid get of the commutator at any step of the process where we use direct or continuous currents. Now, we are driven, then, as Mr. Hering says, to alternating currents; and he has shown in a paper that a very excellent example of power transmission by the alternating current is to use what is known as the three phase system with "double conversion," as it is called. That is, to generate at one end of the line high potentials, and pass the low potential currents through what thus becomes the coarse primary of the transformer, and rises into the fine secondary high potential currents which are fed to the line. Those high potential currents go through the fine wire of another transformer, which is like the first, simply reversed. The low potential currents are then taken from that transformer and utilized for motive power. The fact that transformers of large size can be built with very high efficiency—a loss of only a few per cent.—is of course in favor of the system. The fact also that there is no need of manipulation of the dangerous high potential currents is a great thing in favor of such a system. The only thing against it is the addition of apparatus and the necessity of taking great care of the insulation in a transformer. This difficulty of insulation, however, in the transformers seems to be overcome by immersing the transformer in a bath of insulating oil, when we find that it takes a very high potential to puncture even a moderately thin layer of oil. We find, for example, that one half-inch of oil will stand many thousand of volts—voltage beyond what we are likely to be called upon to use in practice—far beyond it. In other words, we can construct our apparatus with a considerable margin of safety by allowing the oil insulation to be thick enough.

I am greatly in favor of the three-phase system. It seems to me that it is a symmetrical system, one allowing you to do almost anything you please with it. You generate at one end of the line by the use of power obtained from steam, from coal burnt at the mines, or from coal slack, which is a waste product oftentimes of the mines. You generate your power very cheaply. You transmit those currents to the line or if you have a water power you do not generate the steam, but you use the water power to drive this dynamo. You are ready then to make the transmission. The only question in my mind is to whether you should take your lines over ground or under ground. It is certain that if you went under ground you would not require to paint on every pole a skull and cross bones. Currents of a voltage up to 10,000 or 20,000 volts are of course certain death if a person comes in contact with them. We are approaching the condition of lightning—continuous lightning. That is, not simply a stroke, but a continued stroke—a great number of strokes following each other in rapid succession; and it does seem to me that all things considered perhaps it would be a little more costly to begin with, but for moderate distances the cost of putting the line in pipes filled with oil should not be prohibitive; in other words, the employment of the same insulation which is used on the transformers throughout the line. Beginning with a transformer in oil, you carry a high potential conductor in a pipe filled with oil to the further end. In other words put the whole high tension part of it in oil—insulate the whole thing in oil and bury the pipe. In that case, of course, unless somebody digs it up and interferes with it, or gets into the iron pipe which incloses the three conductors, you are practically free from any leakage due to wet insulators, or interference due to lightning. A thunder storm may come up, and the three lines on the poles are innocent enough until a stroke of lightning falls somewhere near, when you have damages to your transformer or to your machines. This can be said, however, in favor of a high potential system, that the liability of damage by lightning is less the higher your potential. In other words, the nearer you approach lightning in the operation of your plant, the less liability there will be that lightning will interfere with the operation of such a plant. It is constructed to stand a moderate phase of lightning, and it would take a considerable addition to break it down. At the same time the oil insulation regulates itself the moment it is punctured. Such a line might in a measure be struck by lightning, and might be deranged for a moment, but the oil passing in between would end the difficulty. It is very different where the apparatus is not constructed to stand more than 3,000 or 4,000 volts instead of 20,000 or 30,000. Then, if lightning comes on the line and you are not provided with all safeguards—and even though you are provided with them all, if a direct stroke of lightning falls on the line, the question is whether damage is not going to result. There are some other points about the 3 phase system that I would like to bring out and emphasize. It seems to me that we can do a great many things with it. For example, we can get alternating currents at the receiving end for the running of lights direct from the mains; that is, by converting down to any voltage. We can therefore run any kind of apparatus which operates with single phase alternating currents, or with multi-phase alternating currents. We have at our disposal, as Mr. Hering has shown, motors which can be run—and efficiently run—by the means of three-phase currents directly fed to them without excitation of the field. That is, motors which do not synchronize, motor which do not run at proper speed quite under load but nearly. The proper speed, very nearly. They run fairly well and they are adapted to distribution here and there. But we can also run a machine from the same system of mains which we use, which is a reserve alternating dynamo which is perfectly synchronized. That is, if the generating plant runs 120 or 150 turns the motor plant at the other end of the lines may run at a definite speed, depending upon the generator speed at the same speed or some definite relation and stay at that speed during operation not vary a particle be perfectly synchronous. Now, in case we wish to lump our power in the receiving station and run at absolutely steady speed, we might use the reserve dynamo reserve three phase dynamo as a motor, and get synchronizing speed. We can distribute by the other form, non-synchronized form of motor, without any field excitation at all But suppose we desire to get continuous currents from three-phase currents, suppose, in other words, we have an existing plant which is based upon the use of continuous currents. There may be street cars that are already equipped; there may be mains laid in the streets which are adapted to use just certain pressures, and there may be motors running from those mains which are only adapted to use continuous currents. Then we have to resort to another kind of a machine, a machine which takes continuous three-phase currents and delivers from the other side continuous currents, which has no commutator on this end but simply three wires, and on the other end a low potential commutator, a commutator which gives you no difficulty in running 110 volts, 220 volts, 500 volts. We may then convert directly from the three-phase currents into a continuous current and supply the existing mains which are to be found. And we may do that efficiently. We can have from the same system a motor generator, it would be called, which is supplying 220, 110 and 500 volt separate machines. Or we could even put them in the same machine, and furthermore we can make a machine that will compound itself. In case the machine is running with very little load, its potential will be, say, 220 volts. In case the load is thrown on, naturally there will be a fall of potential in the whole transmission from one end to the other; there will be a fall of transmission all the way through, and a fall of potential even in the mains which are found in the streets. That fall of potential can be made up by the construction of that machine. In other words we can compound this motor generator by simply taking the accessory field and exciting it, making that field by the secondary currents. This will raise the potential, and the system then becomes a completely compounded one.

We have separate plants and stations in New York here and there using expensive ground and expensive buildings. Supposing we go up the Hudson somewhere and establish a power plant, get our coal very cheaply delivered, get water for condensing the steam in the engines, get rid of ashes by making land somewhere—and we simply lay pipes down to the city, a distance of whatever number of miles is convenient, making the pressure what we find is proper for economy in transmission. We deliver current, three-phase it may be, to the different stations. That is, simply use motor generators feeding into the existing mains. Should we wish to run out new mains transformed down to low pressures, we can do it very easily. In other words we can satisfy almost every need, even down to the plating current; we can give everybody what is required from such a system.

Now, the question is, what is the electrical pressure that would limit us in such transmissions. There really seems to be no particular limit. It would seem to me practicable if it were necessary to raise the pressure to 100,000 volts. It simply means that you have got to have your insulator oil thick enough not to be perforated by 100,000 volts. And in some recent experiments I have made I find that oil is excellently well adapted to stand such pressures. It is even better than solid glass. Where glass breaks down with perfect ease, I find the oil stands up; and if it does break down it re-insulates itself. If there is a puncture through the oil and a spark flies, it does not necessarily result in the destruction of the plant, but the oil slips in and covers up the defect.

H. Ward Leonard: For more than ten years we have had at our command the means, through the agency of the continuous current, of transmitting electrical energy in unlimited quantities over short distances and converting it into mechanical power for any desired application. The hundreds of three-wire systems illustrate this statement.

For more than five years we have had at our command, through the agency of the alternating current, the means of transmitting electrical energy in unlimited quantities over almost any desired distance; but we have not had the means of converting such energy into mechanical power for commercial uses, for there is but little commercial use for a motor which is not self-starting and which when started can be operated at but one speed. Hence, the commercial use of the alternating current has thus far been confined to the operation of incandescent lamps.

During these past years the companies promoting the sale and use of continuous current apparatus have been making plans and estimates of continuous current transmissions, using several thousands of volts directly from commutator to commutator; but neither they nor the public have had the necessary confidence in the result to install the plants. The developing and perfecting of a continuous current constant potential generator of 1200 volts has forcibly impressed at least one company with the difficulties likely to be met with in constructing similar apparatus of 600 volts and upwards.

At the same time the various companies promoting the sale and use of alternating current apparatus have devoted all their efforts to the development of an alternating current motor which should possess the essential qualities of variable torque and variable speed under variable work.

Thus far, neither line of development has resulted in the production of commercial apparatus for the transmission of power over great distances.

I believe that prejudice is largely the cause of this condition of affairs. Each side of the continuous vs. alternating current controversy has been bitter in its denunciations of the rival apparatus, and has apparently considered that it would be fatal to admit the necessity of using the rival apparatus to secure the result.

So long as incandescent lighting alone was under consideration it made but little difference. Either the continuous or alternating current would give satisfactory results. But not so with the transmission of power over great distances.

The high-tension alternating current says: "How easy it would be to get there if somebody could only utilize me." And the low-tension continuous current says: "How easy it would be to use me for any application if somebody could only get me there."

I stand here to make the claim that the transmission of power over great distances necessitates the use of both the alternating and continuous currents, and that by the combined use of the systems the result is commercial to-day over any reasonable distance and for the transmission of any amount of power.

I arrive at this conclusion: The economical use of the electric energy with automatic control of the speed and torque demands that the voltage be varied as the speed, and the current as the torque.

It will be evident that for merely transmitting electric energy from a prime motive power of constant speed there can be nothing simpler or better than the synchronous alternating current motor of constant potential. But nearly every application of the transmitted power demands not only a variable torque, but a variable speed, as will be evident when we consider hoists, locomotives, pumps, ventilating fans, etc. The synchronous character of the alternating current is therefore unsuited for such work. We should have means of varying the voltage in proportion to the speed desired, and means of varying the current in proportion to the torque of the power to be supplied. We should also have a current adapted to charge storage batteries and to deposit metals electrolytically. All these conditions point directly and conclusively to the continuous current. It would seem, therefore, that both theoretical and practical considerations demand that we should transmit our energy over the great distances demanded for commercial applications by means of the alternating current, and that we should then convert our electric energy into a continuous current in order to best utilize it in the actual performance of the work met with in practice.

Under this plan we shall be able to undertake the transmission of power at any distance and on any scale by apparatus manufactured by half a dozen companies to-day.

Let us suppose, for example, that we have a water-power at a distance of twenty miles from a mine where it is desired to utilize 2,000 horse power for various purposes.

Let us start with 10,000 volts and lose 22 per cent. in the conductor. The cost of the generator, conductor and synchronous motor will be about $90 per horse power at the point of work. The synchronous motor will drive the necessary continuous current generators of 500 volts and less to supply hoists, pumps, locomotives, ventilating fans, air compressors, incandescent lights, arc lights, crushers, mills, etc.

If the total power installed be 2,000 horse power, the cost of the working motors will be perhaps $50,000. With 2,000 horse power installed the maximum demand for power will not exceed 1,500 horse power. The cost of continuous current generators and conductors for this service will be about $52,500, and the cost of the synchronous transmission system about $135,000.

Allowing $42,500 as an average cost for the development of the water power and the construction, we have a total cost of plant of $280,000, or $140 per horse power represented in the electric motors at the point of work. The starting up of the synchronous alternating current motor without load can be readily accomplished by any of several simple methods, such as the use of a small storage battery supplying current to one of the continuous current dynamos and operating it as a motor to drive the alternator up to synchronism or the utilization of the energy of a weight upon a hoist in its descent to operate its motor as a generator, which in turn will drive the continuous current generator as a motor, and thus bring the alternator up to its synchronous speed.

With such simple efficient and cheap apparatus made by many companies to-day why should we wait for the solution of such difficult problems as commutators to stand 10,000 volts or alternating current motors which will be self-starting and efficient and at any speed and torque.

Even if we had such motors it is evident that we must interpose some kind of converters to reduce the 10,000 volts to a resonable pressure for applications in mines, and we would still require continuous current for commercial arc lamps, storage batteries, electro-deposition, etc., and a special current for electric drills.

It seems to me that we should install a plant at th

mine exactly as though we were going to drive it by a steam engine, and instead of doing so use the synchronous alternating current motor for this purpose and utilize as our original source of power the distant water power.

In many instances this method will be of especial value where it may be necessary for a few weeks in a year to fall back upon expensive steam power on account of the temporary failure of a distant cheap water power.

If one comprehensive plant be installed of this alternating and continuous current type, I believe an enormous development in this line will immediately follow, and luckily the apparatus required can be turned out rapidly from any one of several large works without the delays incidental to the development of new apparatus and methods.

L. B. STILLWELL: One might get the impression from what has been said to-night, and also from the fact that by far the most daring attempt in the direction of power transmission has been carried out abroad, that American firms and engineers are not prepared for this as yet; but it should be borne in mind in considering what has been done abroad, that it was under government supervision, and that the installation was practically paid for by three of the German states. There are several firms at least in this country who would undertake to do practically the same work if we could get the backing of three of the German or three of the American states. I agree with Mr. Leonard in his assertion that almost any problem that comes up to-day can be solved by the use of existing apparatus. The synchronous, two-wire system is itself adapted to many of the purposes by which we desire to transmit power. I think, that beyond the combination of synchronous and direct current apparatus, and superior for most purposes without question, is the multi-phase or two-phase alternating. As Prof. Thomson has very fully explained, it is adapted practically to every purpose for which we may use power, while it is equally adapted to lighting. Mr. Tesla's work in the direction of motors having rotating fields is pretty well known; but it has been carried forward and perfected in a great many details since Mr. Tesla ceased to give it active attention. There are one or two points that are of interest with reference to the methods used at Frankfort. One of them is as to the comparison of the two-phase with the three-phase system. In the three-phase system the differences of phase between the three circuits is technically 120 degrees. In the two-phase system it is possible to produce a rotating field which will start motors with a strong torque intended to have a phase of 90 degrees. It has been found that where more than one motor is to be run, or where lights and motors are to be run, there is considerable difficulty in maintaining proper phase relations between the different currents of the three-phase system. The fact that in each of the subdivided circuits the relation of line resistance to inductive resistance will vary, tends sometimes to drive the current practically out of one of the wires. There is some reason to think, then, that a two-phase, ninety-degree system would be preferable for combination work. The synchronous plant that has been referred to, that has been installed at Telluride is one of considerable interest. The generator is one of a construction adapted to high potential, and delivers current to the line at a potential, about 3,300 volts. This potential was selected not with reference to the distance, two and three-quarter miles, but with reference to a distance of eight miles, it being the intention to locate other motors at different mines along the range up to that distance. The work for which it is employed, namely, the running of a stamp mill, is of a character where we do not care for varying torque and for varying speed. The motor runs practically all the time. It runs 24 hours a day, and at least six days in the week. I believe that, all delays figured in, since the starting of that plant, the actual time it has been out of operation is only 16 minutes per day, and of the total delays, about 80 per cent. were due to difficulties in the regulating of the turbines. That suggests another point with reference to the operation, not only of two wire synchronous systems, but of the three-wire. As Prof. Thomson suggested, it is certainly possible to operate even the three-phase motors as synchronous motors when the units are large. If there are no small units I can see no objection to doing that. You have the torque to move them up to the speed, but when they are at the speed, why let us have the advantages of the synchronous running, because there are advantages to that. For example, one of the difficulties in combining this kind of plant with the hydraulic plant is the in regulation. If there is a thorough turbine regulator on the market I have not heard of it. A great many circumstances will influence and alter the speed of the turbine, and rather suddenly; and if we run in synchronism our entire load—the motor and all that it may drive, counter-shafting, stamps in a stamp mill, or any other work that it may be doing—will act as a flywheel for the turbine, and the effect is advantageous It is exactly as if we had a line shaft running from our generator to our motor, holding them rigidly together.

With reference to using step up and step-down transformers, it seems to me that they should only be used when the distance we wish to cover exceeds a certain amount. I do not believe that for a distance of less than 10 miles in general it would pay to use them. They not only add to the complication of apparatus, but necessarily add a considerable amount to the necessary investment, and if you omit hem, the problem simply becomes to properly insulate our machine and to provide for making the necessary changes of circuits without unnecessary or undue danger to those handling them. All these not only can be, but have been accomplished. Switch boards are devised in which it is impossible for the attendant to touch either pole of the high-tension circuit.

There is another point which is somewhat interesting with reference to the three-phase as compared with the synchronous. One advantage of the synchronous system for certain plants, particularly for power plants in the West is in the simplicity of the wiring. I have known at least one plant where fluid insulators were recommended, and were furnished by a manufacturing company, and were refused by those installing the plant for the reason that in the West the soil, or the rock, is so hard that they cannot cut it to erect their pole lines as they want to, and the consequence is that the poles are stuck up at all angles, and the fluid insulators ordinarily made are liable to spill the fluid; and they would not use them. They use instead an ordinary glass insulator with bare wire, and that is what is used at Telluride successfully with over 3 000 volts. They have been used all through this winter, which has been a very severe one, and this, by the way, is a more severe and practical test than that to which the Lauffen-Frankfort plan was submitted although that worked at much higher pressure.

DR. LOUIS BELL: I am a little inclined to look at this matter from the point of the fellow who wants a power plant put in, wants it very badly, and wants it immediately. What can he get that will meet the necessities of the situation? Now in power transmission, we have, I may say, three very radically different situations. In the first place there is transmission of large horse powers over a few miles, such, for example, as the plant at the Calumet and Hecla mines, and at other points within the mining regions all over the country—places where the distances of transmission are not very great, still far greater than any with which we have in the past been thoroughly familiar. There are many cases, I believe every engineer will recognize, where the simplest solution is to use existing current apparatus, inasmuch as the necessary voltage will not be over 1,000 or 1,500 volts; and if there appears to be excessive drop on the line, let it drop and use 500 volt motors at the other end. There are plenty of cases where all the conditions of transmission, even of 1,000 or 2,000 horse power, relatively ranged, can be met in a straight-forward way, and met on short notice, by half a dozen companies That is one phase of the situation. Then we come to other cases where the distances are considerable, and yet not great—even small compared with that magnificent experiment at Lauffen. There we have the choice between several methods. We may use the very high pressure, direct current, as has been successfully done in Italy over a considerable distance; or, we may use the synchronous alternator; or poly phase alternating currents of any number of phases from two up to as many as you please. Now the synchroncus alternator has some advantages which I do not think should be forgotten. When, for example, as sometimes happens, as in the Telluride plant, on which Mr. Stillwell spoke, it becomes necessary to pick up a certain unit of power, say two or three or four horse power even, and transmit it bodily to be used in a single unit at another point. The question of a self-starting motor becomes of little importance. In the Telluride plant, I am informed by the superintendent, the motor is run from Sunday night practically to Sunday noon, night and day, and the only work of the starting motor, the small Tesla motor, is for a few minutes once a week. In such cases as that the advantages gained from any self starting system whatever are comparatively slight, especially if the wearing is going to be complicated. So I do not think it pays to forget that there are cases when the simplest kind of apparatus such as can be furnished at short notice, and can be delivered anywhere in the country, is entirely effectual to meet all the cases in hand. And then, finally, we reach extraordinary situations where powers must be transported a long distance, such an one, for example, as that from Niagara to Buffalo. And yet there is something to be said in favor of apparatus other than that which has been often suggested for the purpose. From the standpoint of the ordinary man, who is interested in the dollars and cents side of the problem, I fail to see the particular usefulness of raising your pressure to 25,000 volts for the sake of securing an outlay in the amount of only $4 or $5 per horse power, when in order to do that, you have to use transformers costing somewhere about $40 per horse power. It seems to me that a little less pressure put in the line and a little more copper, would enable the transmission to be carried out at a lower pressure decidedly than 20,000 volts, with equal efficiency, and with the advantage of having the investment in copper, which does not deteriorate seriously, rather than transformers, which may, and sometimes do deteriorate. Of course there will be a point where it will be necessary to use step-up and step-down transformers: but I think the point ought to be emphasised that until distance becomes quite great it is a pretty even question between the cost of line and the cost of transformers, the advantages of durability being on the side of the line, the efficiency being the same, and the initial cost being the same.

Then as regards the question which has been raised several times to-night of two versus three-phase motors, it seems to be a question not yet quite decided. Whether either one of those systems will answer all the requirements where a large number of motors are to be run in parallel, that is one bit of experience which the Lauffen experiment did not furnish us. It taught us that we could transmit power an enormous distance with a fair efficiency, and with at least scientific success. It did not tell us whether those conditions would be suitable in case we had to run instead of one motor and a bank of lamps, 40 or 100 motors. That is one point that needs experiment before we are fairly to say outright whether we should prefer two or more phases, or whether some form of alternating motor which may very soon be devised and which will run on the ordinary alternating system, requiring only two wires, may not enter the conditions even better than the poly-phase motor. It is simply a question of experiment, and on that we need further information. In the present situation it does seem to me that in a great deal of the discussion on the defects of the various systems it is forgotten for a moment that much of what is to be done in the next year or two must be done under the conditions where we are working now. Much of it must be done with existing apparatus, and the man who will make the most thorough success of the transmission of power in that field is he who will attack each separate problem, doing the best he can with the apparatus which he can get, and not tying himself up absolutely to either continuous or direct currents, to two-phase, three-phase, or any other phase motors, but seize the opportunities for transmission of power as they come, and make the best of the situation with the best apparatus that that particular moment commands. It is this practical, commercial side of the problem that I think one is half is apt to forget in the glory of electrical pyrotechnics.

CARL HERING: I would like to correct a figure of Dr. Bell's. According to this estimate from Oerlikon the line cost $4.00 per horse power, and the total plant cost $36.00. Not $40.00 for the transformers alone. The $36.00 includes transformers and dynamos and everything.

DR. BELL: I would simply say that those figures for transformers were obtained practically for minimum price from a well known transformer manufacturer in America. We are not dealing with general prices. Of course it may be that eventually we will get down to a set price. I am simply giving you what it can be bought at this day, this particular day in February. I would like to say though that there is a big difference in running a small transformer and a large one, that is where you deal with 2500 horse power. Now the cost per horse power there would be much less than in such transformers as are in use at the present time.

H. WARD LEONARD: I have been very much impressed by the figures $36.00 per horse power, and was when it was first given. I agree with Dr. Bell that it seems very different from American prices, leaving entirely outside the $4.00 per horse power for line, and even abandoning the converters. It is not possible to-day to buy in the market in America motors and generators at a price which would be $18.00 per horse power of such character as would be required for this work; and when the converters are added it seems to me the price can only be explained by cheap labor.

MR. MARTIN: One statement made by Mr. Hering in regard to periodicity attracted my attention. I think he said the Oerliken people were ready to make a contract for an apparatus at the rate of 50 per second. Now my impression from what I read and learned with regard to the Laffen-Frankfort transmission, was that they never succeeded in getting at any time above 25. Is that so?

MR. HERING: I understood that they ran 40 normally.

MR. MARTIN: Mr. Bradley, how much did you understand it to be?

MR. BRADLEY: I saw the plant running three or four days at 23. It seemed to be very difficult to get above it.

MR. MARTIN: That was my impression. It makes a great difference.

THE PRESIDENT: I notice in Mr. Hering's paper that the losses in all the line followed Ohm's law. Is that actually the case?

MR. HERING: Practically.

MR. MARTIN: I am under the impression that in transmission, when it happened to be damp, as it sometimes is around Buffalo, there was but very little potential at the other end.

MR. HERING: In the Lauffen case?

MR. MARTIN: Yes sir.

MR. HERING: On the contrary, they said that tests made during wet weather showed so little difference that they could not detect it with their commercial instruments.

MR. MARTIN: Then we get different information.

MR. HERING: I did not make the measurements myself.

MR. STANLEY: It may be interesting to the members of the association to know that there is a line of 15,000 volts in operation in this country. We have constructed a small line at Pittsfield using 20 horse power, fed by the station currents,—the line starting at the outskirts of the town and making quite an extensive circuit. We find that there is practically no difficulty whatever at that potential. Fifteen thousand volts, however, is a very different matter than one, or two, or three, or five, or ten, or twelve volts. The striking distance at 15,000 volts is apparently two or three times what it is at 10,000 volts. For instance, if the wire hangs down from the line within an inch or two of the ground there is a most delightful aurora borealis between the ground and the wire; and if a dry board be interposed in the circuit—an ordinary pine board—it does not seem to effect the resistance of the circuit a particle. It goes right through it. We are making these tests at Pittsfield to become familiar with this question from a commercial standpoint, and have undertaken to transmit 400 horse power for lighting purposes, a

distance of twenty-eight miles in one place in this country. The delightful lecture given by Mr. Hering, does not, however, give us some of the points as engineers and as practical men we need in examining and testing the merits of the various devices.

The synchronous motor has certain very beautiful applications, but it has a very serious defect in my judgment; that is when the motor is overloaded beyond a certain point, not only the motor stops, but she goes to pieces -burns up; or she is very liable to burn up. And I do not see how any commercial system of the distribution of power can be made when we have to start our apparatus by a weight, as suggested by one gentleman; or by another motor, as suggested by another gentleman; or by three special circuits which will not work in two, unless they work alone -the plan suggested by Dobrowolsky.

While I am quite certain that 15,000 volts could be loaded on the circuit between Niragara Falls and this city, I am equally certain that no large amount of power can be transmitted successfully by the present aparatus—I mean commercially successfully. If we are going to bring Niagara Falls to this city—or a small portion of Niagara Falls -we have got to adopt some scheme radically different from anything that has been presented at the present; such for instance as the scheme that Prof. Thomson suggested, and lay our wires for a 100,000 volt pressure in an oil pipe. I cannot see that there is any halfway solution of the problem.

Wednesday's Proceedings.

The president called the meeting to order at 10 30 A. M., and announced that the first business was the reading of a paper entitled "From the Tannery to the Dynamo," by Charles A. Schieren. Following is the paper:

From the Tannery to the Dynamo.

BY CHAS. A. SCHIEREN.

It may be of interest to engineers, and the electric light fraternity in general, to learn something of how leather is tanned, and the various processes through which a hide passes before it is tanned and curried ready to put into belting. Naturally, the first question will be, "Where do all the steer hides come from?" Principally from Chicago, because within its city limits there are four large slaughtering establishments where thousands of cattle are slaughtered daily, the hides of which are carefully taken off and assorted for whatever purpose they are best suited. The hides which are the heaviest and most perfect in point of freedom from cuts, brands and other blemishes are selected for belting leather. These hides are put up in bundles, packed into a freight car and shipped to the tannery.

We propose to follow one of these freight cars loaded with belting hides to its destination. After a journey of about 600 miles, the car arrives at the little station of Adamsburg, Pa., right in the mountain region, a spur of the Alleghenies, where the tannery is situated.

Oak tanneries are generally placed near the bark region of the mountains, where the rock oak tree predominates, the bark of which is universally conceded to be the best for making the finest grade of leather. It is interesting to watch the mountaineers fell the huge oak trees, and skin the bark from the same. This is generally done in the springtime, and tanners have to purchase their yearly supply during the bark peeling season, which is from the middle of May to about the middle of June, according to the condition of the weather; the season seldom lasts over six weeks. If the sap rises into the leaves the bark cannot be peeled off, and therefore, oak trees are only cut down in that period.

The peeling bark is done wherever the trees are felled; the bark is gathered together in small stacks and covered to protect it from getting wet, because the strength of the tannic acid is lost by the bark getting wet; it must also be carefully guarded against mildew. Mountain fog is very damaging to peeled bark, therefore the mountaineers load the bark in wagons and deliver it as quickly as possible to the nearest tannery or railroad station.

However, our car of belting hides has arrived at the station, and we will watch the process of tanning. The hides are examined and weighed, and put into the shed. An equal number of hides are taken out daily (whatever the capacity of the tannery may be), and placed in a large vat of pure cold water, generally good spring water. After the hides are thoroughly soaked and the dirt washed out, they are laid across a beam and, with a blunt fleshing knife, the surplus fat or meat still remaining is taken off; then they are placed in a vat of weak lime-water, and are hauled up daily and the lime strengthened until the hair gets loose, which action takes about eight days. After this the hides are cleaned once more in pure water and placed over the beam and, with a blunt knife, the hair is removed; this part of the work is done in what the tanners call the beam or lime house, and very much depends upon the successful liming process in making good leather.

After the hair is off, the hides are washed again and thoroughly cleansed and purified, to remove every particle of lime, after which process they are taken into the handlers. These are composed of large vats, about seven by nine feet, and six feet deep. The hides here are laid across sticks side by side, as close as possible, and hung about three inches below the top of the vat. These vats are generally connected so that when the first vat is fed the tannin liquid will pass through every vat until they are all filled, and cover the hides completely. In the handlers the hides receive their first bath of tannin liquor, which is very weak at the start, and gradually strengthened. During this first stage of tanning the hide plumps up, and is prepared for the lay aways; this process also opens the pores and swells the hide, which gives thickness and firmness to the leather. If the hides cannot be made thicker at this process of the tanning, they will never be made heavier afterward; this is the critical point and has to be watched closely. Much depends on the character of the tannic acid; if too strong, it tends to make the leather brittle and harsh; if the tannic acid should be too sour, it tends to make the leather soft and flabby.

Some tanners use a rocking process to keep the hides in motion, thereby opening the pores of the hide quicker to receive the tannic acid; however, opinions differ as to the utility of the rockers. Some claim (and justly) that the rocking motion loosens the fiber of the hide, and softens the leather too much. The best process is simply to hang them in the vat and cover them with the tannin liquor, and raise them a few times during the day, or draw the liquor through them, which some tanners are now doing with success.

The tannic acid in the handlers generally has a strength of from five to fifteen, very seldom over twenty degrees. The hides remain in that process from ten to twelve days; they are then taken up and, if they are to be used for belt leather, the flanks (bellies) and heads of the hides are cut off and tanned separately, the remaining butt part receiving an extra layer of bark to tan it more thoroughly and make it firmer.

From the handlers the hides are packed away in vats called lay-aways; these are large vats seven by nine feet, and six feet deep, having a capacity of from fifty to seventy-five hides each. The vats are not connected with each other, but only with the pump to change the liquor. The hides are laid nicely one on top of another, and loose ground bark spread between each hide, and when the vat is full it is filled with tannin liquor of from twenty-five to thirty degrees in strength. The hides intended for belting receive at least six layers of bark, or in other words, are changed six times in the lay-aways; the first time they are changed after lying ten days; and then five days are added after each layer, so that the hides in the last or sixth layer take forty days to absorb the tanning liquor and penetrate the leather Each time fresh ground bark is spread between the hides and then covered with tanning liquor.

The leaching and grinding of the bark is an important factor in a tannery. The large pieces of bark taken from the oak tree are thrown into a hopper shaped mill or grinder, which resembles a coffee grinder on a large scale The moss on the outside of the bark creates a great deal of dust; and contains little or no tannin, but it cannot be severed from the rind which really contains the acid. From the bark mill the ground bark is elevated into large tubs which have false bottoms or receivers underneath to take up the tannin liquor. After a tub is filled with ground bark, a rotary sprinkler is set in motion to saturate the bark with a spray of water or liquor, which percolates through the ground bark, and on its way to the bottom catches up the tannic acid contained in the bark; at times warm water is used to facilitate the operation, also weak tannin liquor is sometimes used with good effect; however, old school tanners prefer cold water, which they claim makes purer and sweeter tannin liquor. After the receivers at the bottom of these tanks are filled, the contents are pumped into large supply tanks, from which the liquor is distributed through the tannery as required.

The leaching process is the most interesting and valuable operation in the tannery, and upon its skillful management depends the financial success of the business; opinion differs very much as to the best methods. The large round leach tubs, such as described, are the most popular now in use; however, many tanners still adhere (and some with success) to the old square pressed leach tubs, in which the ground bark is sinply soaked or steeped in water and left for a length of time, until the tannic acid is extracted from the bark. Opinions also differ as to using steam or hot water; however, all have their merits.

Very strange and erroneous ideas prevail among those who use leather, and have no knowledge of the art of tanning—certainly it is an art, and one of the oldest handed down to us. The general opinion prevails that leather made in "ye olden times" is superior to ours of the present time, but such is not the case; in fact, the fundamental process of tanning to-day is precisely the same as that of a thousand years ago, except that we enjoy improved machinery and appliances, which further the process and improve the material. What took our forefathers from fourteen months to about two years, we accomplish in from four to six months, and the quality of the leather is as good, if not superior, to the leather made a hundred years ago; with the aid of steam and power we can facilitate the process and shorten the length of time to produce the leather. "Olden time tanneries" had the lay-away vats in the yard exposed to the elements, and in rainy and inclement weather, as well as during the winter, the tanners could not do any work, and left the leather lying in the vats, generally to the detriment of the stock. In our present improved and model tanneries everything is done under cover, even the bark is put under sheds to keep it dry, and good leather is tanned within four months; however, belt and prime harness leather generally take six months.

When the leather is taken from the last layer of bark, it is oiled on the grain and hung up in a darkened room to dry; to obtain a nice clear russet color the place must be kept at an even temperature, and very little heat used. After the leather is thoroughly dried it is put up in rolls containing five butts (hides) each, and whenever a carload is ready it is shipped to New York; here it is again examined and weighed, and all butts not suited for belting are thrown out and finished into sole leather for shoe purposes.

The perfect hides for belting are soaked in warm water and the center part cut out and used for prime belting; the waste or offal is finished and rolled for shoe purposes. When the pieces are thoroughly soaked and cleansed they are oiled on the grain and hung up to dry, and when in a semi dry condition, they receive a coat of stuffing made of equal parts of coal oil and beef tallow. This is done to preserve the leather and make it pliable for the transmission of power. After the stuffing has entered the pores, which takes about twenty-four hours, the leather is subjected to great strain in large stretching machines. Great care and good judgment must be manifested in this part of the process; each piece of leather must receive an equalizing strain because of the peculiar formation of the hide, the fibers being very fine and closely knit together on the back of the animal, and running coarser and thicker toward the flanks. It is of the highest importance for belts intended for electric light plants to have an equal tension over the entire surface of the belt; therefore, the stretching process of belt leather needs the utmost care, and should receive the closest attention. After the pieces of leather are thoroughly stretched, they are worked smooth on the grain side, and both by hand and machine labor are set down as solid and compact as possible; then they are put into a drying room and thoroughly dried. Afterward one edge of the piece is straightened, and then they are cut into whatever width of belt they are best suited for the pieces of each width are matched accurately as to thickness, and then the laps (joints) are cut by a machine, the edge of the laps are feathered, and the joints cemented (glued) together, and pressed under a hydraulic press, which pressure is considered the best by all first-class belt makers.

Rivets are now rarely put into belts; a double belt well cemented is good for all ordinary purposes, and rivets are superfluous; however, certain fastenings, such as endless copper wire screws, which do not obstruct the surface or unnecessarily stiffen the belt, are a benefit; especially when the belt comes in contact with water or too much oil; this fastening prevents the belt from coming apart, and holds the leather firmly together.

All main driving belts over forty inches in width have to be made in sections, consisting of two or more pieces of leather cemented together. The average hide for belting does not contain more than forty inches in width of solid leather suited for belting, very rarely over that; therefore, wide main belts are made in sections. Ordinarily the pieces are not lapped parallel, but simply butted. For example: A sixty inch double belt receives two thirty-inch pieces for the first layer, laid side by side, and a thirty inch piece over the center of the two lower pieces to break the joint, and two fifteen-inch pieces on top of each edge of the lower layer to complete the width; thus the belt is cemented together. However, for electric light plants where belts are run at high speed and with variable power, which produces sudden strain, the seams of these butted joint belts, in several instances, broke, doubled up and destroyed the belts completely. To guard against such a calamity it is considered advisable to make wide driving belts with parallel joints. For example. A sixty-inch double belt will be made of two thirty-three inch pieces joined parallel with a three inch lap, making one solid piece sixty inches in width, and on the upper part put a thirty-three inch piece in the center, and two eighteen-inch pieces on the edges, all joined with parallel laps; this cemented together will make a sixty-inch double belt with unbroken surface, and as one solid piece of leather having a uniform tension and able to withstand an equal strain over the belt transversely as well as parallel, and thus will prevent such large, heavy driving belts from collapsing at the parallel joints. Every one must admit that main belts made on this plan are superior and more reliable, and would come into general use if it were not for the additional cost of labor and material in making them.

Leather being by nature an absorber of moisture, belts must be guarded against exposure to oil. In electric light and power plants much mineral oil is used, and the great velocity at which the belts are run seems almost imperceptibly to suck or draw the oil from the journals of the engine and dynamos, and allow it to be absorbed by the belts, which get completely saturated with oil, which, in a short time, rots and destroys the fiber of the leather. Various methods have been used to overcome this difficulty. One of the most successful is a certain composition of belt dressing which is rubbed over the surface of the belt, and closes the pores of the leather. No foreign substance can penetrate a belt treated with this compound, and the belts last much longer and give better service. With perforated belts this compound does not seem to be so effectual, because the perforations naturally expose the inner part or the heart of the leather, which is very porous; however, the surface of the belt being covered it shields that part of the leather which comes in contact with the pulleys, and the current of air passing through the perforations protects the belt to a certain extent, and that class of belt runs smoother, with less friction, and is more reliable.

And now, gentlemen, we have reached the point where another curious and erroneous idea prevails among many engineers, namely, that belting should be made of pieces only four feet in length, as if all hides were of the same length and texture. It will surprise these men to learn that there are no two hides alike; they vary in some particular point. Hides exist which will make almost six feet of sound solid leather below the shoulder and again some hides will not make four feet of solid length; the only safeguard is to specify belting made of leather cut below the shoulder of the hide irrespective of length.

Discussion.

MR. STANLEY: I would like to ask if there is any choice in the placing of the leather; whether it is better to place the heads all in one direction and the tails in the other; or whether there is any difference in putting the grain of the leather irrespective of the direction of the belt and the direction in which it is running.

MR. SCHIEREN: I can answer that question readily. In order to make a straight line belt we have to use heads with heads, if the belt is made of anything else than centers; in using centers this is not necessary. The center is perfectly straight, and it is only by the greatest stupidity on the part of the workman that you can make it crooked. He can make it crooked by stretching one side more than the other. In making belts of other than centers there is a right and left, and the workman must be careful not to change the relation. Crooked belts often come from the fact that the workman will put a left on a left, and then again a

right on a right. The joints should be made shoulder on shoulder and butt on butt.

The paper of Wm. Stanley, jr., on "Alternate Current Motors," was then read as follows:

Alternate Current Motors.

BY WILLIAM STANLEY, JR.

It is not my purpose in the present paper to enter minutely into the details of the various attempts that inventors have made to produce an operative motor.

The historian who shall collect the data necessary to trace the rise and growth of the alternating current motor will find that the subject has been pursued by men of science in all parts of the civilized world, and will be obliged to chronicle the fact that, up to the present year, no thoroughly practical motor system has been worked out. The various plans suggested by inventors and by engineers may be classified into three types. They are: First, motors operating in synchronism with the current alternations, having a field magnetization, produced by continuous currents with alternate currents applied to the armature circuits, a type originally demonstrated by Hopkinson, in 1883; second, motors actuated by the inductive effects of a rotating field upon closed armature circuits, first suggested by Mr. Tesla, in 1887; and third, motors operated by alternate currents, in both field and armature, constituting one of the types investigated by Mr. Kelly and myself. As far as I know, the first work on alternate current motors in this country was undertaken at Great Barrington, in 1886 and 1887, when I designed and built a synchronous motor and a motor acting under the repulsive currents obtained by periodically short circuiting armature coils, while they were under induction from the field. One of these motors was designed in January, 1886. Professor Thomson, in 1887 and 1888, also produced motors of this type, and, what was of still more importance, he read a paper before the Institute of Engineers memorable for the clearness with which he treated the subject.

In order to more clearly explain the troubles found in designing these and other alternating current motors, I wish to call your attention to two of the properties possessed by circuits traversed by alternate or variable currents. When dealing with continuous currents, we are accustomed to consider that the resistance of a circuit is determined by the area of the length of the conductor and by the specific material composing it. In dealing with alternate currents, it is desirable to extend the definition of the term "resistance" to a fuller meaning. The term "resistance," as you all know, is that property of a circuit which determines the amount of electrical energy disappearing per unit of current, the value of this property or "resistance" being obtained when the energy in circuit is divided by the square of the volume of current flow.

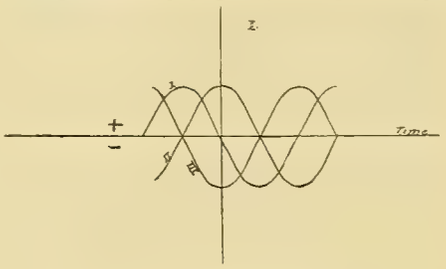
When steady currents occupy a circuit, the resistance value is confined to the conditions which exist within the conductor, viz., the "resistance" is proportional to the length of the circuit inversely proportional to its area, and dependent upon the kind of material employed. When variable or alternate currents are applied to a circuit, the resistance proper may not be confined to the interior of the conductor, but may extend to its surrounding neighborhood, for, with these changing currents, work may be done outside of the conductor as well as inside of it, and, as the losses by hysteresis and by induced currents cause a disappearance of electrical energy, they may be defined the current flowing and resistance factor. When alternate currents are used, this factor is always greater than when steady currents flow, and while in particular cases the disappearance of electrical energy taking place outside of a conductor may be small, there are cases in which the energy lost outside far exceeds the loss within the wire itself. Another point may be noticed. We are accustomed to think of the resistance of a wire as a fixed quantity; we say, a circuit has ten ohms resistance, and we are in the habit of thinking that this value of ten ohms is approximately constant and independent of the current flow. While this supposition is true for steady currents, it is not true for those of changing value. If the conductor carrying an alternate current is of small section, less than one-quarter of an inch diameter, the internal resistance of the circuit remains nearly constant for alternate currents of the frequency we are accustomed to handle, while the external resistance, if I may be allowed to use such a term, increases with an increase of current, and may increase as the square of the current, or faster. While I am aware that this treatment of the term "resistance" is not in ordinary use, yet it is quite orthodox; it has been defined by the mathematicians, and its use may be justified, as it is often instructive in comparing the losses taking place within and about a conductor occasioned by the flow of alternate currents. In designing alternate current motors, for instance, the loss of energy exterior to the circuits has to be very carefully watched; for example, an alternating motor armature wound in the ordinary manner might carry one ampere of current with very little loss other than that due to its interior or ohmic resistance, while ten amperes might cause a loss exterior to the wire by hysteresis and eddy currents several times the ohmic loss in value, or the exterior resistance might become so great as to practically prevent the flow of current to the value desired.

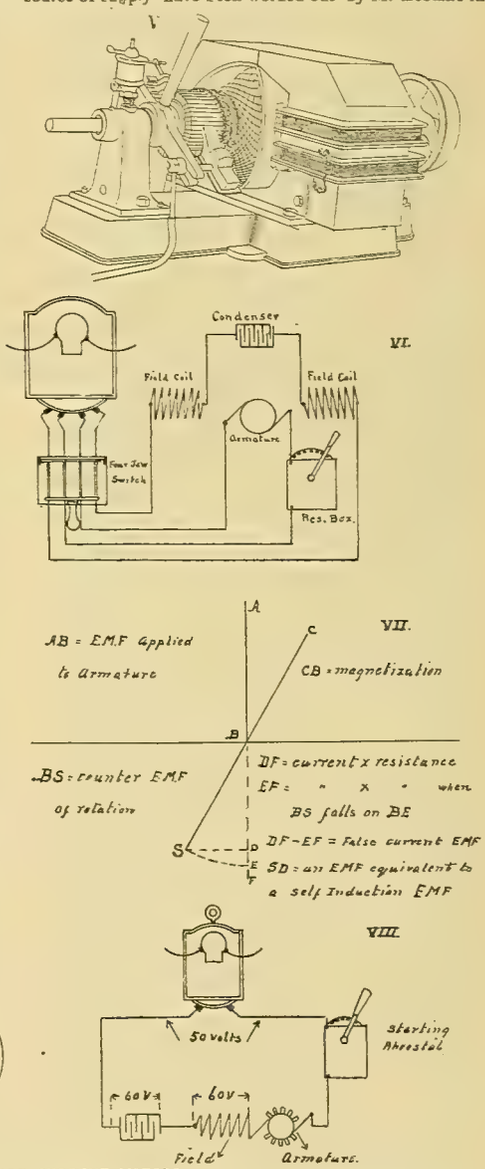
The other property of a circuit carrying an alternate current, to which I wish to allude, is its so-called inductance, which is the property of inducing upon itself an electromotive force. The electromotive force thus produced combines with the other electromotive forces in circuit to determine the direction and value of the current at any time. It is not necessary for the purposes of this paper to trace out just why or how it happens that these electromotive forces are developed, or why they do not coincide in phase. By referring to Fig. 1, you will find the diagrams which illustrate the phase differences of these electromotive forces; that marked *I* is the electromotive force in a circuit which urges the current against the resistance of the circuit whether the resistance be within or about, or both within or about the conductor. The curve marked *II* indicates the relative position or phase, that is, time of flow of the electromotive force of self-induction, which, as you see, is to the right of the first electromotive force, and, lastly, you will find the phase of electromotive force developed upon a condenser when attached to a source of alternate currents.

For the present it is only necessary to notice that two of these electromotive forces, *II* and *III*, have their maximum and all corresponding values at the same time, as, for instance, at the time *C*, *II* and *III* are opposed in direction, *A* being + direction, *B* being — direction, while the maximum values of each falls upon the same time line.

Let us now briefly examine the various types of motors that have been suggested, and which I have classified in three types.

It is well known that if an alternating dynamo be run until its speed of alternation or frequency is approximately the same as that of the generator from which it is to be supplied, and, if its field is properly magnetized, it can be coupled to the generator by simply closing a switch; it will then fall into step with the generator and will take load and behave in a very proper manner; the trouble is to get it into step without employing costly or complicated appliances. If one attempt to start such a machine by commutating the current in the ordinary manner, he will find that the current will refuse to flow in the field circuit, the inductance of the circuit keeping most of the current out. How to start a synchronous motor is the problem still unsolved, but Mr. Kelly and myself believe that we have found a solution.





FIGS. I—8. ALTERNATE CURRENT MOTORS.

It is not to be understood that all dynamos will run as synchronous motors with equal satisfaction, for while the machines made in this country will so run, they are not to be compared for this or multiple connected service with the Mordey machines made in England, which, by the way, I consider to be the best designed alternators yet produced. The reason why the Mordey machines excel as synchronous motors is that the inductance or self-induction of the armature circuit is so low that the slightest tendency to fall out of step is instantly corrected by the necessary current flowing in the armature.

If one attempt to couple two or more of our American alternators in parallel (I refer to surface-wound machines), he will find that a large false or useless current will surge to and fro between the armature circuits; this false current is due to the fact that when two alternators are put in parallel, there are always short intervals of time during which one machine leads and does work upon the other; this interchange of current between the machines tends to bring them into more perfect step. Mr. Mordey's machines may be said to be always alert to correct any difference of phase, in fact, they may be imagined to correct each other at the first intimation of the lagging machine, while the American machines allow the laggard to fall a considerable distance behind before the necessary correcting current passes.

While many inventors were eagerly following their various lines of investigation for the purpose of producing an operative motor, Mr. Tesla had quietly worked out a new solution of the problem on an entirely novel basis, by inventing the rotating field, that is, the field produced by shifting magnetism, and producing it by alternate currents. Mr. Tesla's motor is so simple and so beautiful in theory that many have doubtless wondered why it has not been brought into general use. If I correctly understand the subject, it has not been commercially adopted because of the difficulties in operating it at the frequency generally in use in this country, viz., 130~p.s., and especially because thus far special generators and circuits having phase differing currents must be employed; there have been many attempts to subdivide alternating currents into two or more currents differing in phase. Special arrangements of condensers for producing phase differences from a single source of supply have been worked out by M. Leblanc in France and by Mr. Kelly in this country. As regards the motor itself, there are two drawbacks to its use which have not thus far been entirely removed; they result from the inductive effects of the currents upon themselves and upon each other.

To understand this matter in a practical sense, let us assume a Tesla motor having 300 pounds of iron in its field and armature to be magnetized; suppose it be supplied with a 16,000 alternate current at 300 volts pressure. We have 300 volts then applied to each of the two field circuits. We can count on the motor being magnetized to at least 20,000 C. G. S. lines per square inch of iron, which, with a loss of one watt per pound, would then represent an external resistance loss, that is, a loss outside the wire, of 300 watts, and a resistance of $\frac{300 \text{ watts}}{C^2}$. In this case the internal resistance of the copper coils may be made low and may be neglected.

Now, it is evident that the magnetization produced in the field will react upon the field coils and will develop an electromotive force of self-induction, and this electromotive force, as shown in Fig. 1, will be 90 degrees or half a semi-period from the electromotive force urging the current against the resistance; let the value of this induced electromotive force be 250 volts, then the electromotive

force urging the current against the resistance will be found by

$$\sqrt{(\text{applied E.M.F.})^2-(\text{E.M.F. of Self. Ind.})^2} \text{ or}$$

$$\sqrt{300^2-250^2} = 165 \text{ volts.}$$

That is to say, that of the 300 volts applied, 165 volts are used up in urging current to magnetize the motor when it is doing no work, and 250 volts are available for inducing currents in the armature. If, as we have assumed, the loss due to hysteresis is 300 watts, then the current flowing would be $\frac{300 \text{ watts}}{165 \text{ volts}} = 1.8$ amperes, and the resistance external to the wire $\frac{300}{(1.8)^2} = 92$ ohms.

I do not mean to say that these conditions are actual or cannot be improved; they ought to be. I present them simply to show that, with this type of motor, the full electromotive force employed is not available, as in the example when, with 300 volts applied, but 250 volts are available and 165 volts are lost.

Moreover, it is necessary that a strong field magnetization should be developed in a motor in order that a powerful starting torque may be had; as a consequence, the field circuits of this motor must be composed of a comparatively small number of turns of wire (the flux or magnetization in an alternating magnet being inversely as the number of turns with a given applied electromotive force, and with a magnetic circuit of given reluctance). It might also be shown that the value of the field producing current in these motors, viz., the current required to run the motor empty, is largely dependent upon the air gap between the field and armature, the current at no load being greater as the clearance between the field and armature is increased. The Tesla motor then must necessarily have a false or lagging current at no load, and must expend considerable energy in the production of the rotary field by hysteresis loss, until some one, and Mr. Tesla is likely as any one, shall find an iron without hysteresis, and an air gap that does not require magnetomotive force. I understand that these motors require about .6 of the full load current when running free with a factor of lag of about .7, so that the actual per cent. of energy required to run them free is, approximately, .6x.7 xen =42, or, say, 40, per cent. of their full load energy. This is a rather serious matter when viewed from the standpoint of the station manager, for if the motor service requires .6 of its full load current to run free of work, then evidently .6 of the station capacity must always be in operation. There is another slight trouble with these motors, resulting from the fact that the co-efficient of mutual induction does not keep up as the motor is loaded; this may be explained by saying that the flux, and consequently the electromotive force developed in the short circuited armature coils, decreases as the motor is loaded; this decrease of induction affects the speed of the motor, causing it to fall off with load, while it requires a larger current in the field to furnish an increased amount of work; both of these difficulties, however, are very largely determined by the design and calculation of the motor itself, and may be brought within working limits. I see no reason why this motor may not be made successful and operative by proper designing and careful study.

The problem before those studying the alternate current motor is, however, entirely independent of these difficulties. Had we a reliable means of dividing an alternate current into two currents having the proper difference of phase, Mr. Tesla's motor would be made available and would be of great commercial value. Mr. Kelly and myself have found an entirely novel and complete solution of the problem. As far as we can discover, it has never been attempted by any other experimenters. By the use of a very simple invention, we are able to draw from a single transformer secondary two phase differing currents, having any differences of phase we elect. These currents maintain their phases, that is to say, times of flow, independent of the amperage of the current and of each other. We can apply our invention at the station, splitting the primary current from the dynamos into two phase differing currents, or we can lead the primary current through a transformer and split the secondary into two components.

I regret that I am unable to disclose the methods we adopt, but I hope to be able to publish our results shortly. Our method will then allow us to run the Tesla motor from the same circuits and by the same generators that we now employ in incandescent alternate current lighting. The Tesla motor for the past five years has been waiting for one thing only to develop it, viz., a current splitter, and we have found one.

Mr. Kelly and I have invented what we call a "condenser motor," which differs radically from either of the above mentioned types. The problem which we have had in mind was to construct a motor which should be operated by existing alternate currents in exactly the same manner that we operate an ordinary motor when supplied with continuous currents; to do this, it is necessary to construct a motor whose circuits do not possess (effective) self-induction, or, to put it in another way, it is necessary to take away from the alternate current circuits the effects of the electromotive forces induced in them by their own currents, which renders unavailable a considerable part of the electromotive force applied.

I will attempt to explain our shunt motor without the use of formulæ, illustrating the results obtained as best I can.

Our motor has a laminated sheet iron field, and may be made in any of the multipolar or bipolar types. The field winding is connected in series with a condenser to the secondary of a transformer, which, when fed from the station, furnishes the source of supply. The armature of the motor, although wound with a special winding, is substantially the same as a continuous current armature, and is surrounded by closed copper bands whose function I will describe later. The theory of the motor is, that, given the necessary magnetization and armature current, the motor will operate as well with alternate as with continuous currents. Returning to the field circuit, let us glance at the function of the condenser. If the field windings were connected directly to the transformer or source of supply we should have two electromotive forces in circuit, combining to oppose the electromotive force applied by the transformer. Let the line $A\ B$, Fig. 3, be this electromotive force, and let $B\ C$ be an electromotive force whose value is found by multiplying the current (in the case assumed) by the resistance of the circuit. By resistance is meant the internal or ohmic resistance plus the external resistance due to hysteresis and eddy currents, then A-C is the electromotive force of self induction; the two electromotive forces, $A\ C$ and $B\ C$, combine to always just balance the transformer electromotive force.

Now, in any operative type of motor, the electromotive force $A\ C$ will always be greater than $B\ C$, or simply the opposition of $A\ C$ will be so great as to practically obstruct the flow of current in the field. If, now, we could introduce a third electromotive force, such as $C\ D$, which should always oppose $A\ C$, we could neutralize the effect of $A\ C$ upon the time of flow and value of the current, which, in that case, would not be opposed by any electromotive force, except C, R, or $C = \frac{E}{R}$, as in the case with steady currents. To get this third electromotive force, we insert a condenser whose capacity is so chosen that the field current will develop a potential upon the condenser terminals equal to the electromotive force $A\ C$; if the field current changes in value from time to time, it will change the value of both $A\ C$ and $C\ D$ (as these electromotive forces are in series connection) in almost the same ratio, and consequently these two electromotive forces, the one on the condenser and the other on the field coil, will always neutralize each other's effects, and the circuit will be left free to the current flow, as with continuous currents. Perhaps this may be made simpler by considering the resultant effects produced by a number of alternators coupled in series, Fig. 4. Let A, B and C be these generators; let them be all rigidly coupled to the same shaft, A being set on the shaft so that its armature generates an electromotive force 90 degrees away from that of B and C, while B and C are coupled to produce the same voltage at the same time and have their terminals opposed; then B and C will exert no effect upon the circuit, for they will always neutralize each other. The electromotive force of A corresponds to the transformer electromotive force; the electromotive force of B to the electromotive force of self-induction on the field coil, and the electromotive force of C to the electromotive force on the condenser. In this way we obtain the necessary current to magnetize our motor unrestrained by the electromotive force of self-induction.

The next difficulty to clear up, in order to operate our motor, is to get rid of the external resistance in the armature circuit. In order that a motor may operate economically and regulate properly for changes of load and current, it is desirable that the armature resistance should be very low; the principal resistance offered to the alternate currents in an armature is, as before stated, due to the work outside of the armature wire in the iron core; these losses in the iron are occasioned by the alternating magnetization developed by the armature current; to remove this loss of energy we have had to destroy most all of the armature magnetism in the following manner.

You are all aware that if a magnet core is wound with two equal coils in opposite directions and is connected with a current source, the resulting magnetism will be only that due to the difference of the winding displacement, and will be practically negligible. About our armature, Fig. 5, we place close circuited copper bands or wires, so disposed as to be parallel to the direction of current flow in the armature conductors; the currents flowing in the armature windings induce oppositely directed currents in the stationary bands, and consequently, the armature core is surrounded by two sheets of current during each wave of current flow; the sheet of current on the armature flowing in one direction, while the current in the stationary bands flows in the opposite direction, thus practically preventing any magnetizing effect, and thus, also, preventing any loss by hysteresis and eddy currents in the core. Now, it can be shown that the work lost in the copper bands will be very small, providing the resistance of these bands be kept low, and we have found that this loss can be made as low as one-third of the inside or ohmic loss, a result which enables us, by proper designing, to make our armatures almost as efficient as those of the best direct current type, with small additional expense.

One other point of advantage obtained by the use of the compensating bands should be mentioned. As the cross magnetization of the armature is practically destroyed, there is no change of lead under variation of load as there is no distortion of the field magnetism by the armature current. These results are eminently satisfactory. In describing the Tesla motor I pointed out that there was a loss of voltage, or that, of the voltage applied, a considerable portion was unavailable; in our motor ninety-six to ninety-eight per cent. of the voltage applied to the armature is available, while the operating conditions are identically the same as found with a continuous current motor. It is not to be understood that the motor has an efficiency of ninety-six to ninety-eight per cent. Far from it. In our small motors the losses in the field and armature will aggregate thirty to forty per cent. In the larger types of from two to five horse power the loss will not exceed twenty-five per cent., while in the still larger sizes the losses will be much less. The problem of the efficiency of the motor is almost the same as the efficiency of the transformer, and depends in large measure on the care and skill of design.

To operate our motors it is necessary that the speed of the dynamo should remain constant; as constant as possible. If the stations will give us a definite number of alternations, and will maintain that number, our motors will behave beautifully; if the alternations change, the condenser electromotive force will no longer exactly oppose the lagging electromotive force of self-induction and the field current will change and lag either positively or negatively; mere change of electromotive force will not interfere with the operation of our motors more than it would with any continuous current motor.

Fig. 4 illustrates the general design arrangement of the motor system. The condenser is placed either upon the wall or under the motor in the base; the electromotive force applied to the field is about 150 volts; the armature electromotive force is either 50 or 100 volts. The electromotive force on the condenser is, approximately, 750 volts. While this electromotive force may appear excessive at first sight, there is no real danger from its use, as a contact across the terminals would instantly reduce the potential, and accidental contact is easily prevented by properly insulated wires.

There is one other type of motor to be mentioned—the series wound motor. When operating any of the ordinary types of motors by alternating currents, it is necessary that the phase of the field magnetism must coincide with the phase of the electromotive force applied to the armature circuit, that is to say, the field magnetism must arrive at its maximum value at the same instant the electromotive force applied to the armature arrives at its greatest value, for if these two values do not coincide in time, the counter electromotive force developed by the rotation of the armature will not directly oppose the electromotive force applied to the armature, but will be skewed off one side, and, consequently, will allow a false current to flow in the armature circuit. Fig. 7 illustrates the point, for, suppose they do not coincide in phase, then $A\ B$ represents the maximum value of the alternating electromotive force applied to the armature, and $B\ C$ represents the lagging magnetization, which, as I have stated, should coincide with $A\ B$; consequently, $B\ S$ represents the counter electromotive force of rotation, which is, of course, directly opposed to $B\ C$ and should be directly opposed to $A\ B$, or should occupy the position of $B\ E$. It can be shown that $D\ F$ is the electromotive force urging the current against the resistance of the armature, or $C\ R$, while $E\ F$, which is smaller than $D\ F$, would be that electromotive force, providing the magnetism $B\ C$ concided with $A\ B$. All this simply means that, when operating a motor by alternate currents, the magnetism in the field should coincide with the electromotive force applied to the armature, or else there will be a false current in the armature circuit; the condenser accomplishes this desired result in the shunt type of motor; in the series wound motor the magnetization necessarily coincides with the armature electromotive force, because they both accompany the same current. The series wound type of motor, then, is the simpler to deal with; let us examine it for a moment. If an alternate current source be applied to a series wound motor properly constructed with laminated fields, etc., the motor will run with feeble torque, and if one investigate the cause of this want of torque and power, it will be found at once to be due to the inductance of the motor; the electromotive force of self-induction will greatly reduce the available electromotive force applied to the motor, and consequently, lower its capacity to translate electric energy into mechanical power. We have removed this deleterious effect of the electromotive force of inductance in the following manner: Fig. 8 represents a motor having its field and armature connected in series, while c is a condenser also connected in series; the distribution of the electromotive forces is given in the diagram. The transformer supplies the motor with current at fifty volts pressure, the electromotive force of self induction, located almost entirely upon the field coil, is assumed to be sixty volts; the electromotive force on the condenser is, consequently, sixty volts for the current in circuit and the load on the motor, and, consequently, if the current varies, then both the condenser and self-induction electromotive forces vary in approximately the same manner, thus leaving the circuit to receive current from the transformer and to do work. In my judgment, this type of motor will be of great practical use; not only will these motors successfully handle all constant load problems, such as pumping, blowing, etc., but they will be exceedingly useful in crane and elevator work, while their service in propelling cars can hardly be estimated. In all cases where hand control is required, they can be operated as successfully as continuous current motors.

The most serious question we have met in pursuing this problem has been that of finding a suitable condenser. It may be well to state that none of the ordinary types of condensers, viz., those made of paper, paraffine, glass, mica, etc., are of the slightest use We have found that the residual charge in all of the above mentioned substances absolutely prevents their acceptance; this residual charge seems to depend upon the non-homogeneity of the dielectric and upon the want of an absolute contact between the plates of the condenser and the dielectric surface. When glass is used as a dielectric and a potential of 1000 volts (average) is maintained upon the condenser the glass heats rapidly until, finally, it is shattered to pieces. Condensers of glass, when raised to a potential of 15,000 volts, became phosphorescent, rapid flashes of light appeared in various parts of the glass, while they withstood the potential, which was only for a few moments. Vulcanite we find unreliable; metallic chips are always present, and for this reason, if for no other, it fails to stand satisfactorily, We have succeeded in producing what we call "films" from .003 to .005 of an inch thick, which will surely stand a potential of 1000 volts We believe that these condensers are entirely commercial, that they will not deteriorate, while their cost per microfarad is quite low. So perfect are they, that they show but little trace of residual charge, they do not heat perceptibly when in circuit for a long time, and withstand a potential of from

2000 to 3000 volts with a dielectric thickness of .006 inch. The processes of their manufacture will not be made public at present.

Of the three types of motors mentioned in the beginning of my paper, I have but partially described one; the other two can be worked out. We believe we know how to perfect the synchronous type; we expect to do so. The Tesla motor is, perhaps, the simplest of the three to work out from the beginning, but, like all such problems, it requires study and careful investigation. The so-called multiphase motors, of which much has lately been written, possess no advantage over the two phase type as devised by Mr. Tesla; in fact, the two phase motors are neither better nor worse; but the European multiphase motors appear to have been carefully designed; the relations between field and armature seem better, and, if they possess any superiority over the American rotary motors, it is derived from these conditions rather than from any new departure in the application of the three phase currents.

Mr. Kelly and I have produced motors which are operative on existing circuits. As we have stated, our motors start at full torque, run to a definite speed and behave exactly like direct current motors under load. So perfectly does our compensating winding eliminate the electromotive force of self induction from the armature circuit, that this circuit offers very nearly the same opposition to alternate currents of a frequency of 130~p. s. that it offers to continuous currents; there is, therefore, little falling off of speed due to the self-induction of the armature circuit; in fact, we can over-compound the motor by its own load by setting the brushes off the neutral point of commutation, thus changing the flux through the field.

Your president has asked me to address you on the alternate current motor problem, and I presume he expects me to offer an excuse on behalf of the profession for not having placed in your hands a perfected motor adapted to your circuits before this time. I can only say that the problem has been a difficult one; there are so many opportunities offered to alternating currents to dissipate their energy, so many more than are found with continuous currents, that one has to be very keen sighted to avoid undue waste in constructing alternating machinery, but from the knowledge already acquired, I feel convinced that the coming year will place the alternate current motor firmly on its feet, and that before the year elapses many stations represented in this convention will be testing the accuracy of the statements contained in this paper.

Discussion.

Mr. Stillwell: I should like to ask one question of Mr. Stanley, and that is: In this motor that operates with a condenser or an arrangement equivalent to a condensor is there any faradization of the current behind the electromotive force in the circuits? Suppose we have a long line over which to transmit power; what is the relation of the phases of electromotive force and currents in the circuit from the generator to the dynamo or motor? I understand that there is little retardation if any.

Mr. Stanley: None whatever. The electromotive force flows at the time of the impress of the electromotive force. There is no lagging, and therefore there is no false current, The product of the current in the electromotive force expresses the true energy. In all of the rotating field motors, if you want to find out how much power you are using you multiply the electromotive force and current together, and then multiply by some decimal, some factor, which gives you the relations of the power actually absorbed with the power apparently absorbed. In our motors it is not so.

Mr. Stillwell: I would like to call your attention to the development of the Tesla motor, and to the relation of the false current to the true current, in the operation of that motor. Mr. Stanley's statement is, so far as my recollection serves me, about correct, when the motor is at full load—a motor of four or five horse power; but the Tesla motor behaves very much like a transformer. The development and perfection of this motor, as Mr. Stanley has said, is a matter of attention and careful study of details of construction. Mr. Tesla and C. L. Scott have worked on this subject for a long time, and have brought the Tesla motor up to about the best relation that I believe is practicable with that type of motor, and that is a very good relation for certain purposes. The relation of the false current at no load is not, however, proportionate to the energy. In a transformer of the closed circuit type, when no lamps are burning on the secondary circuit, and consequently there are no currents in the secondary coil, we can obtain the true energy in the primary by multiplying the current and the electromotive force by a factor, which, for the types ordinarily used in this country, is about $\frac{7}{10}$. As lamps are added to the secondary circuit, the phases of electromotive force and the current in the primary tend to coincide, and at a partial load, comparatively small, they do coincide, practically, so that the product of current and electromotive force shows the true energy. In the Tesla motor, the same general relation exists, and if it were possible to operate the motor without an air-gap, identically the same relation would exist. As we load the motor, the phase, the applied electromotive force coming from the generator and the current tend to concide; and while on a motor of 15 horse power, which gives about the same results, at no load we must multiply the current and electromotive force, by two-tenths instead of six-tenths, at full load we would multiply it by eight-tenths or nine-tenths; that is to say, that when a Tesla motor is turning over the false current is very large, but there is a relatively good regulation as to energy. Good current regulation is very difficult to obtain, and therefore there is always some flow in the circuit. This does not apply to the efficiency, and the false reading is by no means as much as would be understood from the bare statement. At the present time it seems to me that the practical question presented is this: Assuming the case of power transmission for a considerable distance, and omitting for the time reference to the very general application of such a motor on existing circuits of small size, in the case of power transmission I think it is very questionable whether the advantages over the multiphase or synchronous type would be real. We should certainly have to pay some price for it, by using some new apparatus, a condenser or something else. If we were to transmit power from Niagara Falls to Buffalo, and were to use existing apparatus—about as good a method as we could use—we could have two satisfactory methods, one the two-phase or multi-phase system, and the other would be the straight synchronous system, with small starting motors to start the large ones. I think if we were called upon to supply power to Buffalo from Niagara Falls it would be a toss between the two methods. It would depend largely upon the amount of power to be transmitted and the potential to be employed. If it were 10,000 volts, it would be sufficiently high for a distance of 30 miles, if we were to deliver not more than two or three thousand horse power. It is probable that we should prefer to use two wires and two sets of insulators on each pole rather than to run three or four wires. The advantage of the latter would be that we could start the motors with torque, so that they could be brought up to their full speed when fully loaded. The disadvantage of the synchronous system is simply that starting devices must be used; but that is a small matter, and a small portion of the necessary investment. The multi-phase and the synchronous type, when run at full load, should be operated synchronously. I do not think there can be any doubt as to that. If we do not operate them synchronously, there is sure to be a retardation of current behind the electromotive force; and the effect of that is to multiply or increase our investment in copper. The advantage of synchronism is decided; it is an advantage we should not overlook, and should not neglect. This motor will run at a speed absolutely equal to that of the generator, irrespective of load. It will not get out of step, if properly designed, unless overloaded to the extent of 100 per cent., which is extremely improbable. If it should happen, it is easy, by means of an automatic cut-off, to protect the motor. For small motors, supplied from ordinary alternating current circuits, as now exist, a motor such as Mr. Stanley describes would have a very extensive, and, I think, very valuable application. There are motors which can be used for this purpose, but there are some objections to their use. The ordinary synchronous motor can be made self-starting without great torque, but with sufficient torque to bring itself up to speed. You will remember that the commission of distinguished engineers who considered this matter at Frankfort, arrived at the conclusion that the ordinary synchronous motor, started with small torque and without load, was a practical and sufficiently effective motor for general purposes; and the views of the commission were in favor of the alternating current, even as against the direct current, for a comparatively limited area. The only objection they raised to the system was that there was a certain amount of sparking at the commutator, and as I have seen one of those machines in operation it may be interesting to know how far it has been improved since. At that time Zippernowski was using the copper brushes, and starting the motor at low speed. The product of revolutions and the number of poles of course did not equal the number of phases at the low speed, and there was sparking. The Frankfort commission undertook to measure the amount of copper that was detached from the commutator by sparking 100 times. Since that time we have very generally taken to carbon brushes, and the carbon brush applied to that motor particularly gets over the difficulty. I have seen this synchronous motor start on a high number of volts without any sparking that would cut the commutator. There is a slight discharge, but not a cutting spark. I am glad to know that Mr. Stanley says that the so-called multiphase motors possess no advantage over the two phase type devised by Mr. Tesla.

Mr. DeCamp: There are a great many central station men here to-day, like myself, who would like to know the relation between electric power delivered to the customer and paid for by him as compared to that of steam. In the city of Philadelphia the prevailing rate for steam is $50 per horse power per year. The price, like other things, has been brought down by competition.

Mr. Stanley: Mr. Stillwell a moment ago suggested that there was a possible benefit to be derived from using a multiphase motor system. I do not believe it. Mr. Tesla, in the wonderful work he did early on that subject, outlined the exact conditions of the operation of his motor. We do not want more than two currents of 90 degrees of phase to produce a perfect rotating field.

World's Columbian Exposition.

The President: We were to have yesterday a report from the committee on the World's Fair, but it was not ready. We have here to-day, however, Prof. Elisha Gray of Chicago.

Prof. Gray: We have a plan to form an auxiliary organization in connection with the exposition, and it is called the World's Congress Auxiliary of the World's Columbian Exposition. There are several departments, and each department will hold several congresses. Ours comes under the head of science and philosophy. We want your aid and support in making a success of the electrical congresses, which are to be held under this plan. We would like you to appoint a committee to advise with the general committee in charge of the congresses. We invite all electrical societies to co-operate in the same way. We will have representatives of the best thought and the best work from all parts of the world in all departments. The congress will meet under the shadow of the greatest palace of electricity that the world has ever seen. It is your affair as much as it is ours.

In the absence of B. E. Sunny, chairman of the World's Fair committee, the following communication was presented:

Everything in connection with the World's Fair undertaking is moving in a most gratifying and satisfactory way. The buildings and grounds are getting into a finished condition with an expedition that promises an absolute completion of the work long before the date for the opening of the fair. No doubt the members of the association are fully posted, of the exact condition of the buildings, which, as I stated before, are being pushed to completion with a most satisfactory speed.

From Prof. Barrett I ascertain that almost double the space available for electrical exhibits has been applied for by American and foreign electrical manufacturers, and there is apt to be just a little disappointment by those who will not be able to get the amount of space that they require. I think, however, that the arrangement for the care of applicants is on such an elastic basis that every one will get about what he wants. Certainly this is the temper of the fair management.

This may be combatted by some, because of the newspaper articles that have recently appeared, to the effect that an important European firm has not been able to get the facilities it desired to make a magnificent exhibit at the World's Fair. I am familiar with the application of this firm, and I know that any disappointment they have met with has not been through any fault of the World's Fair management. They required a great many things which could not be granted, for the reason that American manufacturers would require the same advantages, and they could not be allowed without practically abandoning the plan adopted after much consideration and hard work. No doubt this firm will be able to adapt its wants to the organization of the fair, and will be able to make its exhibit on what will be to it, and everybody else, a very satisfactory basis.

As has been announced by the papers, the specifications are out for the furnishing of 6,000 arc lights and 92,000 incandescent lights and 3,000 horse power in generators for the service of the fair, and by the middle of March the contracts will be closed, so that the work of installation can go right ahead.

The organization of the World's Fair Auxiliary, under whose auspices will be held the convention of the electricians from all over the world, is going forward rapidly and satisfactorily, under the direction of Prof. Gray, chairman. The general plan was adopted for the auxiliary at a meeting of Prof. Gray's committee, and has been published in the electrical papers of recent issue. The aim of the committee is to make the undertaking of the gathering of the electricians on a comprehensive basis, and with the assistance that is being offered the committee in every direction. I have no doubt that the plan adopted for the convention will be the one best calculated for the advancement of the interests of electricity. The situation could not be any more satisfactory for the prospects of the undertaking than it is.

The report was received and ordered placed on file, and the committee was continued.

Resolutions on the Death of George Worthington.

The convention unanimously adopted the following resolutions on the death of the late George Worthington:

Resolved. The members of the National Electric Light association assembled at its fifteenth convention desire to record their sense of the loss sustained by the association in the death of George Worthington.

He was the moving and leading spirit in calling together the company of gentlemen who organized this body seven years ago, and so long as health and strength remained to him he was foremost and unwearied in its service. From the first he appreciated the importance of the organization and its possibilities of usefulness. Busy as he was in his chosen field of journalism he found time and opportunity to lend a hand on every occasion of service.

Highly as we regard the memory of his ability and usefulness as a working member of the electrical committee, we even more highly cherish the remembrance of his warmth of heart and his unselfish devotion to his friends. No one came within reach of his handgrasp without becoming his friend. If he had an enemy no one ever found it out.

Resolved, That the secretary be requested to send a copy of this minute to the family of Mr. Worthington.

The meeting then adjourned until 8 P. M., the afternoon being devoted to a trip to Niagara Falls.

EVENING SESSION.

The president called the convention to order at 8:30 P. M. and introduced M. J. Sullivan, who presented a paper written by his brother, M. C. Sullivan of New York.

The Construction, Safety and Operation of Switch-boards.

BY M. C. SULLIVAN.

Beginning with the very first central station that was constructed, the watchword of the manager has been "improvement." Having realized the main object of his ambition, the supplying of the electric light and power to consumers, and maintaining this supply, his next great work was to improve the means of generating that current. The question of utility was, of course, the principal consideration; but artistic effect was not lost sight of, so that at the

present time we have scores of both light and power stations that are models of electrical and mechanical construction.

In the early days most of the devices that made up the stations were thrown together, and those that received most attention were most important. Thus we find the greatest improvement in connecting the engines to the dynamos. Overhead as well as underground lines have undergone a revolution, and inside wiring is so vastly different from what it was once that an old-time wireman would not know the new system if he came upon it suddenly and without instruction. Everything has been improved, it would seem, save that most of all important station apparatus, the switch-board.

The switch-board may be likened to a pilot-house, or what is technically called the conning tower of a modern war ship. In the early days of naval construction the pilot-house was of no more importance than the pilot-house of an ordinary steamer nowadays; but, keeping pace with other improvements, it was soon discovered that this point of the modern ironclad was the nerve center of the vessel. From here the immense machinery, the rudder, the firing of the guns, signalling—in short, every force which the ship may possess, was controlled from one point. Appreciating this importance, the designer has surrounded the conning tower with every safeguard, and exhausted every ingenuity known to the ship-builder's art.

The switch-board is, or should be, the pilot-house of your station. Here should be located means for determining accurately the working of the entire system down to the minutest details. Disable your switch-board and like the wrecking of the pilot-house of a man-of-war you are helpless. The great advantage to be gained from centralization has been lost. It must, therefore, be apparent that every means should be exhausted to perfect and protect this apparatus.

The manager who has seen this station grow from a mole hill to a mountain, who has been compelled to add on dynamo after dynamo to satisfy the demands of the maddening crowd, now has a problem on his hands to equip a switch-board that will not only handle the service of the present time, but what is in store in the future. He knows from experience that what may be called the "skeleton board," with spring jack connections, will not suffice for this, and he must look about for another method. In thus casting about for the proper assistance, the manager is unfortunately thrown upon his own resources. While the manufacturers of the electrical devices have kept improving all the time and, as station managers know, have also kept improving the price, sometimes for better, often for worse, they have rather curiously left the switch-board to take care of itself. Consequently the manager has had to listen to the tale of woe from the operator, who ever and anon has been tickled with the giddy currents passing through the board, and other inconveniences so well known to those who have had to deal with old-time boards. Drawbacks of this character are more apparent in the arc light station than any other. A great source of the trouble here are the cables, or flexible conductors, used for making the cross-connections from one part of the board to the other. While we may exhaust every means to make the operator safe from contact, the use of these cables cannot very well be eliminated. It is possible, however, to construct a board on which any combination can be made without cables, but it would be so large and cumbersome as to become practically inoperative, in fact would be a very complicated affair. It is nevertheless practical to equip a board for arc service so that every part of the live circuit would be entirely insulated from the front.

In the large composite stations, embracing arc and incandescent lighting, of both high and low tension, and power generators for street railways, condensation is one of the vital features, not in the sense of crowding anything, but in utilizing every inch of space to install the apparatus necessary to do the work required. A most effective way to build a switch-board for stations of this character is to have it arranged in the form of a square so that one side could be devoted to each division of the service.

Stations occupying a large open floor with high ceiling present the opportunity for building the ideal switch-board. This could be raised above the floor a sufficient distance so as not to occupy any valuable floor space. For this matter it might be suspended from the ceiling. The wires from the dynamos could run directly to the left, thence through the switch-board, and from the latter to the cupola, arranged as nearly over the switch-board as possible. This arrangement would give us a central starting point for our lines, enabling us at once to trace each and every wire of the system. However desirable such an arrangement as the above may be, the conditions are such that we cannot always do as our best judgment dictates, but rather have to make the best of things as we find them.

The prime object to be secured in switch-boards for high tension service is safety, not only to the attendants, but to the station. The necessity for this received a terrible emphasis when the famous Grosvenor Gallery Ferranti station at London went up in smoke because of the poorly constructed switch-board. This can be accomplished by having every part of the board over which current is transmitted insulated in such a manner that contact from the front is impossible.

The prime necessity of switch-boards in railway power stations is facility for rapid manipulation whereby any part of it can be reached in the shortest space of time. Here also the indicating instruments must be in plain sight, so that the movement of the current, with its rapid vibrations, can be readily noted.

In low tension incandescent station plants, with their multiplicity of circuits, and the necessity for manipulating things quickly, so that whenever interruption may occur it will be reduced to a minimum, there is no limit to the refinement to be obtained. It can be reduced to the simple question of putting switches in circuit, or we can design the board in such a manner that it will be universal throughout, whereby any dynamo or dynamos can be placed on one line, or several lines on one dynamo. The indicating instruments, switching devices, resistances, lightning arresters, in fact all accessories, should be arranged to occupy the smallest space possible, and be within easy reach of the operator. It is not necessary or advantageous to have the board arranged in the form of a perpendicular wall, as now seems to be the general rule. It is just as well to design it so that the switches can be arranged in the form of shelves up the front of the board; or, in the case of extremely large stations the board itself could be made to occupy the whole of the floor space in a room, and the instruments fixed on tables, leaving an alley between each table of sufficient room to get around readily. These tables need not be of any great length, for should they happen to be, it would take too much time to reach certain points. They should be cut in sections so as to make the distance to be covered as short and direct as possible. Cases where measures of this kind are necessary are not often met with, however.

All switches and apparatus for this service should be manufactured with a lug or extension of the contact, so that the connection could be made from the back of the board. The resistance boxes and all of the regulating apparatus, which requires considerable space, should be placed behind the board and provided with a rod extending through the face of the board. The board should be as symmetrical as possible, so that in rapid manipulation the grasping of the wrong switch cannot occur.

Rapid manipulation being essential in arc light stations, although not in the same degree as the three other types of stations, this feature is one that must be considered. In designing a switch-board for this work, we should keep before us the question of safety to the operator, for if we can make him feel comfortable, freeing him from the hazard of working on a board that is not insulated, he is going to possess more confidence. Many attempts have been made to design a board for this purpose, that would do away entirely with cables without being cumbersome. Complete success has not crowned these efforts.

A very convenient form of board for this service is to arrange two slabs of marble or slate or other form of insulating material, leaving a distance of say six inches. One slab, say the inner one, may have connections from all the dynamos, each dynamo circuit having its own bar. The outer slab contains holes through which the current from these dynamos circuits may be plugged into any circuit or circuits, making it a sort of checker-board arrangement, the squares being defined by the lines of wire running horizontally and the dynamo circuits running vertically, or vice versa. The plugs by which the circuit is completed should have hexagon insulated handles, so that a good hold can be had. All the lightning arresters, armeters, etc., should be placed directly on the slate, or what may be used for the purpose, and the board should be complete in itself in every way before any wires are attached. Binding posts can be provided for the connections, and the work of disconnecting any circuit from the dynamo board is but the question of a moment. As cables will be necessary in the different combinations, a trough should be provided along the front, in which the slack can rest to prevent them falling to the floor. We now come the most important feature of the whole question: What material should be used for our switch-boards? As it must be fire-proof the use of wood is entirely prohibited. We must therefore look for something entirely different. Various efforts have been made to make wood fire-proof. This has been accomplished to a limited degree, but the element of doubt still remained. Slate, as many of you know, is the best thing that nature has yet offered us. For strength, lightness and insulation it is the only material in sight. Unfortunately, however, slate is an alluvial deposit of a laminated character, and often contains metallic substances which destroy its insulation, making short circuits and other disagreeable features. When in the rough stone it is hydroscopic, to a considerable extent, and when it becomes saturated with moisture makes surface leakage possible. Great care should be consequently exercised in selecting slate for switch-boards, and only that which possesses absolutely no metallic properties should be used. This can be determined by the well-known rules of electrical testing.

The drawbacks met with in slate have determined some manufacturers in using marble for this work. This has only one-fifth the breaking strain of slate, and where it is used in the place of slate this must be taken into account. Marble presents the same hydroscopic elements of slate, and there is some metal in it, but owing to its peculiar formation, this metallic substance is not in any great quantities, as it is between the laminations of slate.

Iron should be used for the framework of all switch-boards, and in the case of high tension circuits a wire should be run from this framework to the ground, which is entirely insulated from the circuit, so as to prevent the board from becoming charged and discharging through a person who happens to be near by.

Complete plans and specifications should be perfected, so that when an order is given to the manufacturer to make a board, you will know whether it is his fault or your own if things do not turn out as you desire This may require more time and attention than you wish to give this branch, but if you have experienced the inconvenience some people have suffered, you will feel very much different

Improvements have and are constantly being made This spirit of progress may be credited to the wonderful development in electricity during the last ten years. Our central stations really mark the different steps in the grand march of our industry. Shall they not continue, and shall not the next decade follow out the unchangeable law of progress by bringing forth improvements destined to make the glorious past pale into insignificance? Everything points that way, and to him that shall review the events of the next ten years it will no doubt be given to speak of our station switch-boards as embodying the highest electrical and engineering knowledge—in short, perfection.

Discussion.

The President: The question of switch-boards is one that comes home very close to every man in a central station; and there is probably no point in which central station practice is so weak as in good switch-boards. It is a very noticeably weak place in the construction of a station which I have something to do with here in Buffalo, and I am not alone in that, as exceptionally few of the stations that I have been in have modern switch-boards. This subject is one that every active member of this association should consider earnestly.

Mr. Scott: We have a wooden switch-board, and according to the paper that has just been read that is contrary to law. But it is wired in such a manner as to make it fire-proof and I have found that the great danger from fire with switch-boards is either from a dirty connection, a loose screw or from lightning. We have had trouble from all those causes; and in order to obviate the trouble from lightning we provided each feeder with a double lightning arrester. We have two lightning arresters on each leg of each feeder running to separate grounds so as to be certain that if one lightning arrester does not act the other will. Then in order that it shall not reach the main plug cut-out to the dynamo, we put a double fuse block cut-out on each feeder, and fuse that only to the limit of that feeder, fusing the dynamo cut-out to the limit of the dynamo, so that if any lightning does pass the lightning arrester and comes in, it takes the feeder cut-out instead of the main cut-out, from which it might arc and destroy the armature. And I think that if managers will look carefully to these points -fuse their feeders less than they fuse their dynamos, provide as good lightning arresters as they possibly can, and have men thoroughly examine the screws and the connections at stated times, a wooden switch-board is just as good as one of slate or marble. I do not believe in slated wooden switch-boards. I think a plain wall of well shellacked hard wood is better than slate, because edges and corners are susceptible of attack where a full board is not so liable to it, and I like the full board better on that account.

We have one of the wooden Westinghouse lighting arresters and a marble lighting arrester on each feeder.

Mr. Robertson of Minneapolis: The matter of switch-boards is something that has given us a great deal of trouble. We started in when we put in our Westinghouse plant with what is known as a Spencer plug switch-board. Our switch-board is of wood. I have seen lightning flashes come in there that would destroy a switch and would not even faze the safety fuse, so that we have come to the conclusion out there that a fuse is not a protection against lightning; neither is a lightning arrester. We have never made any very great efforts to make a modern switch-board of our arc light board. It has been enlarged from time to time, as we have added different dynamos and circuits, until now it is a mixed-up mess of cables and terminals, and I doubt very much if any operator could learn just how to connect and plug up that switch-board in a week if he tried.

Mr. Leslie: We have suffered very severely from lightning in our station in New York. On one occasion a bolt of lightning came into the cupola and agitated all the lightning arresters, but at the same time burnt out our station. We then laid the matter before a manufacturing company, and it built for us a rubber board—that is to say, a slate board with rubber handles; and there was rubber all around it. And that burned out when there was no lightning; burned out from arcing in throwing over a heavy load from one machine to another. Then we set about building a switch-board on our own account, and we finally devised one which we think answers the purpose and affords us absolute safety. It is made up of slabs of marbleized slate, and the machine connections are run horizontally on the board and connected up by wires running from the machines overhead, and the connection is made behind the board. The line wires do not come into the switch proper at all. There is an addition to the switch-board on top—a final switch. This switch is arranged so that it makes a connection on each side of the board. If you throw it up the + will make connection on the face of the board, and the — will make connection on the back. Both the line wires are connected with this switch, but they are securely insulated from each other, so that there is no possibility of short-circuit there. The result is that we have a throw of about 18 inches, and no arc on any load that we have thrown there yet will follow it, although our lines are very long, and the arcing is very severe. The board made up in that way is exceedingly simple, and there is no pos-

sible chance for a cross or contact between different exciters or different machines. We use the plug system, and the board is arranged in two sections, so that if we are carrying our load on, say, nine or ten machines we have twenty on the board—we set up the other sections with the other machines, so that in case anything happens, the moment that you throw over these switches you will start the whole load on the other machines. There is no studying out how to do this, that or the other thing, but the board is always prepared for an emergency beforehand, and lies there in readiness for just the unexpected to occur. The whole success of the board is in that throw-over switch that I have mentioned—the final switch. It is quick, and we sometimes make switches there that are very difficult to detect in the effect on the lamp itself; it is so sudden. The board itself, as I said before, is of slate, and there is no wood to speak of about at all. We do not believe in wood, because we have been burned out on account of wood. We had bad luck with lightning arresters, so we discarded them, and although we have passed through two summers of very heavy lightning storms we have not suffered any more damage in the matter of armatures than we did previously, when we had lightning arresters.

THE PRESIDENT: I think that you will all agree with me that if a station burns down, in eight cases out of ten it is due to a defect in the switch-board, or from the way in which it is wired up. We all complain of high insurance on our stations. When we go to the insurance companies, they detect faults in the switch-boards the first thing.

MR. FAIRBANK: We have one of the Thomson-Houston slate switch-boards, one of their latest pattern. I do not know that I can describe it so that those not familiar with it will understand it. It is through the back and front. The lines come into the back part of the board, and the machines are connected in the front. Connections are made with a plug which reaches from one board to the other. There are on our board twenty circuits, so arranged that we can couple any line or any machine with any circuit. It avoids all cables, and it is perfectly safe. There is no place about the wood where a person could receive a shock in any way. There is nothing that could in any way reach the wires, and in our station our switch-board is situated in the center of the station instead of at the side. We can get all around it and test all our wires from the back of the board, or from the front. The wires are carried from each machine under the floor, and up on the under side. The line wires go out overhead, and before they go to the wire tower they go through the lightning arresters, which are situated right above the board, in plain sight of the dynamo tenders, and where they can be easily reached. We like the board very much, and I have not seen anything elsewhere that is so entirely safe as that is.

WORLD'S ELECTRICAL CONGRESS.

The chairman then called upon Prof. Gray of Chicago to address the convention on the subject of the World's Electrical Congress.

PROF. GRAY: I will briefly outline the plan for the World's Congress Auxiliary. This body gets its authority from the United States government through the exposition authorities. The World's Fair organization proper has contributed $200,000 toward a building which is to be erected on the Lake Front, which after the Fair is to be a permanent Art Institute; but during the Fair, in consideration of this amount of money which is appropriated toward the construction of the building, it is to be devoted entirely to this World's Congress Auxiliary, which is to hold a series of congresses, beginning with the opening and closing at the end of the exposition. Now, they furnish these rooms free of cost to all these congresses. There are twelve or thirteen different departments, and some of those departments are subdivided into separate congresses. Now, the idea of this organization is that all the world may participate, as your president has suggested. When we go into the congress, then, we go in as individuals. We cannot organize in our corporative capacity. We can help to organize this congress, because we can better work in that way, through these various organizations; but when we go into the congress we go in just like a man from England would, or from France or Germany—as members of that particular congress, and not as members of the American institute, or the National Electric Light association, or any other association. For the time being we merge ourselves into this general congress—and for the reasons that I have stated. It is a world's congress, and not a local one. Now then, it is manifestly for the interest of every one devoted to electrical science, and interested in electrical progress in all of its departments, to co-operate in this way. For instance, we will attend meetings where all of the different sections will meet, electric light sections, electric railroad sections, telegraphic and telephonic sections, and the sections on the theory of units and standards, etc.—to hear papers that will begin to be prepared a year in advance by speakers selected from the very best men in the world, on some original topic relating to this science in some of its features. We want to meet, then, in general session, all of us, in one grand congress, to hear these papers. And then when you come into your sections you do not want to be confined there to just the members of this association, for instance, on electric lighting; but you want to hear from eminent men from all parts of the world. You want to get all the information you can; that is the great value of this congress. It is the same thing that you have here but on a much larger scale.

I will read from a general statement, published by the World's Congress Auxiliary, giving the different departments, and the subdivisions, etc., of the various congresses:

The World's Congress Auxiliary is constituted as follows:

First—A central organization authorized by the directors of the World's Columbian Exposition, and recognized by the government of the United States as the proper agency to conduce a series of World's Congresses in connection with the Exposition.

Second—A local managing committee for each congress. This committee constitutes the means of communication and action between the auxiliary and persons and organizations desiring to participate in a given congress. Each committee must necessarily consist of a comparatively number of persons, who are resident in or near the place where the Congress is to be held.

Third—But a World's Congress obviously requires the co-operation of the world. Each committee therefore has adjoined to it, and constituting its non-resident but active branch, and Advisory Council composed of persons eminent in the work involved and selected from many parts of the world. The members of such councils will co-operate with the proper committees by individual correspondence.

Fourth—General, honorary and corresponding members are also appointed and they are invited to give their advice and co-operation in relation to the whole series of the proposed congresses.

Fifth—Committees of co-operation appointed by particular organizations are recognized by the auxiliary as representatives of their respective societies or institutions.

Sixth—The Chairmen of the general committees constitute the President's advisory council.

Here is the department of engineering. You know in engineering we have civil, mechanical, mining, metallurgical electrical, marine and naval engineering. Now all these different engineering societies can come into this congress as an engineering congress. But they come there as a general congress. Of course they come from all over the world. They merge themselves in that World's Congress for the time being; but in the preparation and organization they act in their various organized capacities. I want to say while I am on this topic that some of you may have seen that there was a double assignment. Electrical engineering was assigned to the department of engineering, but when we came together it was agreed that electrical engineering should be dropped from the program of general engineering and merged into the electrical congress. And although they had sent out their letters and their programs, it has been agreed since to merge that branch into our Congress. And here is another announcement which has just been given out:

While electrical engineering has been included in the scheme for the Electrical Congress of 1893, it was also originally assigned to the department of engineering, for consideration in the Congress of engineers. It was thought however by representatives of the Electrical Congress that this double assignment would tend to detract from the completeness and success of that congress. A conference on this point was held between Prof. Elisha Gray, chairman of the general committee of the electrical congress; O. Chanute, president of the general committee of engineers, and President Chas. C Bonney, of the World's Congress Auxiliary, and it was mutually agreed that the double assignment above mentioned should be canceled and the entire subject of electricity remitted to the electrical congress. The importance and the magnitude of the other great interests to be considered in the Engineering Congress made their representatives feel that they could well afford to be generous to their brethren of the Electrical Congress in the matter of electrical engineering. Their courtesy in this regard will certainly be highly esteemed.

MR. MEAD of Pittsburg: I understand that the desire is to have the different electrical associations first name a committee or representative delegates as subsidiary to the local organization, and through those delegates to work up a general attendance of the associations at home later.

PROF. GRAY: Co-operation is desired not only by creating a general interest in the congress, but by making suggestions to this committee. You know somebody must have it immediately in charge; somebody must do the work; somebody must be responsible. Now, we want to get our committee, which consists of this local committee that we have mentioned and the advisory council, and your organizations as co-operating with us. We want to get a consensus of opinion. We want by correspondence and otherwise to know what are your ideas and what are the ideas of the majority of the electricians here and all over the world, as to just what that program should be, for instance, and just how the congress should be conducted. And the whole thing should be worked up, the program should be mapped out, the assignment of the duties to the various individuals who are to take part should be made, and when we come together we shall not have to lose time by reason of not knowing what we are there for. So there is a vast amount of work and thought to be put on that subject before the congress assembles.

It would be well for every club and every association that is at all interested to appoint a committee. Then later on perhaps we will get all those committees, or an executive committee from these committees together, because there will be a great deal to think about when it comes near the time of the congress. We will have it all mapped out and understand what is to be done as near as possible before the congress meets.

JUDGE ARMSTRONG: I would move that there be a committee of three appointed to whom this matter be referred.

The suggestion was approved, and the following named gentlemen were appointed: Judge Armstrong, F. W. Cushing and W. L. Candee.

The President then introduced Hon. Erastus Wiman of Staten Island, who read the following paper:

ELECTRIC LIGHTING FROM A FINANCIAL STANDPOINT.

BY ERASTUS WIMAN.

It would seem as if in the evolution of progress on this continent that electricity was the flower and fruit. The stupendous change which in the condition of the human race has been possible by development on this side of the sea needed just such a revelation as is possible only in electrical science. A drama of such proportions, on a stage of such magnitude, by a people of such intelligence, illustrating such principles as self-government, such events as a material progress beyond all that the world has ever seen, needed above all things a new force, a new hint from the mysteries of the unknown, a new law of nature as forceful as gravity, as helpful as heat, as widely diffused as air. Electricity thus takes its stand just at its right place in the marvellous procession of events in the human progress towards a higher and nobler life, which has been rendered possible by the discovery of America.

The advent on this continent of the Anglo-Saxon race, the high principles and purposes that animated the Pilgrim Fathers, the sturdy development of all that was best in the mental, physical and spiritual nature of man, laid the foundations for the material progress to which all the world has contributed. Hither have come the strongest, the youngest, the most intelligent and the best adapted of human kind, to be assimilated into the great body politic, taking part and lot in the government and development of the country. But great and well prepared as were the people for the momentous task before them they would have had no progress to compare with what has been achieved had not the country itself been the most magnificent the sun ever shone upon. In area so vast, in minerals so abounding, in agricultural possibilities so abundant, it is no wonder that Emerson described North America as "Another name for Opportunity." How magnificently the American people have availed themselves of this opportunity of all opportunities in the world's history, it is needless here to recount. How vast is the internal commerce that throbs and pulsates over this fair land we may not now stop to estimate, and how important a part this great city of Buffalo is destined to play in it, electrically, we can only dimly guess.

But in contemplating the progress made in the last century, and seeking to discover the influences and forces that have most contributed to the growth of wealth, to the comfort, safety and happiness of the human race, as illustrated on this continent, it may be safely claimed that electricity, even in its early stages, has played a not unimportant part. It would seem as if in a country of such vast areas as is the United States, nothing in the whole category of events should be so highly beneficial as a means of instantaneous communication, and yet this vast boon of instantaneous communication was only possible by electricity. With wide stretches of territory extending from ocean to ocean, from the most northern latitude to the most southern, the power of communication without delay, without the loss of a moment, was of stupendous importance. It may safely be said that of all forces that rendered possible rapidity of growth, rapidity of accumulation of wealth and development, this power of instant intelligence, transmitted all over these vast areas, has been the most forceful, the most effective. Next to possessing so vast a country, as Emerson again says, "the last, best gift of God to mankind" came with it, in due and proper time, this most marvelous force of electricity, whereby its remotest portions were instantaneously placed in communication with each other, and through which enterprise was stimulated, all movements quickened, the news spread abroad the land, and the whole series of commonwealths bound together in a common progress.

Incidental to the unequaled usefulness of telegraphy in the marvelous progress of the country, has been its contribution, in a special degree, to the railroad service, which to so great an extent has contributed to material growth, the increase of wealth and to the comfort and happiness of humanity. The use of the railway telegraph has practically doubled the tracks of every single track railroad on this continent, rendering the movement of trains so precise, so rapid and so safe that without this facility of instantaneous communication the railroads would not have achieved half which by its aid has been accomplished. So that incidentally electricity is to be credited with no small portion of the enormous results attributable to that vast system of communication which in the last half-century has done so much in making this vast continent blossom as a rose.

But just as telegraphy had reached its perfect degree of usefulness in general purposes, as in the railroad service, shown by the perfect growth in electrical science, it was supplemented by a still more wonderful faculty of communication in the telephone. My friends, in all the series of wonders which the electrical world has revealed, this telephone is to me the most wonderful. To a layman like myself, who simply wanders along the outer edges of this magical land of discovery, this transmission by the aid of electricity of the human voice in audible and natural tones to great distances, is of all things the most marvelous. Not only is it the most marvelous, but it is the most effective, and in the highest degree the most useful. No one thing could have more perfectly fitted in to make this country grow and prosper, to knit together its neighborhoods, its people and its places like that which has been done by the telephone.

Mankind has not yet adequately appreciated the debt of gratitude which it owes to Alexander Bell, to my friend, Thomas Alva Edison, and the other gallery of worthies, who not only invented this device, but by an exercise of the highest business sagacity have ele

vated it into a condition of usfulness in a few short years well nigh universal. That an ample reward has followed quickly the display of this business sagacity, and in return for the constant employment of the telephone to a degree more exacting and more beneficial than almost any other known device, is a circumstance that all should be profoundly grateful for, who know the difficulties, delays and disappointments which usually follow in the train of invention, promotion and introduction for the eventual benefit of the dear public.

But another field of opportunity for the usefulness of electricity for the benefit of mankind has been found in its uses for the creation of light. Just think what it means, these words "creation of light," and how supreme the effort of man thus in imitation of the most divine of all acts, implied in the words, "Let there be light." In that command the most stupendous results followed in the creation, in which is revealed not only all that is upon the earth, but all the wondrous revelations of the heavens above. It is a singular fact that so many ages had passed since the world began, and that only by the slighest degrees was the darkness which falls like a pall upon the earth mitigated. Many can even now remember, especially in country places, the tallow dip, the short sixes, the oil and spirit lamp, and the uncertain though mellow rays of the finished wax candle. It is quite within the memory of many men here that petroleum with its wonderful power of illumination was discovered, and all the world has since been blessed, not only by its illuminating power, but by the business skill and sagacity, which through the Standard Oil company has diffused this article so universally, so safely, and so cheaply; illustrating the high benefits of a well managed monopoly, as against the universal condemnation of that economic feature of the hour.

It remained, however, for electricity, and within our own lifetime, to beget a degree of success in this wonderful work of the creation of light that nothing else had ever yet achieved. Once started on its mission, the progress made in adapting this subtle current to artificial illumination has been most remarkable. It may be doubted if in the history of any science the same rapidity of movement has been made as in the adaptation of this form of energy to the highly useful and beneficial purposes of the creation of light. Great as have been the results to the country in instantaneous means of communication by the telegraph in general use, in the railway service, and by the telephone, it may be questioned whether any of these uses exceed the benefits and enlargement of capacity which the highest form of artificial illumination made possible; for instance, remote places adjacent to cities, to which a gas main was an impossibility, have been reached by an electric wire. Neighborhoods have been joined together, localities connected and property increased in value by rendering communication at night secure and safe as in the day. In the application of the arc light to public works of great importance like aqueducts, tunnels, and especially to manufacturing, numerous branches of business are susceptible of being carried forward twenty-four hours in the day, which without it would be impossible. Thus is doubled the capacity of many establishments and the earning power of many an investment. In all public places, as in theaters, halls, and in almost all business establishments, where business after the setting of the sun is essential, electricity is already beginning most effectually to supplement daylight, and play a part almost as effective as the sun itself. As one in a journey across the country in a railroad car dashes through the cities and sees the long stretches of electric lights in cities like Rochester, Buffalo and Detroit, and going farther west, even to the Pacific, touches the newest towns, he sees how universal the use of the arc and incandescent light on the streets has become. It shows to what an extent, over what broad areas this beautiful system of illumination has pervaded. But not only in the streets is electricity found, but it is beginning to be seen in almost every store, every hotel, every place of resort, so that by its rapidity of growth it has made an advance hardly equaled by any other article of consumption. Indeed, so far has it come to be now a universal street light that a prominent president of one of the largest gas companies in the country declined to avail himself of an automatic street gas lighter at a mere nominal sum, simply because he said it was useless to compete longer against street illumination by electricity.

It will thus be seen that, so far as fulfilling the purposes of its manufacture, electric lighting is a definite and ascertained success. So far as experimentalization is concerned nothing now remains to convince the public of its safety, of its effectiveness, of its heathfulness, and of its general adaptability to all circumstances. Hence, as an article of merchandise, the light furnished by electricity is just as much in demand to-day as wheat, or corn, as beef or bread. So that this assemblage of electric light men may congratulate themselves, that notwithstanding many difficulties and obstacles, they have, by the excellence of material, by its reliability and effectiveness, created an article of merchandise of real value, for which there is a strong demand.

It is true, that in the creation of this article of merchandise, up to this period, there have been many mistakes. There has been a great waste of money, and if the past had to be lived over again, there are not a few who would shape their policy in an entirely different way to achieve the result now reached. But the very success of the business, in the creation of the demand, has been its own misfortune. I mean success in the rapidity of new inventions, in the labor-saving devices, in the marvelous progress which electrical science has made in the past few years. All this has been in a certain degree costly; but no one will now regret the cost if the article produced is only safe, certain, effective and profitable. The value of the franchises acquired, the goodwill of the business secured, the pre-emption of the electrical field for further growth and use in every variety of its application, must always be borne in mind as not the least valuable of the assets acquired.

The question of profits remains to be decided in very many localities. I have been favored during the last month or so with an enormous number of letters, in response to a request for information as to the condition of the electric lighting business all over the country. A great deal has been sent me of a confidential nature, and I can only give the general impression which the whole correspondence has made upon my mind. My conclusions are, first, that there is an enormous demand, only as yet partially developed and partially met, for electric lighting; second, that the public have been led to believe that it can be created for very little money; third, that in competition with gas, an insufficient price has been asked for a light infinitely more brilliant, infinitely greater in candle power; far more healthful, and, as a rule, far more safe; fourth, that at the start of many electrical plants, the most meager and insufficient foundations were laid for a business requiring the utmost precision and the most perfect material. If a mill for the manufacture of cottons or woolens were to be erected, the greatest possible skill would be required, the best material needed, and the most perfect engineering ability obtained. But in numerous electrical plants this kind of expense was thought unnecessary. The result has been, that numerous establishments have been created that needed almost everything in the shape of good construction that could make it a mechanical success.

It is these conditions, coupled with the rapidity with which inventions have followed one upon another, the constant reduction in the price of electrical machinery, the rapid growth of electrical appliances, and the radical changes and methods, which in six months would appear to be old in the history of a business which was so new and making such tremendous strides, as make it exceedingly difficult to maintain the expenditure on capital account within the original limit of corporations.

But these changes are not confined to electricity, but extend quite as much into the domains of mechanical sciences generally. Probably no commercial enterprise has so stimulated the inventors of steam apparatus as has electricity. Indeed, it has brought out a new order of things entirely in this respect.

The high speed engine, working under high pressure and with great expansion, yet with a precision and uniformity of motion which reduces variations in speed to one-quarter—yea, one-tenth—per cent. is a creation sprung from the demand of electrical machinery. So is the sensitive and quick acting governor, by the aid of which only, this almost perfect performance of the engine is made practicable. So are also the perforated belts, which clasp the spinning pulleys without slip and without cushion. The clutches, which with unfailing hold grasp the rapidly revolving shafts, or release them without a jar or grinding, are, so to speak, creations of electricity.

So also the wrought rimmed pulleys traveling with immunity at a rate at which their old fashioned cast iron predecessors would invariably collapse, perchance dealing death and destruction.

Who would, twelve years ago, have thought it practicable to place ponderous steam boilers with their glowing furnaces on the sixth floor of a building, six solid stories full of steam generators, small and compact in the space they occupy, gigantic in the power they send forth. It has been electrical progress which lifted these boilers to their exalted location in the very heart of our large cities, where every square foot of space is valued in dollars, and room for a steam plant represents a large fortune. To assist in creating light was the original object of these boilers; later they have also been called upon to deliver heat and to supply power for the many industries which best thrive close to the thronged thoroughfares of trade and commerce. It was the wants of electricity which reconstructed the steam boiler, so that now a 500 horse power boiler need occupy no more space than 100 horse power used to cover.

And how many barrels upon barrels of lubricating oil have not been saved by the improvements which electric light works made necessary in bearings and journal boxes? In short there is no article used in transmission of power, no part of the modern steam plant, which has not been more or less modified to meet the need of greater speed, greater uniformity and absolute reliability, unconditionally demanded by the introduction of electric light.

But nobody must imagine that all these improvements came without a struggle and without losses, caused by failure of plant. Such losses are expensive lessons, so expensive that in themselves they form almost a complete explanation of the fact that electric lighting up to the present time has failed to be a general financial success. Nowhere else could be found a more striking illustration of the old proverb, that "Necessity is the mother of invention." Thus invention—and perhaps not all unqualified successes—have been made at so rapid a rate that a piece of machinery becomes antiquated before its very newness has worn off.

"Knowledge is power," but when dealing with electricity we yet meddle with a giant whom we do not thoroughly know, whose strength, temper and capabilities we can hardly more than guess at. Increased knowledge will make the giant our docile servant, and teach us how hereafter to wrest a profit.

Looking back upon the past, it is easy enough to account for the difficulties, obstacles and want of profit in many establishments, but if there is one thing more than another that has made the progress towards profit a difficult one, it is the mistaken apprehension of the public that electricity can be got for nothing. There is something so mysterious and occult something so magical about electricity, that the impression has got abroad that it is only necessary to press the button, and with the least exercise of skill, labor or expenditure, the miracle is produced. The attempt to compete with poor gas, at a low price, with infinitely less illuminative power was, of course, a necessity. But the public estimation of electricity has never yet reached the standard which it should have done. The slow introduction of the current into private houses is perhaps the best illustration of this condition. Even to-day, in some cities, it is thought that the arc light can be had for fifteen cents a night and the incandescent light for a mere song. Fifteen dollars a year is slightly over a quarter of a cent an hour, yet for this, for ten to twelve hours, a beautiful bulb of incandescence is expected at every street corner and in every remote suburb for almost less than it would cost to burn a wax candle.

The public estimation of the cost of electric lighting has been allowed to prevail to an extent destructive of profit. There has been an hallucination prevalent that there was something miraculous about the production of electricity. The cost of coal, labor and machinery has not entered into the calculation of either the ordinary city official or the private customer. The expectation that something could be produced for nothing, which inheres in the human mind as to the possibility of invention, has attached itself to electricity more than to any other element in the supply of human wants. The consequence is that in making new contracts, even to-day, there is the strongest disposition to get the prices down, not to what the article can be produced and paid for, but for the least possible amount, irrespective of profit and equally irrespective of efficiency. There is a true and false economy, and that is the falsest kind of economy that expects a public service at less than its cost and output and profit.

Having in the process of time developed a large demand for light, evidences of which are seen on every hand; having at the same time gone through a most unusual experience in not only creating that demand, but in the production of the article for its supply, a review is in order as to the present position of electrical securities and the prospect of profit. It may as well be admitted that there has been a serious and costly struggle, and that, taken as a whole, the result in the shape of a total profit on the total investment in electric lighting is not to be seen in the shape of dividends. There are, however, happily, exceptions to this general statement, and in the returns sent to me from all parts of the country, there are a considerable number of companies whose career has shown that in electric lighting there resides the potentialities of a profit equal to that of any legitimate enterprise. The successful companies illustrate what it is possible to do, and though they may not be numerous in comparison with others whose record for profit is small or who report a loss, yet that money can be made continuously and rapidly out of electric lighting is clearly demonstrated. In order to cite an example of steady growth in revenue, and also to show the corresponding ratio of expense, I append the figures for seven years from one of the most successful companies in the East, whose management has been characterized by the highest ability, and whose location and name it would hardly be proper to disclose. The figures are authentic, and show a record of which any man might be proud:

Earnings of an Electric Light Company.

For 1885—Receipts	$30,768.70
Expenses	24,901.54
Net earnings	$5,837.16
For 1886—Receipts	$47,613.76
Expenses	24,700.83
Net earnings	$12 912.93
For 1887—Receipts	$57,750.71
Expenses	34,691.85
Net earnings	$23.058.86
For 1888—Receipts	$75,734.14
Expenses	46,235.83
Net earnings	$29,498 31
For 1889—Receipts	$135,254.08
Expenses	94,178.69
Net earnings	$41,075.39
For 1890—Receipts	$199,195.72
Expenses	150,195.48
Net earnings	$49,0 0.24
For 1891—Receipts	$247,679.88
Expenses	187,092.77
Net earnings	$60,587.11

The company commenced to pay dividends January 1, 1887, at the rate of 8 per cent., payable in quarterly dividends of 2 per cent., and has continued the same up to date.

Before closing the book, December 31, 1891, we charged off from the earnings of 1891, for depreciation, $10,000 from the steam plant, and $30,000 from the electric plant. On January 1, 1892, capital stock $800,000; surplus, $90,000.

The above figures speak for themselves, and in the progress shown in receipts and profits there is contained a hopeful sign for many another company whose career up to this time has yielded an inadequate return. Indeed, to present a totally different picture, here is an extract from the letter of an esteemed western friend that shows the ruins of a senseless competive struggle and the folly of low prices:

"I am the president and manager of five electric light companies in this city, but three of which have actually survived financial pressure and bankruptcy.

One of these three, with a capital of $150,000, fell behind nearly $100,000 in seven years, and last year, the stockholders voluntarily came up with the assessment of $60,000 to save it from bankruptcy. Another working under the strictest economy, is barely able to meet operating expenses. Still the other, a foundling of the Gas Company, is, under exceptionally favorable conditions, and paying no salary to its executive officer, making a little money; after 18 months operation, it last month declared a dividend of 3 per cent."

With such an experience it is no wonder that the gentleman writes as follows:

"I am aware that books can be kept so as to show an earning, but this is in many cases at the expense of a constantly depreciating capital investment.

"As a matter of course profitableness of any undertaking depends upon the price obtained. In my judgment electric light projectors are themselves to blame for loss of profit through false representations as to the economy of operation. If the truth had been told, and contracts refused except upon a paying basis, the electrical business throughout the country would now be upon a much better footing.

"The promoters of electrical enterprises, and the sellers of electrical apparatus and appliances are rapidly killing the goose that lays the golden egg,' by falsely representing the great economy of operation, and consequently the great profits of such undertakings, thus falsely educating the public into the belief that anything like a reasonable price is extortionate.

"The true policy of the friends of the electrical industry should be directed to show that electrical undertakings upon the basis of the present price are not profitable, and if they expect perfect service they must pay better prices, prices that have prevailed because the companies themselves have not heretofore appreciated and understood the cost of operation, and the great loss due to accidents and rapid depreciation."

These two extremes of success and failure tell the whole story of electric lighting in the past seven years. The companies that have succeeded have done so under favorable circumstances, with a freedom from ruinous competition, exacting good prices, and above all other requisites, with good management. If there is any department in human activity where brains and tact are required to a degree greater than any other, it is in the administration of an electric lighting plant. This is evident, not only because there was great lack of expeience and knowledge of a business that was in the production of an article that was in a certain sense mysterious and unknown, but because there has been an amount of misapprehension as to its cost on the one hand and its value on the other, hardly ever experienced regarding any article of merchandise.

Some attempt has already been made to account for a misunderstanding as to the cost of electric lighting, but it is proper to allude to the folly which has prevailed in selling it for less than cost. The insane competition with each other in localities where one company was needed and more than one was ruinous is well nigh passed, but there remains the competition with gas companies and the effort is made to constantly lower the standard of electricity to that of gas. It was perhaps essential that in the early history of the effort to use electricity as an illuminant, it was necessary to get down to the standard of the fumes of coal, and in order to show the superiority of one over the other, to yield for a time in the matter of profit. But so rapid has been the growth in the use of electricity, so immeasurably superior is the current to the fume, in health, in brilliancy, in beauty and attractiveness, that the time seems near when electricity can claim the rightful place, and demand the price just so much higher as it is an illuminant just so much better. It took sixty years to introduce gas and make it a reliable servant of man. Its early history shows losses quite in proportion to those in electricity, while its later progress shows that long ago it reached its limit of illumination, its possibility of modern profit, its constancy of danger, and its maximum of unhealthfulness. It has remained for electricity to show in every new edifice, in every modern place of public resort, in almost every commercial center, in banks and hotels, as well as in thousands of miles of street lighting, how immeasurably superior is the electric globe of light to the meager and inefficient gas burner. With this achieved, and a general verdict in the public mind as to the superiority of one over the other, is it not time to break away from a similarity of price as we have broken away from a similarity of production. An advance in price commensurate with the superiority in the article produced would add largely to the earning power of electric lighting companies, and it is time it was contemplated and acted upon.

One misfortune has been in electric lighting that a large investment has been available for only a small portion of the time. All day long, when other works by rental or by active employment were earning money, electric light plants have been compelled to stand idle. Even gas companies spend the whole day making gas, accumulating it in their reservoirs for distribution during the night. Electric light plants, however, are compelled to manufacture and distribute at one and the same time. A change, however, impends, in which these costly plants and lines of copper can be used every hour in the twenty-four. The development of the facility for the transmission of electricity for power has, however, within the last two years made rapid progress. The introduction into the smallest manufactories of the current to be used constantly or intermittently has, in many localities, become very general. Already in the correspondence sent to me there are quite a few indications illustrating how advantageously the electric light plants can be used during the day for the purpose of power. In cities where manufacturing is going forward, there are hundreds of establishments in which the power required can be furnished from a central station. In the working of sewing machines, both in large establishments and private houses, in the running of small lathes, hoisting machinery, elevators and even large trip hammers, in the circulating of air in sick chambers, in even rocking the cradle, the usefulness of electricity is becoming apparent, so that a new era opens for the usefulness of the plant, poles, wire and franchise during the day.

whole electrical communities is watching with interest the possibility of the development in this city of Buffalo electrical transmission arising out of the successful effort which is now being made to harness the power hitherto latent in the Niagara river. The boldness of the proposal, the extent and character of the enterprise which is now nearing completion in this effort, the pluck and push in the work, challenge alike the attention of the engineering and commercial world. The relation of this enormous power of nature to the transmission of electricity is the most important consideration which now occupies the thoughts of those most interested. The success which has attended the 3 phase current from Lauffen to Frankfort in the transmission of power 112 miles, without material loss, comes just at the right moment to make it seem possible that the enormous potentialities in the forces of Niagara can be made to reach a degree of usefulness never dreamed of in the past and hardly realized in the wonderful present. It seems fortunate, therefore, that the convention which is here assembled should, as it were, be in the presence of the most stupendous event possible in the history of the science of electricity. In the development of the next few years will be found ample food for thought and effort, out of which may grow a relief for electric lighting plants of the greatest possible consequence. If in the city of Buffalo and from the Niagara river there can be transmitted power in such enormous proportions as are now contemplated, subdivided and reduced, so that into every factory and almost into every house, the force and energy can be controlled and operated, there is latent in every central station the possibilities that may come to every town in the country and to all the electric light plants now lying idle during the day, an imitation in modified form of the power that, of all forces in the world, Niagara is the best example.

The remarkable success which has attended the introduction of electricity into traction should in a large degree be attributed to electric lighting experience. It is clear that much of the perfection in machinery, both electrical and steam, which enables electric roads to start off on a career of abundant success, would have been impossible had not the field been already explored by the light organizations. Hence it is natural there should follow in many localities a union between the two interests, that of electric railways and electric lighting, and in this prospect there is a hope for the future of promise and profit. In the reconstruction of central stations, therefore, the wants of street lines of travel as well as of street lines of light are to be contemplated, making existing properties often more valuable, and bringing into constant use all the facilities, permanent fixtures, fixed charges, expense of administration, and other expenditures now directly chargeable only to electric lighting. The construction of electric railways into new localities hitherto inaccessible, and the profit possible by the enhancement of value in real estate is a tempting field for the electric light proprietor. The advantages of affording along these new lines a supply of power into every house, equally with a supply of light, begets an attractiveness for these new neighborhoods thus created second only to the advantage which is imparted by the rapidity, the cleanliness, the frequency and economy of the electric railway systems now so universally approved.

The momentous revolution in values as the result of highly improved means of street communication by the aid of electricity is one of the economic features of the hour. In no department of business activity within the past three years, has there greater profit been made, has there greater good been done. The growth of wealth in numerous cities, of which Boston is one of the best examples, has been very great from this means, while communities have been knit together, the outlying and inaccessible parts brought within easy hail, and solidity, strength, and rapidity of movement made possible, with all that follows in its train. It is not alone money that is thus made, not alone an enhancement of values, nor is it by mercenary considerations all these benefits should be judged. It is in quickened social life, in intellectual activity, in all that makes this people great and forceful in civilization, that results from such uses of electricity. It is in the creation of homes in the outlying suburbs, the facility of getting away from the workshop and tenement house, and the creation of new hopes and new aspirations for women and children, hitherto huddled and crowded into close and unhealthy city quarters that have followed the electric railway expansion, so successful in the past few years. You remember the German ballad, where the traveler crossing the stream near his native town after a long absence says:

"Take, O Boatman, thrice thy fee;
Take, I give it willingly,
For, invisible to thee,
Spirits twain have crossed with me."

In estimating the profit and loss of electricity, and especially in recalling all the experimentalization in the electric lighting field, the success thus achieved in other and better senses than material gain must be estimated at its full value.

The success which has in so brief a period attended the application of electricity to traction, and the enormous numbers now moved throughout the country by electric roads, makes it reasonably sure that before very long steam roads in crowded localities will be worked by electrical energy. Already the great Illinois Central having so large a portion of its tracks in the city of Chicago, has in contemplation this marked change. The Wisconsin Central is also favorably considering it. Possibly it is a little too soon to anticipate this change, but that it is coming there can be no question.

In New York city, in Boston, in Brooklyn, and in such suburbs as Staten Island, there is no reason why electricity should not be substituted for steam. Steam locomotives, built to carry their coal about and to employ an engineer and fireman for each five hundred horse power generated, cannot compete with the great compound, condensing stationary engine, whose forceful power can be extended by a delicate wire distances of twenty-five miles and under.

It is only a question of time when numerous roads having a limited or circumscribed area will consider the propriety of changing from steam to electricity, and, with that in view, electric lighting plants now being constructed, should contemplate a sufficient enlargement so as to be able to sell power to near-by steam roads. It would indeed be a revolution of enormous proportions if, from these central stations, a force sufficient could be furnished for operating suburban roads whether steam or electrical.

In this connection it is impossible to contemplate the extensions of the lighting and railway systems dependent on electricity without alluding to the consolidation now in progress between the two great organizations that, more than all others, have promoted these most important interests. After a somewhat careful study of the question of competition, of consolidation and the establishment of a strong and well managed single concern, compared with weak and numerous rival undertakings, my deliberate conviction is that all the dangers of monopoly, all the possibly increased charges for supplies and other fancied ills, are as nothing compared with the waste of unbridled competition. In the consolidation of the Edison and Thomson-Houston companies a new and important era opens for all interests concerned in electricity, and with such experience, such skill, such business sagacity and such inventive faculty as has been developed within these companies, now that they are united in one, nothing but good can result, not only to the companies themselves, but to the electrical community at large.

A survey of the electrial business world is full of the deepest interest. This new and mysterious force has achieved more for the advancement of the country than almost any other, in the provision of the means of instantaneous communication, its usefulness to railways, in its lighting remote localities, and in its adaptation for traction and street railways. More money has been made out of its introduction than in almost any other department of human activity.

In the telegraph business a larger capitalization exists, in proportion to the cost of the material, with a capacity to earn a dividend upon the amount, than in any other department; while in the telephone, and and more recently in the electrial railways, the amount realized is in excess of that from any other investment. It is true that in electric lighting a universal success has not been achieved, but beyond all question a great and useful purpose is being served in the creation of light, for which a profitable and steady demand exists, and which can be supplied through the experience and the improvements attained, as the result of the operations thus far.

The future is full of promise for these undertakings, especially in the value of the franchises, the ability to furnish power, in their combination with the gas industries of the country, which must only be a question of time, and in their ability to promote and to assist in the application of electricity to street railway enterprises. The whole subject of electricity, as applied to business, is full of the deepest interest, and no one who feels grateful for having been born in this age, and enjoying all the advantages of the most advanced civilization, can fail to recognize in this wonderful force the advantageous contributions toward the good of mankind, and hold in high estimation the men who in so short a period have so rapidly promoted its introduction and high degree of usefulness.

Thursday's Proceedings.

Vice-President Francisco called the meeting to order at 10:20 A. M.

The first business was the reading of the paper on "Franchises for Quasi-public Corporations," by Allen B. Foote, an abstract of which is herewith presented:

Muncipal Franchises for Quasi-public Corporations.

BY ALLEN R. FOOTE.

I believe that an American economic system is as necessary to American industrial independence as was, or is, an American political system to American political independence. The particular feature of foreign economic systems to which objection may be incidentally made in this paper is state or muncipal ownership of industries. Those who advocate such a policy in this country are wrongly educated foreign socialists and college professors who have been educated abroad.

It is fortunate for you and myself that we have heard from Erastus Wiman on the subject of "Electric Lighting from a Financial Standpoint." He has been able to show why the stocks and bonds of electric lighting companies are worthy of being a preferred investment by the ablest financiers. I can tell you at once why they are not. It is because

there is a flaw in the title deed under which they are doing business. A recent editorial in the *New York Herald*, referring to "Saving Banks Investments," says: "There can be no question that the scope of securities in which savings banks may invest their funds should be enlarged if it can be done with safety."

Will the enlarged list of securities include the stocks and bonds of corporations whose plants and business are at the mercy of vandals? Every stroke of the axe that felled the poles in the streets of New York city was a blow at the prosperity of the city and state, a direct crippling of the interests of wage-workers. Had there been no flaw in the title deeds under which those companies were doing business, their stocks and bonds would have been good securities for the investments of savings banks. If savings banks had been investors in their stocks and bonds, how many poles would have been chopped down? None. New York city would have been spared that exhibition of barbarism.

The production, transmission, subdivision and cost of mechanical power determines the number of persons who can use such power with a profit. The number of persons such users of power are able to employ with a profit determines the number who can enjoy the rate of wages the utilization of mechanical power enables such employers to pay. Cost of power is the determining factor. The lower this cost, the better the opportunity for making a profit. The more certain a profit becomes, the greater will be the number of persons employed. The larger the number of persons employed, the smaller will be the number of the unemployed. The smaller the number of unemployed, the better will be the wages of the employed, and the smaller the tax on the employed for the support of the unemployed, the greater will be the profit of labor. The greater the profit of labor, the greater is the prosperity of individuals, municipalities, states and nations. While every person has a vital interest in the settlement of questions affecting industrial prosperity properly to secure the greatest economic advantage, those most interested are the wage-workers and the unemployed.

The municipal needs with which we may now deal are the production, transmission and subdivision for use, of a supply of good water, gas and electricity for the production of light, heat and power, the electrical transmission of intelligence and the transportation of persons and property. Properly to supply these needs, it is necessary to create quasi-public corporations, and grant to them franchises giving them the right to construct, maintain and operate the necessary works, and to construct, maintain and operate through the streets and alleys, the necessary street and service connections to enable the service to be supplied to every building in the municipality.

A means of producing light, heat and power for public and private use, distributed from a central station, is a perpetual municipal need. The best interests of its users demand that such means shall be abundant, wholesome, reliable and safe, and that it shall be furnished at the lowest possible price. A means for the electrical transmission of intelligence is a perpetual municipal need. The best interests of its users demands that such means shall be quick, accurate, reliable and safe, and that it shall be furnished at the lowest possible price. A means of inter-municipal transportation for persons and property is a perpetual municipal need. The best interests of its users demand that such means shall be rapid, reliable and safe, and that it shall be furnished at the lowest possible price.

That these requirements may be properly satisfied, true economic conditions demand:

First—That a corporation organized to supply a perpetual municipal need shall have the exclusive right to perform the service perpetually.

Second—That the service shall always be supplied by the best methods known to science that are made commercially available by the best practices known to the art.

Third—That all accounts shall be honestly and correctly kept; that economic thrift be insisted upon in every department, and that charges be so fixed from time to time by a competent and disinterested tribunal, as to yield a revenue sufficient to pay all fixed charges, expenses of administration, operation and maintenance, and a reasonable per cent. dividend annually upon the investment.

A comparison of these economic conditions with the conditions fixed by the law on this subject in all states will quickly show how blindly the blind have been led in efforts to secure the greatest good for the users of the services supplied by municipal franchise corporations. Had laws governing the organization, management and control of municipal franchise corporations been enacted in accordance with the requirements of true economic conditions, instead of in compliance with the dictates of an unintelligent self-interest or prejudice, how great the change in their wording and meaning would be. There would have been no reference to a particular source, force or instrument, such as gas, telegraphs, telephones, electricity or horses. The character of the need to be supplied, not the character of the method of supplying it, would have petermined the designation of the work to be done. The soverign law of labor and property would have protected the right to work.

What would be thought of persons who would undertake to secure improvements for a city in the form of buildings of the largest dimensions, employing the most durable material and the best style of architecture, by offering a title to real estate on which the buildings were to stand that did not guarantee exclusive possession and perpetual tenure? The moral and economic sense of the community would be shocked by such a proposal. Yet there are persons in every community who will contend that works costing more than the best buildings in the city which, if operated under true economic conditions, will enevitably enhance the value of all municipal real estate more surely than any other factor of modern civilization shall have no better title than the one indicated. Where are the prosperous cities that are built on land that is not controlled by an exclusive and perpetual franchise—the right of possession? Where such rights are granted there will be found the best structures demanded by the use for which they are intended. The best works, while costing much more than the cheapest, are less expensive to maintain and operate, their service is more reliable and safer. The law that prohibits the best title prohibits the best works and entails a perpetual loss of efficiency upon the users of municipal services.

How supremely ludicious a city council would appear that should vote that a street railroad company might use horses to draw its cars but should not use the best horses it could buy. How strange it would seem if a state legislature should enact a law that a company might generate and distribute gas for the purpose of light, heat and power, but that it should not adopt the best gas-making methods. How incredible it would be to expect a city to vote that a company might supply it with water from a pond filled by a surface drainage only, but that it should not open an exhaustive vein of pure water by drilling an artesian well. How unintelligent would be the action of a government that would grant the privilege of sending telegraph messages from point to point but forbid sending telephonic messages. These things are all as consistent as laws providing for the supplying of municipal needs by mentioning the methods to be used and thus limiting municipal franchise corporations to the use of the methods named, instead of requiring them to adopt the best known methods at the time of incorporation or that may thereafter become known. How strange it appears in the light of the requirements of true economic science that municipalities have supposed they could obtain a supply for a perpetual need, requiring expensive plants, conductors through all streets, service connections to make the supply available in every building, and have the service wholesome, reliable, safe, and rendered at the lowest possible price, in the way in which they have undertaken to secure these advantages.

They have limited the right to do business to a comparatively short term of years. They have allowed others to build, as it were, on the same piece of real estate. They have limited the methods to be used so that, when the discoveries of science and invention have made better methods available, existing corporations could not use them, thus compelling the organization of other corporations and a duplication of plants. They have created unnecessary uncertainties by limiting the contract for public service at a fixed price to one, five, or ten years, instead of making the contract perpetual and the price adjustable so that it shall always bear a fixed relation to the cost of production. They have taxed the supply that aids their industry, ministers to their comfort, and increases the value of their property. They have failed to discover that the right and facility with which municipal franchise corporations can change their methods, in order that they may keep abreast with the best known conditions of the times, render their administration flexible and their service desirable, just as the right and facility with which a people can change their legal enactments enable them to keep abreast with the best known conditions and render their government flexible and stable. They have not seen that franchises granted as indicated require no change to make them applicable to any possible condition or change the source or method of supply, that they will forever prohibit the arresting of reductions in the price of the service through the duplication of plants, under the pretext of bringing into use some important discovery, or to secure the benefits of competition under the mistaken impression that competition can permanently improve or cheapen a service which requires to be handled as a unit.

A perfect franchise is the exact equivalent to a perfect title to real estate. It conforms fully with the conditions that give economic value to all property. It is in accord with ethical and economic laws that proclaim and establish the dignity and freedom of labor. It conveys and guarantees unrestricted, exclusive and perpetual possession, subject to such use and control as shall best serve the public welfare.

A condition of vital importance to wage-workers, in the discussion of a question of this kind, that cannot be urged upon their attention with too much force, is the fact that every time an industry is removed by legislative enactment from the list of self-producing industries and placed in the list of non-profit producing industries operated under government ownership, an avenue to industrial independence is closed. Profit-producing industries are avenues to industrial independence and economic freedom for all who are engaged in them. For the wage-workers, more than any others, the self-interest of the individual, the moral interest of society, the group interest of the municipality, state and nation, demand that all avenues to industrial independence and economic freedom shall be kept open.

DISCUSSION.

JUDGE ARMSTRONG: We have had this question discussed in our meetings before; and we know that there are so many elements entering into the question of [illegible] that [illegible] cannot be done [illegible]. When we can [illegible] this question from [illegible] point [illegible] have no difficulty in [illegible] franchises, so that they [illegible] perpetual.

C. E. SCOTT: The tendency of [illegible] has been steadily toward [illegible] when granting charters to electric lighting companies. This has certainly been the case in my own state. If electric light companies [illegible] customers the best article obtainable at a reasonable price they will be able to go right on. There will be no danger of anybody else coming in, for there is not enough margin of profit in it.

The paper by Richard Hammond, "How to Fire a Steam Boiler," was next read.

HOW TO FIRE A BOILER.

BY R. HAMMOND.

It has been said that "the waste of fuel due to improper firing is often of more consequence than any other loss which is produced in the operation of a steam plant," but in a great many cases the waste of fuel cannot be entirely charged to improper firing, as there are other causes by which a waste of the evaporating power of the fuel is produced. The principal of these are:

First, the improper construction of the boiler in relation to grate surface, tube area, heating surface and combustion chambers; unless these proportions are properly worked out, it matters little whether the firing be done by mechanical means or by the more intelligent fireman, waste of fuel must necessarily follow.

A great many contrivances have been placed on the market, such as mechanical strokers, and other means by which coal and air can be supplied to the furnaces of steam boilers for the purpose of obtaining good combustion without producing a waste of heat by allowing too much air to pass above the grates, or an insufficient supply below the grates; by this statement I do not mean that any particular method of firing will produce any more heat from a pound of coal than nature put into it; just as good results can be obtained from hand firing as have been obtained by the best mechanical means.

It is often the case that firemen are paid insufficient wages for the work they are expected to do. We should be as particular to have good firemen in charge of our boilers as we are in having good engineers in charge of our engines; a good fireman should be just as capable of manipulating the furnace of his boiler so that his steam recorder and his coal and water records will show just as good cards as the engineer can show in the manipulation of the steam he uses in his engine. If we paid the same attention to all the details of the construction and setting of our boilers and their economical use of fuel as we do to our engines our steam plants would be far more economical. Everything is "shined up" about the engine; engineers go into all the details of its construction and management, and the greatest care is taken in the figuring out of its proportions so that it will have the very highest possible initial steam pressure and temperature, and the very lowest possible terminal temperature and pressure: all endeavoring to get the greatest horse power from the pound of coal, this securing the greatest economy—these very same highly educated individuals who designed these engines, forget that all the power comes from the pound of coal, and pay little attention to how that power is transmitted from the coal pile to the engine. It is just as essential to good economy that the boilers should have the very highest initial or furnace temperature, and the highest possible steam pressure, and the lowest possible chimney temperature, as it is for the engine to be economical under similar conditions of high initial pressure and temperature and low terminal temperature.

Experiment has proved that bituminous coal requires 150 cubic feet of air per pound of coal for good combustion; an excess of air results in a waste of heat which it carries into the flues and chimney, and often a greater loss in an insufficient supply to produce good combustion.

In my experience for steam plant boilers carrying 80 to 160 lbs of steam, I find that at least 20 lbs. of bituminous coal should be burned per square foot of grate per hour, and the air spaces of the grates should not be less than 50 per cent. of the grate area, and the draught pressure not less than ½ inch of water; if the grate surface is so large that only 10 lbs. of coal is consumed, it would be more economical to reduce the grate surface and burn not less than 20 lbs. with good draft, thus securing a good combustion. The same weight of coal burned on a large grate would not be as economical on account of the low temperature; the temperature of the furnace should not be less than 3,500 degrees, and the ratio of the draft area through the tubes or flues should not be less than 1-6 nor more than ¼ of the grate surface, and the proportion of heat surface to grate surface should be at least as 35 to 1.

Under the conditions just stated boilers should be fired very economically whether done by mechanical means or by hand. I have noticed in firing marine boilers on the great lakes that the firemen spread their coal evenly over the entire grate at each firing, and they produce steam very economically, while firemen on coastwise steamers will pile up the coal just inside the furnace door, and as it becomes coked will rake it back over the incandescent fire and grate with equally as good but no better results in the way of economy than obtained by the lake firemen; both of these ways of firing are equally good, but in all cases the grate bars should be entirely covered, and the amount of air required above the grate should be admitted from above instead of below the grate.

Different grades of bituminous coal require different methods of firing, and by a little experiment the experienced fireman soon finds out and adopts the best method of firing, and in all cases he should keep his flues and tubes clear of ashes and soot, as well as his fires and grate bars

In firing anthracite coal, the coal must be spread evenly over the grate in all cases, and like bituminous coal must be burned at a high temperature with good draft.

The steam users should see to it that all parts of their boilers and settings should be of equally good proportions for strength and economy as their engines; employ good intelligent firemen as well as engineers, and see that both produce good indicator cards. By a little attention in this direction steam users will themselves soon become experienced firemen and engineers, and can readily tell whether the firemen and engineers are doing their duty.

D. ASHWORTH: The point that is touched upon there impresses me with the fact, in which I think you will all agree, that we have for a long time drifted into the idea that anyone is capable of being a fireman. If there is any position connected with the engineering department that requires a fair degree of intelligence, it is that in the fire room. I am well acquainted with the fact, and you are, that we are more apt to soar aloft into intricate problems and shout for the beautiful results of fine workings in electric problems, and pass by these supposed unimportant factors.

J. B. EDSON: Engines have been shoved ahead and improved by the introduction of electricity, which has demanded a higher class of engines. Refinements that were thought impossible, and not looked for before, have been introduced; and engines have been supplied to meet all the requirements, and the economy of the engine has been taken care of; but when we start at the coal pile and work up to the engine, we find the matter neglected. The uniformity of firing is an portant matter, as also uniformity of feed water, cleanliness of the fire; the grading of all the operations according to the kind of fuel and the draught and the steam to be generated. The engineer should master all these points, and then hand them down to the consideration of the fireman—who may be only brute, brawn and muscle, but who is capableof earning a little more money, and saving much to the owners.

S. A. SEELEY: I think we have had more trouble in the electric light business with engineers and firemen than the mechanical lines have.

MR. COGGSHALL: I would like to ask Mr. Hammond with what depth of fuel upon his grate bars he gets the best results, using either anthracite or soft coal?

MR. HAMMOND: About six inches in either case.

E. F. PECK: I have had considerable experience in this matter. We were paying $1.75 a day to our firemen, and we expected them to work twelve hours a day, every day in the year, without vacation. We now pay them $2.25 a day, and give them a week's vacation in the summer. In looking over our records I find that where we were using 2.75 lbs. of coal per hour per lamp, we are now using 2.51 lbs. I do not know whether it is due to improved firing, or whether we have got to a more economic point with our engines. I believe, however, that the additional wages has brought about this result.

WORLD'S CONGRESS INDORSED.

MR. Armstrong offered the following resolution:

Resolved, That the national Electric Light association cordially indorses the plan of holding world's congresses at the Columbian Exposition, and pledges its hearty co-operation to make the Electrical Congress under such auspices a success.

The resolution was adopted.

The next business was the paper of E. F. Peck on "Overhead Construction" which is presented herewith:

OVERHEAD CONSTRUCTION.

BY E. F. PECK.

In view of the great interest taken at present in underground construction, it would seem almost incongruous to agitate the well-worn subject of overhead construction. Still, as the majority of electric lighting companies in this country will have to contend with this method of construction for some years to come, it my be that the subject will still be debatable. There is certainly room for improvement in this direction in many of our cities and towns, due, perhaps, to the fact that it has been the practice of electric lighting companies to cheapen as much as possible this important branch of their work. Then the material which has been supplied in the past has not been of such a character as to permit first-class work and, rather than stand the expense and loss of time incident to the manufacture of fixtures, a great many of the companies have used fittings that were originally intended for the much lighter work of telegraph and telephone companies. The work was also done with a view to the present only; and the rapid increase of business has overtaxed the poles and fixtures, which had originally sufficient carrying capacity. It may readily be seen that this has led to the erection of overhead lines that have, after a year or two of service, become dilapidated, unsightly and dangerous. Then patching was in order, which soon resulted in a tangle and snarl that grated upon the nerves and tried the patience of the central station manager, or superintendent, whenever he had to contend with it. This, briefly speaking, has been the history of the company with which I am connected, and is, no doubt, the history of many of the companies represented at this convention.

How can this state of affars be remedied? In order to answer this question as briefly as possible, and, at the same time, to bring out a discussion that will, I trust, prove both interesting and instructive, I will outline some recent work that has been done under my supervision in Brooklyn.

We had reached that point where further patching was out of the question, and reconstruction became a necessity. The first point of attack was our switch-board. This was the old style plug, socket and cable board, with wooden framework, originally designed for 36 circuits and 36 dynamos, but now, due to the increase of our business, handling 53 circuits and 42 dynamos. I will not dwell long on this subject, as I understand that an exhaustive treatise on switch-boards has been prepared by one of our members.

The switch-board that I have planned is arranged to manipulate 80 circuits and 66 dynamos, divided into three units, which I will describe as sections A, B and C—circuits and dynamos in each section being interchangeable—section A to provide for 32 circuits and 22 dynamos, and sections B and C each providing for 24 circuits and 22 dynamos. Each section consists of two rectangular slate slabs, placed five inches apart, supported on a suitable framework of steel I beams and channel bars, occupying three sides of a square. Into these slabs are fitted rows of metal bushings, which are properly connected together by copper strips, so that the horizontal rows of bushings on the front board are connected to the dynamos *via* single throw jack-knife safety switches, while the vertical rows on rear board are connected to the circuits and also to an extra row of bushings on the bottom of front board. This extra row is used to connect two or more circuits together by means of cables and plugs, the connecting of dynamos to circuits being done by means of an ordinary plug of brass tubing, provided with an insulated handle. Above the switch-board proper, which stands about five feet high, slate slabs extend to the ceiling of the room in which the board is located, providing space for necessary lightning arresters, combined ammeters and polarity indicators to be used on each circuit.

The next improvement which became necessary was the building of a suitable wire tower. The wire tower of a central station is an unknown quantity and a problem that is hard to solve. The first question is as to its shape. Shall it be rectangular, octangular or circular? This can only be answered by one having a thorough knowledge of the situation of the station and the directions which the circuits are to take after leaving the same.

While at Montreal I saw a very pretty arrangement of a wire tower on the new station of the Royal Electric company. It was octangular in shape, each side being about ten feet wide, with a rectangular section of slate framed into each section. This permitted the introduction and insulation of wires without other precautions, and, owing to the shape of the tower, provided for a lead for the circuits in eight directions. In our Brooklyn station, it is necessary to have the wires leave the tower in one direction only, so it was built rectangular in shape. The tower is built directly over the switch-board and is 23 feet long and 10 feet wide. The framework of the tower, inside wire rack and outside wire rack, are all framed and bolted together, and guyed to the roof in the rear of the tower by means of wrought iron rods, provided with turn-buckles. The front, or side through which the wires enter, is made up of two thicknesses of two-inch plank laid diagonally to each other and fastened together with wooden pins. This was done to insure sufficient strength without framing and to permit the promiscuous boring for glass bushings. The inside finish of the tower is of hard oil varnish, and the outside of three coats of insulating and fireproof paint. The roof is of slate, the eaves of which extend over the outside rack, thus, to a certain extent, sheltering it from the weather. At the bottom of the inside rack of the tower is an auxiliary slate switch-board of very simple construction, consisting of two rows of metallic bushings and binding posts. By use of plugs and cables on this board the tangles and cross-connections incidental to all central stations are confined to this particular point. This arrangement also permits the transferring of circuits to any one of the sections of the main switch-board, thus adding to the flexibility of the entire system. From the outside rack, the wires are carried to a distributing pole of Norway pine set directly opposite the center of the tower. This pole is 92 feet long, 30 inches in diameter at the butt, 18 inches in diameter at the top, and is set 12 feet in the ground to insure stability. This height was necessary to allow the wires to clear a three story building to be erected in front of the wire tower. On this pole are fitted 11 double sets of eight pin arms, and 11 double sets of 16 pin arms, a total of 44 arms, providing for 176 wires, or 88 circuits. The 16 pin arms are set parallel to the arms on the tower rack, and the eight pin arms are at right angles to same, to enable wires to run north and south. These arms are of the best quality of long grained oak of the following dimensions: Eight pin arms are eight feet long, three and three-quarter inches by four and one-half inches, pins nine inches between centers, excepting pins nearest middle of arm, which are three feet between centers, to allow a man to pass between wires when ascending the pole. Sixteen pin arms are ten feet six inches long, four inches by five inches, with pins six inches between centers. The pins used on these arms are of selected locust, one and one-half inches in diameter, and the glass insulators are of the deep grooved, double petticoat pattern.

From this point, the poles gradually decrease in length until a height of 50 feet is reached, which height is maintained on all our main lines. On lines carrying from eight to sixteen wires octagonal chestnut poles are used 35 feet long, 10 to 12 inches at butt and six to eight inches at top. Lamp poles are of the same material and shape, 24 feet long, eight inches at butt and six inches at top.

Particular attention is paid to the guying of poles where necessary; and we are using for this purpose four No. 6 B. & S. galvanized iron wires twisted together to form one strand, and introducing turn-buckles on all main guys. This wire is purchased made up in this manner, and we find it a great improvement and saving over the old method in vogue of allowing linemen to waste their time in making up guys as needed.

While on the subject of poles, I wish to call attention to what I consider an erroneous method of treating poles to preserve them, which is practiced by many companies. Pitch or tar is applied to the butt, thus confining the sap, which ferments and hastens decay.

There are many different ways of treating poles, but I know of no method which is successful unless applied to the entire pole. The well-known creosoting process is objectionable on account of the dirt and unpleasant odor connected with it, as well as the fact that the creosote does not penetrate to a sufficient depth. The same objections apply to the Burnettizing and Kyanizing processes.

My attention has recently been called to the Haskins process, which seems to be highly successful. This process consists in the placing of timber in an air-tight retort and subjecting it to the heavy pressure of superheated air, which permeates the whole section, thereby accomplishing the same result as a charring process, without losing any of the chemical properties of the wood.

In regard to the character of wood to be used for poles, the choice is limited in the vicinity of New York, those obtainable being chestnut, Norway pine, Princess pine, cedar, yellow pine, spruce and white pine. The Princess and Norway pine, although not as durable as chestnut, are the most desirable for the heavier poles, on account of their straightness and size. For lighter work, I prefer hewn or sawed chestnut poles to all others, and they are still obtainable in lengths up to 40 feet. Cedar poles are excellent as far as life is concerned, but too crooked and knotty to be useful for first-class work. My experience with yellow pine, spruce and white pine has been very discouraging, the life of each being short and uncertain.

The next step in the way of improvement which suggested itself was a better method of hanging commercial lamps. It has always been a source of surprise to me that more attention has not been paid by lighting companies to this important matter. The small additional expense necessary to ornament these fixtures certainly ought to warrant an improvement.

Last in the line of improvements came the wiring. It was only a question of rubber covered wires versus weather-proof. We compromised the matter by using the best grade of rubber covered wire for all leads from the switch-board to the main poles, and on all lines crossing under telephone or telegraph or uninsulated wires. For the balance of the reconstruction the best grade of weather-proof wire was used. It will be noticed that I have used the term "best grade" for both classes of wire. This term is a little ambiguous, as I am reminded each day by our friend, the wire salesman, who claims that his brand of wire is the best and that all other kinds are not in it. So it remains for the purchaser to judge for himself as to the respective merits of the different brands in the market.

On some of the loops to buildings, where two or more circuits were necessary, we have used, with great success, duplex cables, thus doing away with a complicated and unsightly network of wires and fixtures. All wires are run on deep grooved double petticoat insulators, the use of rubber hooks and porcelain knobs being avoided. It would be difficult to formulate rules for this branch of construction, it being simply a question of judgment and experience. However, a few suggestions may not be amiss. Great care should be used in the stringing of wire, for insulation of a whole circuit may be ruined by the carelessness of linemen in handling. Joints should be soldered on all electric light work when possible. I have found that wrapping a joint with tin foil, and then covering with a good rubber tape, makes an excellent substitute for soldering, and is easily applied. Keep wires on the same relative pins to the end of the line, thus avoiding confusion, and making it an easy task to locate trouble.

Diagrams of principal poles, showing location of circuits, should be kept in every central station, for they are often the means of preventing serious trouble. Do not leave loops up that are out of service, excepting to pick them up again, as they may become a menace to your live wires. If more attention were paid to overhead construction by the electric lighting companies, substantial, neatly painted poles being used, with well-insulated wires kept taut and thoroughly inspected, the everlasting hue and cry against the "deadly" electric light wires would soon change to one of commendation and praise.

DISCUSSION.

PROF. ELIHU THOMSON: I agree with the sentiment expressed in the paper, that were it not for the fact of the unsightly ways of overhead construction, we should hear less criticism from the public. There is no question in my mind that it is merely the apparent absence of system that gives rise to a great deal of the prejudice. I noticed during the reading of the paper that it recommended that tin foil be used instead of soldering joints. That may possibly work for arc light circuits, for the reason that although the tin foil is not to be relied upon as making the connections, it would undoubtedly act as a kind of sealing agent to keep the elements of corrosion away from bright copper.

Our desire in the past has been to get into business as soon as possible. It should now be our desire to get our business in as good trim as possible, and make it as permanent and attractive as possible. Abroad the habit is to put up light ornamental poles for the arc lamp; and some of the designs are really elegant and not expensive.

MR. SEELEY: I think there is only one way of making a joint, and that is twisting it with some kind of a sleeve. I have tried tin foil, and I find in using it the linemen are not careful with it; after it is put around the wire, in taping it, it is often abraded, which opens the seams of the foil.

MR. PECK: In regard to using tin foil on a joint, I did not mean to have it understood that I recommended its use. I simply spoke of it as one method of making a joint when it was not easy to solder.

MR. SEELEY: I wish further to state that I believe it is entirely a mistake to erect large poles. I think it has been thoroughly demonstrated in the past year by the Long Distance Telephone company that they are failures. An eighty foot pole is liable to break in heavy storms in winter and surely we are carrying more weight with a hervy

copper wire on a pole, than where a small No. 12 wire is used on telephone poles. I think the average pole should not exceed fifty feet in height.

The paper on "Operation of High-Tension Currents Underground," by E. A. Leslie, was then read:

The Operation of High Tension Currents Underground from a Physical and Financial Standpoint.

BY E. A. LESLIE.

In presenting this paper I shall endeavor to confine myself strictly to my own experience and observation, submitting only such data as I may have been personally able to collect, and leaving it to you to decide whether, it having been determined that the successful operation of high tension currents underground is physically possible, the financial aspects of the case will permit its general introduction. Wasting no time in giving a history of the legislation which has brought about an almost complete revolution from overhead poles and wires to underground conduits and cables in New York city, I shall proceed at once to facts and figures.

Conduits.

The underground conduits in New York city for high tension currents are owned by the Consolidated Telegraph and Electrical Subway company, who lease its ducts to the various electric lighting companies.

The prevailing type of duct is of iron pipe, mostly three inches in diameter, running along the sides of the streets into manholes about 275 feet apart. These are the so-called "trunk ducts." Over the trunk ducts are superimposed from two to four distributing ducts, with four-way handholes about 50 feet apart. Many of these handholes are brought to the surface of the street and are covered with an iron plate, which is easly removable, giving ready access to the wires in the distributing ducts. In many places, however, the handholes do not approach the surface, and, in order to get at the wires to make changes or connections it is necessary to dig up the street. Again, on some of the prominent streets no distributing facilities whatever have been provided and the companies are compelled to make long and expensive house connections from manholes. This is particularly true of Sixth avenue above Eighteenth street and Broadway above Thirty-fourth street.

The Subway company has also a number of miles of a system which is made up of sectional iron castings and so framed together as to combine in one conduit both trunk and distributing facilities.

These conduits have no surface handholes, and in order to make changes or connections, it is also necessary to dig up the street. The manholes are about 275 feet apart as in the case of the iron pipe.

There is also a small amount of conduit in use, which is composed simply of cement lined iron pipes running from manhole to manhole, of about three inches inside diameter.

The cost of the New York conduits is an unknown quantity. The Subway company guards the secret well, and beyond the general statement that they have cost, on an average, nearly $5,000 per mile per duct, no reliable information can be gained. In these figures, however, are doubtless included the expenses of years of legislation and long and costly litigation. It is the universal opinion among electric light men in the city that the actual average cost should have been less than $3,000 per mile of duct.

Cables.

The companies with which I am connected use, principally, cables insulated with a rubber compound, although we also have in use 35 or 40 miles of cable, the insulating material of which is fibrous. Perhaps the best description of cables I can give is to embody herewith a copy of our specifications, which, with slight modifications, are in general use by the New York companies.

SPECIFICATIONS FOR UNDERGROUND CABLE.

Wire.

No. B & S. (solid or standard) must contain no joints or splices.

Lead Coverings.

To have an alloy of from four to five per cent. tin. Thickness of lead, $\frac{3}{32}$.

Insulation.

Outside diameter, 32ds (usually $\frac{5}{32}$ to $\frac{7}{32}$ all around the conductor). Resistance of insulation without lead covering, after at least 48 hours' soaking at temperature of 75 degrees Fahrenheit, 1,500 megohms per mile.

Resistance, dry test with lead cover and without lamp connections, 1,500 megohms.

Resistance of insulation after three years' use to be up to the standard required by the Board of Electrical Control, which is not less than five megohms per mile, per 100 volts of current employed up to, for example, 3,000 volts, *i. e.*, 150 megohms.

Copper.

Conductivity of copper 98 per cent. To be medium hardness; that is to say, a mean between hard drawn and soft copper.

Diameter.

Outside diameter of cable, including lead covering, 32ds (depending upon the size of the wire).

Electrical tests of insulation to be made at factory by company's representative. If insulation is taped, outside diameter of cable to be 32ds.

Capacity.

Cable shall be capable of carrying an alternating current of —— volts and ——amperes, or continuous current, —— volts and ——amperes.

Laying and Connecting.

The cable to be laid and connected by the Electric Light company under the supervision of the manufacturers, who shall carefully supervise the work, and, after accepting the same, shall be liable under the guarantee, in the same manner and the same extent as if they (the manufacturers) had themselves laid and connected the cable.

It is usual for manufacturers to guarantee their cables for a term of three years. As the form of guarantee may also be of interest, I quote that with which I am familiar in its entirety:

Guaranty.

Whereas, The Electric Light company, a corporation duly incorporated under the laws of the state of New York, has purchased from feet of electric light cable, as called for by the annexed specifications, which are hereby made part of this guaranty.

Now, therefore, in consideration of such purchase and of other valuable considerations to us in hand paid, the receipt of which is hereby acknowledged, we,

a corporation duly incorporated under the laws of state of , do hereby guarantee and warrant the said cable to be a satisfactory practical working cable for the purposes and currents specified in the said specifications, for a period of three years from the date of its being put into use. Nothing herein contained, however, shall be deemed as a guaranty or warranty by us for any failure of said cable due to the use of the current in excess of that referred to in said specifications, or for failure due to mechanical injury from improperly drawing into the conduits, and improper connections of the said cable.

In the event the said cable or any part of it fails to meet the requirements of this guaranty or warranty during the term thereof, we hereby covenant and agree to replace the cable so failing with cable that shall meet the said requirements during the term of said guaranty or warranty, the cost of replacing said cable to be borne by us.

In the event of any failure of said cable being discovered by the said Electric Light company, we, the said shall receive prompt notice thereof, and hereby convenant and agree to forthwith investigate and test the cable so discovered to have failed; and if it shall appear that such failure was not due to the cause herein specifically excepted, then we, the said covenant and agree to bear the expense of such investigation and test, and replacing the whole or the failing portion of said cable; but otherwise, all such expense shall be borne by the Electric Light company.

Whenever such investigation and test may become necessary, said Electric Light company shall furnish unto us, the said such facilities and information as are within the control and knowledge of the said Electric Light company, relating to said cable, the circuits in which they are made up and the use thereof, together with access to manholes and terminals, so far as controlled by the said Electric Light company.

In witness whereof, etc., etc.

The cost of lead-covered cables, such as the above specification calls for, varies considerably according to the size and manufacture. Roughly speaking, however:

No. 4 cable ranges from 15 to 20 cents per foot, or, from $792 to $1,056 per mile.

No. 2, from 25 to 30 cents per foot, or, from $1,320 to $1,584 per mile.

No. 00, from 37½ to 45 cents per foot, or, from $1,980 to $2,376 per mile.

No. 0000, from 55 to 65 cents per foot, or, from $2,904 to $3,432 per mile.

In other words, underground conductors cost from four to five times as much as overhead conductors, which is a matter to be carefully borne in mind.

Laying.

The manner of laying cables is simple. It is first necessary to draw a rope through the duct to be occupied. To do this, rods about three feet in length are used, having brass male and female screw attachments, one at each end. The first rod is inserted in one end of the duct; then another is screwed into it and pushed forward, and this process is continued until the first rod emerges into the manhole at the other end and you have an unbroken line of connecting rods through the duct. A rope is then attached to the last rod, and, as the rods are pulled forward and unscrewed in the manhole at the distant end, the rope is gradually drawn through. Unless a large number are to be drawn into a single duct, they can be drawn by hand, without any special machinery. If, however, it is desirable to draw in as many, at one time, as the duct will hold, it is necessary to use a winch or windlass, or, in lieu of either, a snatchblock with a rope and tackle, and enough men to pull the mass. Great care should be observed not to allow the cables to twist in the duct, as, if this occurs, it is next to impossible to withdraw any given conductor thereafter without removing all conductors in the duct. In cutting the cables to fit given sections, about 12 feet should be allowed for slack between manholes, for racking around the sides of manholes and for metallic joints. The cost varies considerably. To draw in two cables in a duct would cost in the neighborhood of from 2½ to 3 cents per foot of cable; but to draw in four or six, or even eight, as has frequently been done, the cost diminishes and will not average over two cents per foot, or even less, assuming that the men in charge have had experience and understand their work thoroughly.

Jointing.

The proper jointing of cables is a matter of paramount importance. Unless the joints are made by an experienced person, it is almost impossible to secure a joint which will give the same insulation resistance as the cable itself, and yet, unless the joints are so made, the object of securing immensely high insulation in the cables proper is entirely defeated and a large proportion of the original investment practically wasted.

The New York Subway company on its early inception, framed a set of rules governing the operation of underground conduits. Among them is one which has always challenged my admiration and the man who framed it either built wiser than he knew, or was a remarkably gifted person. This rule at first was considered absurd and impossible of compliance, but to-day I think I am safe in saying that every electric light company governed by it will acknowledge its wisdom and admit that, by having enforced a high standard of insulation from the very outset, a large amount of subsequent experiment and waste of money has been avoided. I quote the rule:

"Section 4. Electromotive Force.—All conductors drawn into and operated in the conduits, and intended to convey currents of an electromotive force exceeding 100 volts, shall have at the temperature of 75 degrees Fahrenheit, an initial insulation resistance of not less than 15 megohms per mile per 100 volts electromotive force of current in the circuit. Whenever the insulation resistance of a conductor as aforesaid shall prove to be less than five megohms per mile, per 100 volts, the use of that conductor shall at once cease, unless the actual electromotive force in its circuit be reduced so as to re-establish the foregoing ratio."

You will observe that the initial tests of cables laid by any of the companies in New York city must show an initial insulation resistance of not less than 15 megohms per mile per 100 volts of current used. This means that with an alternating current of 1,000 volts the cable must show, before the current is turned into it, to have an insulation resistance of not less than 150 megohms per mile; with an arc circuit of 2,500 or 3 000 volts or even 4,000 volts, initial insulation resistance must not be less than 375 megohms, 450 megohms and 600 megohms, respectively. Taken into consideration with the fact that on an ordinarily humid day, overhead circuits will not show an insulation resistance of more than from 200,000 to 500,000 ohms per mile, the above requirements seem altogether impossible of attainment and to be ideal rather than practical, but this is not the case. On the contrary, it is rare, indeed, that the initial tests of cables laid in New York city do not show from three to four times the initial insulation resistance required by the rule, and, of the hundreds of miles of cable actually in operation at the present time, and which have been in operation from two to three years, and with which I am personally familiar, I do not believe that there is one that will not show, under like conditions, nearly, if not quite the same high degree of insulation as when the original test was made. In fact, I have proved this to be true many times, and will cite one of our latest tests.

Initial Test, Nov. 17, 1889.—Weather clear; temperature, 60 degrees Fahrenheit; constant, 33,000. Leg No. 1: Length, .95 mile; deflection of galvanometer, 25 divisions; total insulation resistance, 1,320 megohms; insulation resistance per mile, 1,259 megohms. Leg No. 2: Length, .95 mile; deflection of galvanometer, 20 divisions; total insulation resistance, 1,650 megohms; insulation resistance per mile, 1,567 megohms

Last test, Feb. 5, 1892.—Weather, fine; temperature, 25 degrees Fahrenheit; constant, 33,000. Leg No. 1: Length, .9 mile; deflection of galvanometer, 12 divisions; total insulation resistance, 2,750 megohms; insulation resistance per mile, 2,475 megohms. Leg No. 2: Length, .9 mile; deflection of galvanometer, 10 divisions; total insulation resistance, 3 300 megohms; insulation resistance per mile, 2,970 megohms.

It is, of course, apparent that the conditions under which this last test was made were much more favorable than in the case of the initial test. But I think it is also apparent that the insulation resistance of the cable has suffered little or no deterioration after more than two years of constant use.

This would be impossible with poorly insulated joints. The first cable laid by the Manhattan Electric Light company on Broadway was insulated with rubber compound and the joints were made by contract, on the representation of the contractor that his men were professional jointers. After the cable was connected throughout, a test showed less than a megohm of insulation per mile, and this bad condition of things was quickly shown to be in the joints; every one of them had to be cut out and our lesson was well learned. Since that time we have never allowed any but our own men, specially trained and educated for the purpose, to make joints on rubber compound cables. I once wrote a gentlemen regarding joints, that, in making each and every one of the thousands of joints in use, we have observed in every case, the same care and precaution in making them as is observed by the Atlantic Cable company in repairing breaks in mid-ocean, where, in such cases, it used to be the custom, before they maintained their own ships, to charter or equip a vessel to reach the locality of the break, the cost of which ran anywhere from $40,000 to $60,000, and where this whole sum was dependent upon the making of one first-class joint. This may sound like an exaggeration, but, nevertheless, I can assure you that our extraordinary precaution has saved us an unknown, but large amount of trouble and, on that account, our almost total immunity from interruption is largely due, The cost of joints will run from $2 to $3 apiece and any manufacturer can give proper directions how to make them and what to use, both as to metallic contact and insulation, but, in the case of the rubber compound cables, the difficulty lies more with the man than with the method. Men whose hands are naturally moist cannot make a good joint, *i. e.*, a joint which will test "infinity."

Testing.

We are required to test all underground circuits at least once per week. For this purpose a portable reflecting gal-

vanometer is used. Where the cables enter the station a test room, free from the jar of the building, is usually provided in which to set up the instruments; but, in cases where the cables are reached from the station by overhead wires, it is customary to rent a quiet room adjacent to the junction-pole and connect by a well insulated "lead" for permanent use. The total insulation of a circuit with all converters or arc lamps connected, will generally fall below the requirements of the rule above quoted, but, unless it is shown to be less than say one megohm per mile of cable, its condition, as a "completely connected circuit," is usually accepted. But, as a general rule, when the insulation falls below this standard, what are termed "ex-converter" and "ex lamp" tests are called for. These require, in the case of incandescent circuits, that every converter installation be cut out, the cable ends freed from all contact and test of cables only be made to ascertain their exact condition. The arc circuits are similarly treated by disconnecting all lamps and switches. Unless the results of such tests come within the limit prescribed by the rule, the circuits are not allowed to be operated until the defect has been removed and the insulation brought back to the required standard. Fortunately defects are rare, and tests of this character are not now called for with sufficient frequency to prove burdensome.

House Connections.

House connections are built by the Subway company at the expense of the electric light companies; but the Subway company claims not to relinquish ownership therein and will not allow their joint use by two or more companies, except by special arrangement. The cost of house connections in New York city is appalling to the man of exclusively overhead experience. I will quote a few selected at random:

First—On upper Broadway. No distributing facilities except from man-holes.

TO NO.	HOUSE PIPE.	CABLE AND LABOR.	TOTAL.
1300 Broadway,	$128.11	$48.44	$176.55
1409 "	118.50	61.04	180.53
1451 "	108.12	52.14	160.26
1317 "	118.58	86.55	205.13

Second—On upper Sixth avenue. Same as above.

TO NO.	HOUSE PIPE.	CABLE AND LABOR.	TOTAL.
558 Sixth avenue,	$108.57	$59.93	$168.50
527 "	141.06	79.96	221.02
1011 "	78.51	54.10	132.61
840 "	155.08	88.56	243.64

Third—Many of the streets have subways upon one side only. House connections from hand-hole boxes to the opposite side of the street are long and expensive, for instance:

TO NO.	HOUSE PIPE.	CABLE AND LABOR.	TOTAL.
1800 Third avenue	$124.67	$43.60	$168.27
1905 "	124.59	50.60	175.19
2101 "	118.54	61.66	180.20
1000 "	153.65	47.60	201.25

Fourth—Distribution to side of street on which conduit is laid, or where there are distributing facilities on both sides of the street:

TO NO.	HOUSE PIPE.	CABLE AND LABOR.	TOTAL.
1324 Third avenue,	$24.82	$25.42	$50.24
2102 "	24.54	16.00	40.54
2110 "	29.34	23.20	52.54
2108 "	27.66	22.20	49.86
600 Eighth avenue	31.03	22.47	53.50
728 "	21.84	23.84	45.68
859 "	22.46	25.03	47.49
725 "	22.16	24.59	46.75

Fifth—The cost of connections to city lamp posts, including pipe, cable and labor, averages about $110 per post.

You will observe that in some cases the cost of these connections exceeds the gross revenue derived from an arc lamp for an entire year, but, unless we resolve not to develop the particular territory in which these cases occur, we are obliged to invest our money and take chances for the future.

Fortunately, it often happens that one house connection will serve for two or three different installations, and in this way, the average cost per installation or per arc lamp, is very largely reduced. For instance: In the fall of 1890 our arc lamp connections cost us, on an average, only $43; in the spring of 1891, an average of about $30; the ratio of new connections to new installations or lamps being as one is to two. In other words, for 100 installations or lamps we were required to make but 50 house connections. This ratio could be largely and safely reduced were we allowed by the authorities to use more than 100 feet of overhead wire with each underground connection.

Some Features of Underground Operation.

It is a fact worth knowing that the underground service is more reliable than that of the overhead. Storms, blizzards, sleet and wet snow have little or no effect upon it, and neither has lightning, where the circuits are entirely underground. In consequence, cases of interruption are rare; crosses never occur; grounds but seldom, and open circuits are unknown, except when a break occurs at a lamp or a switch.

The number of "burn-outs" in the subways is small, and thus far, after three years' experience, not a single instance of burn-out has occurred in our "rubber" compound cables that has not been directly attributed to some imperfection of manufacture, which originally escaped detection, or to mechanical injury after the cables were laid. And these have not amounted to more than 10 or 12 all told. We have, however, had several instances with the "fibrous" compound, but whether due to accidental abrasion of the lead covering, which is fatal to that form of insulation, or to some inherent defect, we were unable to determine, as the intense heat of the escaping current destroyed all evidence in each case.

During the first year of our experience we suffered considerably from mechanical injuries caused by the carelessness of employes of other companies having common access to the man-holes with ourselves, and I presume our own men were equally culpable as regards the property of our neighbors, but the common experience of the companies suggested greater care and consideration upon the part of all, and, by carefully stowing the cables away upon racks built along the sides of the man-holes, mechanical injuries have now become exceedingly rare.

On wet nights we have an occasional case of trouble in a leaky switch box, or, at an exposed joint, where the wire running to the lamp is connected with the cable. These joints were at first covered with ordinary tape, but after a few months' exposure the tape would invariably leak under the high pressure and sometimes convey the current to the lead covering and result in a burn-out.

In the case of rubber compound cables, we now simply cut back the lead a few inches, strip off the taping, make an ordinary metallic joint, and then slide over the bare metal a floor insulator, open at both ends, and standing upright so as to allow the rain to run through the lower end, the insulator resting upon the rubber compound, not upon the lead covering of the cable. This, of course, refers only to lamps where switch-boxes cannot be used, such, for instance, as city lamps. Where fibrous cables are used, a regular insulating joint of pure rubber is made, connecting to a short piece of specially insulated wire. The joint is immersed in boiling hot parafine and the specially insulated wire is then connected in the ordinary way to the wire running to the lamp. This is done to protect the insulation of the cable from moisture and also to facilitate connecting and disconnecting with the lamp, which the regulation tests frequently render necessary.

In laying cables it has been found desirable to place both "legs" of incandescent circuits in the same duct. When they are separated into different ducts great loss results from self-induction.

The use of the subways makes it possible to employ much heavier single conductors than could be used overhead. There are in some of the ducts conductors having nearly, if not quite, 500 000 circular mils area, and such sizes as No. 00 and No. 0000 are quite common. The conductor, being composed of small wires stranded, affords sufficient flexibility for all purposes; but in sizes up to and including No. 2 B. & S. the conductor is generally solid.

In the matter of public safety, the records of the past three years show but one death to have occurred from current conducted underground, and that particular case occurred on top of a city lamp-post on a wet night, the victim neglecting to use his gloves. Prior to 1891 deaths caused by shock from overhead wires occurred with considerable frequency—sufficiently so to arouse great public excitement and hasten the burial of the wires underground. But it is fair to state that more than nine-tenths of all the accidents were primarily due to the inferior character of the overhead construction and the extraordinary multiplicity of wires of all kinds in the streets.

The arrangement of the underground system is exceedingly cumbersome; that is to say, it requires much greater time, as compared with overhead methods, in the construction both of trunk lines and house connections. Under the old overhead system an order for an arc lamp, for instance, could be executed within two or three hours after its receipt, and the whole cost of hanging was not to exceed anywhere from $8 to $12; now, however, in order to hang an arc lamp and connect therewith, it is necessary to make formal application to the Subway company for the house connection, and this requires, on its part, anywhere from three to ten days' time. After receiving due notice that the house connection has been built, we are then required to apply to the Board of Electrical Control for a permit to hang the lamp and connect it with the underground conductors. This requires additional time, amounting to from three to ten days, often two weeks and even longer; and, in a number of instances, before we were finally permitted to fill the order, the prospective customer had become disgusted with the delay and cancelled his contract. The Subway company has also to apply to the Department of Public Works for a permit to open the street and must receive the same before they can proceed with the work, making in all three distinct applications to three different bodies for each house connection.

Again, the underground system rigidly circumscribes the territory in which current can be distributed to the streets through which subways are built. Lights cannot be served 200 or 300 feet off the line of the subways without a long underground connection, the cost of which would, in nine cases out of ten, prove prohibitive.

I recently read an article in an western paper, to the effect that the wiring of the plant located in the city in which the paper was published, was all overhead, because the underground systems in New York city and elsewhere had proved to be a failure on account of gas explosions, which were so serious and frequent in their nature as to make the operation of high-tension currents underground infinitely more dangerous than dynamite. Now, as a matter of fact, although it is true that the earth beneath the street pavements of New York city is completely saturated with gas, but very few explosions have actually occurred and those not at all serious in character. Only one interrupted our business, and, in that case, only for a few hours and on but two circuits. The Subway company uses a system of blowers, which keeps the subways reasonably free from gas, and this source of danger or interruption, at least so far as the city of New York is concerned, may be wholly disregarded. Nevertheless, without the blowers it might be reasonable to apprehend danger.

The Financial Aspect.

A good system of underground conduits fairly covering the electric lighting territory of a large city will, in my opinion, cost on an average from $2 500 to $3,000 per mile, per duct, but, in the case of a single duct in a trench, the latter figure is likely to be exceeded, depending largely upon the character of the digging and the engineering difficulties to be overcome. For the purpose of comparison, however, let us assume $3,000 to be the cost of one mile of distributing duct and then consider the cost of one mile of construction for one arc and one incandescent circuit, by both underground and overhead methods, as follows:

UNDERGROUND.		OVERHEAD.	
Duct	$3,000.00	50 poles prepared and set at $12.00	$600.00
11,000 ft. No. 4 cable at 20 cents, laid.	2,200.00	11,000 ft. No. 4 wire, at 4½ cents.........	495.00
11,000 ft. No. 2 cable at 30 cents, laid.........	3,300.00	11,000 ft. No. 2 wire, at 7¼ cents	797.50
40 house connections at $75.00	3,000.00	40 house connections .	480.00
Total........	$11,500.00		$2,372.50

Hence, from these figures, it must be assumed that the initial investment for an underground system will exceed by about five times the cost of an overhead system, and the fixed charges on this very expensive feature of investment in a central station plant must be correspondingly increased.

But in New York city, as before stated, the underground conduits are owned by a subway company, which has an exclusive franchise and which leases its ducts to the various electric light companies upon the following schedule of rentals:

Distributing ducts........................	$1,000	per mile,	per annum.
Trunk ducts, 3 inch..................	900	"	"
2½ "	800	"	"
2 "	700	"	"
1½ "	550	"	"

These rates have the effect of increasing the usual ordinary expenses of a central station enormously, and, although some overhead wires are still in service, and our field of operation is almost wholly confined to the more important streets and avenues, the amount of the duct rental already equals the combined cost of coal, water, oil, waste and the salaries of chief engineer, engineers, firemen, coal handlers, boiler cleaner and oilers employed in the engine department.

The development of electric lighting territory is, consequently, much restricted, and streets which would offer fair inducement for overhead wires cannot be considered at all from an underground standpoint. A case of this kind occurred in our last bidding for street lights. A certain company bid for the lights on Fifth avenue, between Twenty-third and Forty-second streets, about 15 in all, at the rate of 60 cents per light, per night. This was 20 cents above the ruling price. Being called upon to explain, the company stated: First, that there was no commercial arc lighting to be had in the locality whatsoever, and it must rely solely upon the street lights for revenue. Second, that there were subways on both sides of the street and that, as the lights were distributed on both sides of the street, they would be obliged to lease a duct on each side. Third, that, therefore, the duct rental "on Fifth avenue alone" would amount to "32 cents per light per night."

There is another onerous featrue which discourages the extension of territory, and that is, that the Subway company requires us to execute a bond agreeing to pay rental for a term of five years on all new ducts constructed and this bond must be secured by collateral of unquestionable value. This insures the return of their capital, even at their own estimate of cost, but it imposes a heavy burden upon the electric lighting companies.

And right here it seems pertinent to remark that I have long been convinced that it is a matter of paramount importance to an electric light company to own the subways it occupies and to possess the right to extend the same as the development of its business may require.

While I have no complaint to make against the Subway company of New York, I know that the subways could be operated by the companies for much less money than they are now required to pay, taking into full consideration the matter of interest on capital investee, cost of maintenance and operation, and every other charge which can be justly considered. Therefore, for those to whom opportunity is yet given, it might be wise and prudent to at lest secure the right to construct underground conduits, even although they may not adopt their use for some time to come.

As to maintenance, our experience with cables has not been sufficiently great to give us a definite idea as to their possible life. Aside from this, however, it costs no more to maintain the cables than it does to keep overhead wires in good order, say from $15 to $20 per mile per annum—probably not quite so much; but, unless the cables last at least 20 years the cost of maintenance is likely to be far greater.

Finally, summing up the whole situation, the following conclusions may be fairly reached:

First. The underground service is not only a physical possibility, but an established fact upon a very large scale.

Second. It is less liable to interruption than overhead wires.

Third. It is less dangerous to human life.

Fourth. Its cost is enormously greater.

Fifth. It is cumbersome to a degree and lacks, to a considerable extent, the flexibility of overhead wires.

Sixth. Its cost precludes its extension to sparsely lighted districts, which must either be reached overhead or permanently abandoned.

The paper on "The Underground Construction of the Buffalo Railway Company," by J. B. Craven, was next read:

Underground Construction of the Buffalo Railway Company.

BY J. B. CRAVEN.

With hesitation I have accepted the invitation of the president of this association to read a paper at this meeting on the "Underground Construction of the Buffalo Railway Company."

The subject is broader than appears on the surface; in fact, too broad and deep for me to deal with it thoroughly, but the knowledge that what little I know, together with

the results obtained in this city, may furnish one or two points for discussion which may give to all of us some valuable information, has decided me to ask your attention for a while.

Underground construction for railway use is becoming every day a more prominent feature of railroad construction. Overhead mains and feeders will not much longer be tolerated, especially in larger cities, where already the common councils are making it part of a railroad franchise that feeders, at least, shall be buried. The trolley wire, being bare, is of necessity left overhead, as safer and more economical, but it behooves us to meet this popular demand of placing all wires possible below the surface, otherwise we may be compelled to put the trolley wire itself there. Such an order would put the electric railroad industry back for quite a number of years, for not only would it be expensive, but, to my knowledge, no commercial under ground trolley system has yet been put on the market.

Underground construction for railroad use brings us many problems to solve. While not using a high tension current, we have one side of our system always grounded, so that between the many miles of cables in use and the earth we have a difference of 500 volts; thus you see at once the necessity of having and keeping up the highest insulation possible. This question of ground return requires that the insulation resistance of a railway circuit be twice that of an arc or incandescent underground system, where you have a metallic circuit; then there are the constant and excessive strains that one does not meet either in arc or incandescent lighting, due to the throwing off and on of the cars. It is almost impossible to figure your feeders to carry the maximum current, so that at any time you are liable to have your cables overloaded, bringing very heavy strains upon them.

Another question is the one of connecting overhead with underground wires. This brings lightning to the field to be guarded against, for the large surface of trolley wire offers an attractive path for lightning, and how to protect the underground feeders and mains has been quite a problem. Lightning has little regard for insulation, seeming to want a path only to earth; this path is offered by the underground cables, so that we have to introduce some arrester at the junction of the underground and overhead wires to give it some other path.

This arrester is placed inside a water-tight iron box on top of a pole, wherever tap is made with overhead wires; this box also affords a good place where overhead and underground wires can be connected and keep moisture from the cables; this is accomplished by wiping a 3 inch lead cup onto the lead of the cable and filling it with insulating compound.

We have in this city about 11½ miles of subways, divided into two trunk lines, which branch off and carry feeders to the outlying districts. Our conduits are laid in cement, 30 inches below the surface of the street. They are crowned in the center, so that the water will drain to the manholes, which in turn drain to the city sewers, with a bell-trap to prevent sewer gas coming back.

Lately, on account of natural gas finding its way into subway and manholes, we have found it necessary to attach a blower at the station, which ventilates the whole system. Manholes we have placed every 400 feet, and have tried to make the distance standard, as pulling a greater distance brings an excessive strain on the cable when drawing in.

After careful consideration before this work was started, we decided to depend on our cable for insulation, not on conduits made of insulating material. To me it seems impossible to prevent moisture from penetrating the latter system, thereby lowering the insulation. We depend on our ducts for mechanical protection alone.

The cables in use here are lead covered, provided with an exterior fibrous jacket or covering saturated with pitch, the purpose of which is to protect the cables while being drawn into the duct. We have some 45 miles of cables, which have been in use since July last. These are of two classes. One depends for insulation on pure Para rubber, the other on a composition, our shortest feeder being two and a half miles in length, some of the longer ones reaching a distance of eight miles, yet the insulation on none at the present day is below 120 megohms, the short ones testing as high as 1,100 megohms. In laying this cable all tests were made in the testing room at the station; this was made feasibly by the use of a telephone circuit throughout the underground system, so that a workman making a joint in a manhole was in communication with the man making the test and could always find out if his work was satisfactory. The joints made were the standard joints used by the companies from whom the cable was bought.

I may mention also a joint as made in the cable, using composition for insulation. The method here employed differed from the foregoing in that the lead sleeve is slipped over the completed copper joint, dressed down and wiped, the sleeve then being filled with compound through two small holes tapped through the top which are afterward closed permanently with a soldering iron. Each feeder, for the purpose of tapping off branches to feed the trolley wire and to facilitate the breaking of cables in case of trouble, is run through a junction box every 1,000 feet. The box shown has eight stubs, which allows 3 cables to pass through and be broken, and two taps to be taken off for feeding purposes. A small telephone box is is placed in each manhole, the terminals of which are all in multiple. A few words in regard to the testing of this system and the difficulties encountered on account of one side being grounded.

We are obliged to test at night, when the load can be thrown off one feeder and onto another; then the feeder is disconnected by means of a switch where it connects to the overhead, and the test is then made. It is rather a slow process, but the only one left open to us.

The testing-room is equipped with first-class instruments for practical use. The galvanometer, which is of the Thomson reflecting type, is enclosed within a magnetic shield made of wrought-iron pipe, and also suspended by three springs to absorb vibration. The rest of the instruments consist of a chloride of silver battery, standard resistance and shunt and reversing key. To the left is seen the telephone communicating with the manholes.

Thus far we have looked upon the difficulties and disadvantages of the underground system. No arguments have been advanced in its favor, but I think you will agree with me that it has some. First, it does away with the public objection of disfiguring the streets, obstructing firemen in their duties, and in the case of high tension currents, a menace to life itself; and then the liability of wires falling, causing a suspension of traffic, and, in case of a storm, causing a delay and loss of thousands of dollars to the company itself.

AFTERNOON SESSION.

The president called the meeting to order at 3:15 P. M.

Mr. Armstrong offered the following resolution

Resolved, That the members of the National Electric Light association extend their hearty thanks to the Bell Telephone company of Buffalo, and the American Telephone & Telegraph company, of New York, and the Postal Telegraph & Cable company, for their great kindness and courtesy in extending to us the free use of their wires, privileges of which we have shown our appreciation by a very general use, and which have helped greatly to the enjoyment of our very pleasant stay in the city of Buffalo. To our president and the citizens of Buffalo, who have so hospitably treated us, we desire to extend our thanks. We close this convention with the firm conviction that it has been the most successful one in our history.

The resolution was adopted amid applause.

The association then went into executive session.

ELECTION OF OFFICERS.

The following named officers were elected for the ensuing year:

President, James I. Ayer, St. Louis, Mo.; first vice-president, E. A. Armstrong, Camden, N. J.; second vice-president, C. H. Wilmerding, Chicago, Ill.; secretary, George F. Porter, New York; executive committee, (new members) H. H. Fairbanks, Robb MacKie, C. Lee Abell; (old members) John A. Seeley, E. F. Peck, Chas. R. Faben, Jr., Frederic Nichols, M. D. Law, A. M. Young.

The next meeting of the association will be held in St. Louis, Mo., February, 1893.

The Banquet.

The convention was formally closed on Thursday afternoon, but one of the most enjoyable features of the meeting was reserved until Thursday evening, when a banquet was held at the Merchants' Exchange. About 350 members and guests were present. The reception room and banquet hall were decorated with choice flowers and there was an elaborate display of bunting and flags. During the evening an excellent musical program was presented.

The following toasts were responded to:

"The City of Buffalo," Hon. C. F. Bishop.

"The National Electric Light association," Hon. E. A. Armstrong, Camden, N. J.

"Buffalo Manufactories," Richard K. Noye.

"Municipal Lighting," C. H. Wilmerding, Chicago.

"Buffalo Electricity," John G. Milburn.

"Electrical Press," T. C. Martin, New York.

"The Buffalo Press," Charles F. Kingsley.

"Electricity," Prof. Elihu Thomson.

"Our Partners in Niagara Falls," A. J. Corriveau, Montreal.

Convention Notes.

The "Ajax" switch was shown by Mr. Van Nuis.

Benedict & Burnham of New York were represented by D. L. Hungerford.

E. B. Hatch of Hartford, Conn., represented the Johns-Pratt company.

E. E. Bartlett of Bartlett & Co. was one of the "allied powers" at headquarters.

John A. Roeblings Sons' company of Trenton, N. J., was represented by F. H. Sparling.

Lewishon Bros. of New York were, as usual, represented by their representative, S. Rosenstamm.

The Perkins Electric Switch company of Hartford, Conn., was ably represented by E. H. Bunce.

The Bryant Electrical company of Bridgeport, Conn., was represented by President W. C. Bryant.

P. J. Fiedler, general manager of the Boston Braid company, showed a large assortment of silk covered wire.

J. B. Edson of New York, presented a very unique circular describing his recording and alarm gauge.

General Manager T. J. Smith represented the E. S. Greeley & company of New York. He was accompanied by I. M. Post.

The Keystone Electric company of Erie, Pa., presented one of the novelties of the convention in its new reversible motor.

E. H. Peck of New York, presented the claims of the Phœnix Glass company and secured many large orders for tinted shades.

P. H. Alexander of Alexander, Barney & Chapin of New York, who has never missed a convention, represented his company.

The Sterling Water Tube Safety Boiler company, of Chicago, Ill., was represented by General Agent J. B. Sargent, of 620 Atlantic Avenue, Boston, Mass., who presented a neat catalogue describing [illegible] boiler. It contained many views of [illegible] gave a number of recent sales.

Robert Macan of Cincinnati, [illegible] trical circles through the West was a [illegible] upon the convention sessions.

General Manager E. S. Minott of the National India Rubber company of Bristol, R. I., showed a complete line of samples of wire.

C. A. Schieren & Co. of New York, were represented by C. A. Schieren and C. A. Schieren, Jr. E. P. Atkinson and A. B. Lawrence.

The Jewel Belting company of Hartford, Conn., made no extensive exhibit, but secretary C. E. Newton and C. L. Tolles secured several orders.

C. E. Bibber of Boston, general manager of the Consolidated Electric Manufacturing company, exhibited a number of new electrical devices.

P. C. Ackerman of New York, representing the American Electrical works of Providence, R. I., showed a full line of samples at the Iroquois.

N. S. Possons represented the Eureka Tempered Copper company, of North East, Pa., displaying a fine exhibit of its specialties in the corridor.

S. S. Wheeler of the Crocker-Wheeler Motor company of New York, was very busy in explaining the many advantages of his well known apparatus.

The Electric Secret Service Co. of New York, was represented by C. P. Mackie, general manager, and S. S. Bogart, the electrician of the company.

The new "Niagara" dynamos and motors manufactured by the Lovell Manufacturing company, of Erie, Pa., received many complimentary remarks.

Pass & Seymour, of Syracuse, N. Y., had a very complete exhibit of fine porcelain specialties, and attracted the attention of many central station men.

H. A. Cleverly of Philadelphia, Pa., as usual, left the impression that the Cleverly Electrical company was able to produce anything that an expert would desire.

H. L. Shippy, New York manager of the Roebling Sons' company, was an attendant at the convention, receiving his usual pleasant reception from his many friends.

Richard O. Heinrich, who had charge of the Weston Electrical Instrument company's exhibit at the Frankfort Exposition, represented the company at Buffalo.

The John T. Noye Manufacturing company, of Buffalo, was visited by a large delegation Thursday, inspecting the works. The visitors were royally entertained.

General Manager W. D. Packard, of the Packard Lamp company, of Warren, Ohio, attended the convention. He had samples of the company's lamp on exhibition.

General Manager W. H. Weston of the Weston Switch company of Philadelphia, Pa., had a large exhibit of switches, including a number of new devices in this line.

W. W. Law, president of the Electric Appliance company, of Chicago, showed a new swinging ball lightning-arrester, the N. E. Switch, and new Acme single-pole switch.

A general invitation extended by the Aluminum Carbon company to inspect the productions at the factory was accepted by quite a large party on Wednesday morning.

The Hart-Hegeman Manufacturing company of Hartford, Conn., was represented by A. H. Pease, its secretary and treasurer, who had a line of its new switches on exhibition.

The Falls Rivet & Machine company, of Cayahoga Falls, Ohio, distributed an elaborate circular, showing quite a complete list of electric plants installed by the company.

E. E. Ries of the Ries Electric Specialty company of Baltimore, showed his new alternating lamp socket, which he pronounced a great improvement over the old device.

The Stanley Electrical company of Pittsfield, Mass., was represented by the following well-known gentlemen: R. Fessenden, Henry Hine, Wm. Stanley, Jr., and C. C. Whittlesey.

The Electrical Engineering & Supply company, of Syracuse, made one of the best exhibits of the convention in the line of supplies. Its catalogue was much sought for future reference.

A large party, in charge of S. S. Leonard, of Cleveland, made a visit to the street railway power house to examine the Hill clutches. Those who attended were amply repaid for their trouble.

H. S. Brown secretary of the Security Insulator company, of New York, received many compliments from delegates upon the practical results to be obtained by the use of this insulator.

A handsome souvenir of the C. & C. Electric Motor company was distributed about convention headquarters. It contained much interesting information

on electrical apparatus generally and described in detail the motors and generators manufactured by the C. & C. company.

J. M. Orford of the Union Electric Manufacturing company of Bridgeport, Conn., had a number of new electrical devices, in the way of switches, which were very much admired.

Secretary C. J. Swift of the Duplex Electrical company of Corry, Pa., took a party of ten to the Duplex Works to examine the new motor, which resulted in making several sales.

James J. Murray & Co., of Philadelphia, were represented by J. K. Martin, who had a full line of globes for incandescent and gas lighting purposes, the flint globes attracting unusual attention.

The Okonite company, of New York, gave several very pleasant receptions in its parlor, which were attended by many members. A most enjoyable programme was presented on each occasion.

E. W. Wilkins of the Patrick & Carter company of Philadelphia, Pa., distributed a very neat souvenir memorandum book. He also showed large photographs of the company's new annunciator.

H. B. Cutter, general manager of the Cutter Electrical Supply company of Philadelphia, Pa., had an assortment of new incandescent flexible lamp stands, which won the admiration of all who saw it.

The Eddy Electrical company of Windsor, Conn., was represented by A. D. Newton and M. E. Baird. It was favored with several large orders, one of which is to go to a point on the Pacific coast.

R. B. Corey, general manager of the Electrical Supply & Construction Co., of New York, thoroughly convinced the people of Buffalo as well as the delegates of the superior quality of the Ward lamp.

Diehl & Co. of 385 Broadway, New York, distributed a catalogue complete in all details showing the various lines of electric ceiling fans. Their testimonials leave no doubt as to their efficiency.

The Paranite Rubber & Insulated Wire company, of Jonesboro, Ind., was represented by C. G. Butler, who had a very complete line of samples of the company's aerial, submarine and underground wires.

P. C. Ackerman, manager of the New York office of the American Electrical Works, of Providence, had on exhibition a full line of samples of the wires made by the company, including electric light wire,

Probably nothing attracted more attention than the new electric pump of Otis Bros. & Co., of New York, operated by a Crocker-Wheeler motor in the corridor. A. E. Hall explained the mechanism of the pump.

Although H. T. Paiste, of Philadelphia, was a little late in reaching Buffalo, his corner in the rotunda of the hotel was surrounded by a large number of delegates, examining his line of new novelties in switches.

James Leffel & Co., of Springfield, O., manufacturers of the Leffel water wheel, distributed a very neat brochure on water wheels. This concern has had over thirty years' experience in the manufacture of water wheels.

H. G. Pratt, treasurer of the Samson Cordage company of Boston, was prevented from coming with the Boston party, but showed his usual push by arriving on a train but half an hour after the special, over another route.

Charles D. Shain of the Edison General Electric company of New York, had charge of the affairs of the Edison company. He made a complete exhibit at the Masonic Temple, where the company's Buffalo offices are located.

The Gould & Watson company, of Boston, was represented by E. P. Sharp, who had a line of the company's keyless water-proof sockets. The new Whitney direct reading voltmeters were for the first time shown by this company.

E. S. Willyoung, of Queen & Co., Philadelphia, represented his house most acceptably. Mr. Willyoung explained several new devices which Queen & Co. have recently placed on the market and in which much interest was manifested.

The Beacon Vacuum Pump Electric company, of Boston, made an attractive exhibit of its lamps, in size from 16 candle power up to 250 candle power, presenting many new designs. The company was ably represented by S. S. Sherman.

The Thomson-Houston company had one of its new poles with switch connection on exhibition in front of the local office on Court Street. It was one of the features of the convention, and was visited by the majority of the delegates present.

R. K. Whitehead of the Crescent Insulated Wire & Cable company, of Trenton, N. J., was well pleased with the practical results of his attendance upon the convention. He secured several of the largest orders which this firm has taken this year.

A convention without General Manager C. E. Bibber of the Consolidated Electric company presenting something decidedly interesting would be a novelty. At this convention he brought out the new Hamil arc lamp for incandescent circuits. The construction is simple.

magnet, annunciator and office wires, rubber covered wire, lead encased wire, telephone and incandescent cords.

N. V. Titus, general manager of the Economic company of Boston, relied upon his persuasive powers and the well known record of the company's lamp rather than an exhibit. Results show that his estimate of the combination was well founded.

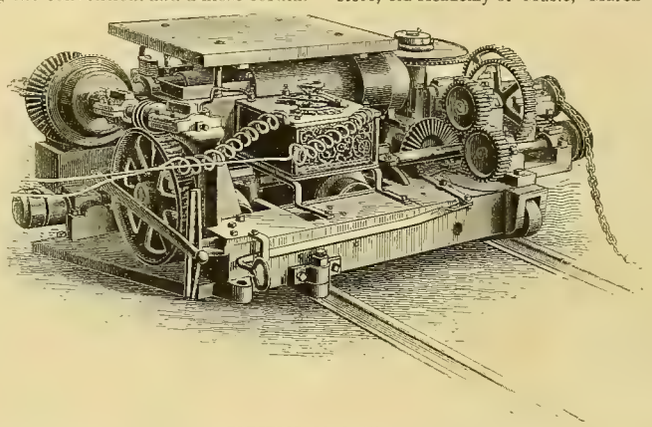
Members of the association who had visited Montreal in September were reminded of their pleasant reception and entertainment on that occasion by the receipt of an illustrated souvenir of the last midsummer meeting prepared by A. J. Corriveau of Montreal. It contained many familiar views of the city.

The Chapman Valve company, of Indian Orchard, Mass., made its initial bow before the electrical people of the convention, and the complete line of valves shown by its representative, Edward L. Ross, and the goodly number of sales which he reported is convincing proof that this firm will again be represented.

One of the most interesting features presented in connection with the convention was the entertainment of Marshall P. Wilder at the headquarters of the Okonite company. Wilder was at his best and kept the visitors in good humor throughout the entertainment. Captain Candee and Mr. Manson were congratulated by all on securing such an excellent attraction.

A representative of the Hubbard Photographing company, of 242 Fourth avenue, New York, accompanied the electrical special from New York to Buffalo, and also went on the excursion to Niagara Falls. Several views were taken of the delegates at Albany, Buffalo, Utica and Niagara Falls, at the ice mountain and the entrance to the elevator of the tunnel.

F. P. Little & Co., of Seneca street, Buffalo, kept open house during the convention, and a most cordial welcome was extended to the many delegates who called. A large share of the detail work for the entertainment of the members was arranged by Mr. Little, and the hearty congratulations that were extended to him were convincing proofs that his efforts were appreciated.



ELECTRIC COAL CUTTER.

S. V. Doty, general manager of the Aluminum Carbon company, of Buffalo, placed the visitors under great obligations by the many attentions shown. The Buffalo reception committee, of which he was a member, showed by the manner in which it took care of the delegates that it thoroughly understood what was necessary to make them comfortable.

The Standard Paint company, of New York, was as usual represented by Frank L. DeRonde, of New York, and P. H. Hover, of Chicago. Their supply of tortoise shell calendars, which were in great demand, was soon exhausted. While at the convention they received the information that the underwriters of San Francisco had decided that they would not accept any wiring unless covered with P. & B. paint.

F. A. LaRoche of the LaRoche Electrical Works of Philadelphia, Pa., made a long journey in order to be in attendance at the convention, coming directly from Cuba to Philadelphia, and leaving that city for Buffalo three hours after his arrival. He was warmly congratulated, and assured that there would be no question of numbers in attendance hereafter at conventions if other members displayed the same zeal in getting around.

The Utica Electric Manufacturing & Supply company showed a handsome line of samples of its manufactured specialties, including a new lightning-arrester for lighting or power circuits; also a quick-break snap switch, made in sizes from 50 to 1,000 amperes, a complete line of porcelain fuse boxes, cut-outs, a new carbon brush-holder, and an extended array of novelties which attracted universal attention. General Manager Bossart represented the company.

It is said that Granville Woods, a colored resident of New York, is the first of his race to attain prominence as an electrician. He has a new method of supplying electrical energy to cars.

Electric Coal Cutter.

The accompanying cut illustrates a coal cutter of the undercutting type driven by a 15 horse power C. & C. electric motor of special design. This machine is in operation in the Mean Run Mine, Pennsylvania. The motor placed in position on the machine is covered by a heavy board which serves to protect it from possible injury from any heavy object falling upon it. The starting box is also placed on the machine in a convenient position as can be seen from the illustration. The armature shaft carries a beveled pinion at each end and by a mechanical device this can be made to operate the endless chain to which the coal cutting knives are attached and which revolves about the arm, and also to operate the feed chain, which is made fast at one end, so that the machine can be moved forward at any desired speed or allowed to remain stationary if the hardness of the coal so requires.

Electricity in Minneapolis.

Minneapolis is an enlightened and progressive city—a fact attested by many manifestations of enterprise, not the least of which is the widespread use of electricity for light and power. An interesting compilation showing the growth of electrical applications and giving the latest lighting and power statistics has been made by W. E. J. Deming, city electrical inspector. It is as follows:

The first electric light in Minneapolis was an arc light, run from a small Brush plant, in the Pillsbury A mill and was started Dec. 24, 1881. This was followed by a 10 light United States (Weston) plant in the Big Boston clothing store, old Academy of Music, March 31, 1882. It is a singular fact that the local newspapers made no mention of these lights at this time.

The first isolated incandescent plant was a United States (Weston), located in the Pillsbury A mill in January, 1884. At the present time there are seven isolated arc plants, running 380 lights, and 70 isolated incandescent plants running 22,110 lights. The above includes 3,025 multiple series lights run by the street railway company.

In 1883–4 a few incandescent lights were run from storage batteries charged from central stations, but this soon proved a failure and they were abandoned. Prior to 1887 the only incandescent lights run from central stations were a few scattered groups of series multiple lights run on arc light circuits. About this time the furnishing current for incandescent lighting for commercial purposes became an established fact, and at the present time there are 27,822 incandescent lights running from central stations, not including street railway lights.

Electricity as a motive power was used to but a small extent in Minneapolis previous to 1890. At the present time there are 575 horse power of motors in use, exclusive of the street railway and small fan and dental motors. The street railway company has 6,500 horse power of motors in use, and this makes a total of 7,075 horse power.

There are 1,803 arc lights running from central stations. Electric heating is in its infancy, and is not yet a perfect success, though about eight horse power of current are used for this purpose here, chiefly in laundries, hat stores and clothing factories.

The total business of furnishing electricity in Minneapolis for light, heat and power may be summed up as follows:

Isolated arc lights	380
Central station arcs	1,803
Isolated incandescents	22,110
Central station incandescents	27,822
Total lamps	49,932
Horse power of motors	7,075
Horse power electro heaters	8

If the entire business in the city were reduced to incandescent lighting it would amount to 164,989 16 candle power lamps.

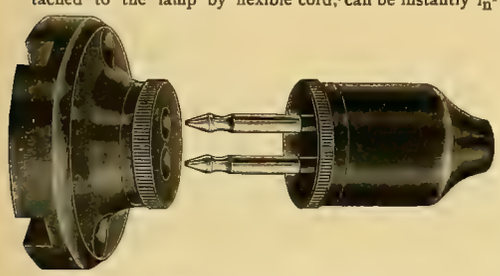
At the last meeting of the Royal Scottish Society of Arts Prof. Blyth of the Anderson college, Glasgow, read a paper on the "Utilization of Wind Power for the Generation of Electric Light." The writer stated that last summer he had used a machine on the principle of the Robinson anemometer, with hollow cups, rotating horizontally. It worked satisfactorily, and in a fair wind gave out 4 electric horse power. Even in a gale it ran satisfactorily.

Lighting the Armour Manual Training School.

The latest addition to the benevolent institutions supported by the income from the extensive Armour Flats is the Armour Manual Training School, which is now nearly completed. These flats cover nearly two entire city blocks and front on Dearborn, Thirty-third and Thirty-fourth streets and Armour avenue, Chicago. They were established by Philip D. Armour, and the control is vested in a board of management. The Armour Mission, with a regularly installed pastor, a free kindergarten, free dispensary, free reading room and a day nursery, have for some time been in operation as the result of this beneficence. The training school is a handsome building of stone and pressed brick, situated on the corner of Thirty-third street and Armour avenue. It is intended to make it a first-class institution for the manual training of boys, with the idea of laying a good foundation for the education of skilled artisans. The building will be lighted by electricity generated in an isolated plant. The contract for the wiring and fixtures, which has been secured by the Chicago Edison company, calls for over 1,800 16 candle power lamps and they are to be wired on the three-wire convertable system. The arrangements for the generating plant have not yet been completed, as it has not been decided whether to install several types of dynamos, in order to illustrate the distinctive operation of each for the benefit of the students, or to put in an entire equipment of Edison machines.

Wood's Receptacle Socket.

This device is a modification of Wood's trailer connector, previously illustrated in these columns, and it is intended to assist in the economical distribution of incandescent lamp light. The bases of the combination are to be arranged in places where it is convenient to put them in circuit, within easy reach. The double pole plug, attached to the lamp by flexible cord, can be instantly inserted or withdrawn and as it is a double break, it causes no sparking. Ample space is given for securing the cord terminals inside the plug shell. The base is adapted to either outside or concealed work, and it, as well as the plug, is finished in polished hard rubber.



WOOD'S RECEPTACLE SOCKET.

This receptacle socket is manufactured by the Electrical Supply company, Chicago.

Proposed Technological Institution for Chicago.

The following letter from Prof. Cook, who has charge of the natural science department at Northwestern University, is self-explanatory:

EDITOR WESTERN ELECTRICIAN:

Now that the establishment of a school of technology is under discussion, it will no doubt interest your readers to know that some time ago the trustees of the Northwestern University decided to establish such a school, and undertook to raise an endowment fund of half a million dollars for that purpose. In this attempt they have already met good success and have raised a large sum of money. Consequently there is little doubt that the school will be established at no distant date. Whether this school will be connected with the university professional schools in Chicago or with the literary department in Evanston is not certain. In either case it will be within a thirty minutes' ride of the center of the city, and can claim recognition as one of Chicago's educational institutions.

C. S. COOK.

Evanston, Ill., Feb. 15, 1892.

A Suggestion to American Exporters.

If American firms could only understand the ways of our rigorous customs, says the *Canadian Magazine of Science*, a great amount of trouble would be saved to Canadian purchasers. Complaints have been raised by several prominent electrical firms, and they but echo the sentiments of many more. It may be well, therefore, to mention that two certified invoices should be sent with the shipment of all goods, whether taken through or in bond. One invoice should be marked certified and correct, and signed by the shipping firm for the custom house, and the other similarly certified for the purchaser. Should this be followed, a great deal of trouble and worry would be avoided. We do not propose here to enter into a description of the endless amount of annoyance caused by the tardy way in which invoices are sent, but merely point out to any of our readers who may be more or less employed in shipping goods to Canada, that if they wish to continue the trade with their Canadian cousins, they must send the invoices promptly, and duly certified.

Isolated Electric Plant in the Highlands.

The London *Field* gives some particulars of an interesting application of water power for electric lighting and heating purposes at a shooting-lodge in the West Highlands. A dam was built across a small mountain burn some 800 feet above the lodge. The water is led for some distance past the dam in an open drain, and at a point about 650 feet above the turbine; it is conducted to it in a closed pipe. The waterfall thus made is the highest that is used for electric lighting purposes in the British Isles. The current is conveyed from the turbine house to the various buildings, the lodge about 200 yards distant, the stables, laundry, and head stalker's, cottage some 400 yards distant, by means of insulated conductors laid underground in tarred wood troughing, and the cables are completely protected by melted bitumen run into the troughs. In all, there are some 292 electric lamps installed. An interesting feature of the installation is a system of electric stoves, which are used for warming and keeping dry the cellars and various other parts of the buildings.

Electrical Action of the Human Body.

In the course of a series of lectures delivered by Prof. McKendrick before the Royal Institution of London the speaker showed some interesting experiments to demonstrate that there was in reality a distinct electrical action of the human body. He showed the effect of animal electrical currents by means of a very sensitive galvanometer. Current from animals such as the torpedo fish had long been known, he said, but it was mueh disputed whether there was such a thing as an electric current from man. This man-current he demonstrated by putting his hands into a three-quarter per cent. solution of common salt contained in two flat vulcanite dishes. The effect upon the galvanometer was greater as the number of fingers inserted was increased, and was greatest when the muscles of the arm were contracted. There were no fewer than 50 species of animals that were living electric batteries, the speaker declared, although only five or six were generally known. In concluding the lecture, Prof. McKendrick warned his hearers not to suppose that the final settlement of these questions had been reached. Many problems awaited solution, and he urged that every one should keep an open mind for the reception of the truth, from whatever quarter it might come.

CORRESPONDENCE.

New York Notes.

NEW YORK, February 27.—From all accounts the northwest corner of Broadway and Murray street will some day be occupied by the office building of the Postal Telegraph company. It is stated that negotiations with the Trinity church corporation for a ninety-nine years' lease of this property have nearly been completed. The property includes five buildings, all of which will be torn down as soon as the lease is signed and plans have been decided upon for the new building. The price is said to be $50,000 per annum over all taxes and assessments.

The New York telephone subscriber has the "lower rate" bee in his bonnet. More than two thousand telephone subscribers in the city have enrolled their names on the books of the Telephone Subscribers' association, and every one vows he will stand by the association in any action it may take to curb what is called the telephone people's extortion. The fight is to be taken to the legislature and if this does no good there will, in all probability, be a strike. Secretary Frank S. Gardner of the association has returned from Albany after a two days' visit to the council of the state board of trade. He had intended to have a talk with some of the leading democratic legislators for the purpose of getting a senator and an assemblyman to introduce the "Telephone Commissioners' Bill," but was obliged hurry home because of a death in his family. Secretary Gardner was much encouraged by the interest taken in the fight for lower telephone rates by the State Board, and said that a committee of five, in which he was included, had been appointed to find means for relief from the excessive rentals now charged, and report at the next meeting. It is said, however, that Tammany influence will keep the rates up. It will be remembered that the "Telephone Commissioners' Bill," which was introduced in the last session, was lost by the famous deadlock. There were rumors in Albany at the time that the Metropolitan Telephone & Telegraph company, and the New York & New Jersey Telephone company, which operates in Brooklyn, were counteracting the efforts of the friends of the bill by contributing $50,000 a year to the democratic state campaign fund. Both Mr. Croker and Edward F. Murphy, Jr., of Troy, are to be questioned about those rumors. The telephone companies, however, denies the charge absolutely. The campaign will be vigorously pushed, and the names of new members continue to be received One merchant yesterday handed in a list of 250 names.

Mr. Edison is reported as being satisfied with the arrangements made between his company and the Thomson-Houston people. In a recent conversation he is reported as saying: "The stories in which some of the newspapers have called this a game of 'freeze out' are founded on a misapprehension. I expect the consolidation will result financially to my advantage."

The negotiations for the consolidation, Mr. Edison continued, were being conducted by J. Pierpont Morgan and H. McK. Twombly. The entire question was one of pure business, which was being conducted on a "friendly and satisfactory basis." E. A. Colton had been selected as the head of the new company, and it had been proposed to call the new concern the General Electric company, leaving all personal elements out of consideration. The name was, however, not fully decided upon.

Mr. Edison was asked about the alleged strained relations between himself and Samuel J. Insull, who has been the general manager of the Edison General.

"There is nothing in that story," he said. "Mr. Insull was once my private secretary. We are on the best of terms now. I expect he will come with me again when the consolidation has been completed. He is a valuable man, and he knew my affairs so well when the Edison General company was formed that they could not do without him very well."

"What will be the effect of the consolidation on the suits now pending between the Thomson-Houston and the Edison companies?" Mr. Edison was asked.

"I think there are forty or fifty suits in which the companies are interested," Mr. Edison answered. "I do not suppose the consolidation will result in stopping the litigation. The papers in the cases are on file. In many cases there are principles involved which will govern in determining suits over patent rights, etc., with the Westinghouse company. I suppose these suits will be carried to a decision."

W. F. O.

Nashville, Tenn.

NASHVILLE, February 27.—The entire plant of the Capital Electric company, which had the contract for the public lighting of the city, has been sold under a decree from the United States Circuit court to satisfy a judgment of $80,000 in favor of the Thomson-Houston Electric company. After some spirited bidding the plant was knocked down to the Thomson-Houston company for $75,000. The plant includes the lot and old power station on Front street, the lot on Grundy street, new buildings and machinery, together with all rights, franchises, etc. The Thomson Houston company was represented in the transaction by Frederick W. Hunter. Mr. Hunter, Thomas Taylor, J. F. Stierly, James Clark and James Stiles had, previous to this sale, secured a charter for the Cumberland Electric Light & Power company, so that the Thomson-Houston company now controls the entire electric lighting plant and franchises in this city, and will proceed at once to rebuild and enlarge the power station on Front street, expending about $100,000 in increasing the capacity to meet the present and future requirements.

The Capital Electric company gave its commercial customers satisfactory service, both as to light and power, but its public lighting has been very poor for a year—lamps too few in number and the current insufficient and very unsteady. The city installation was made in October, 1889, and the contract with the city was for three years, each lamp to burn all night and every night at the price of 23½ cents per night. The number of the lamps is sixty short of the contract requirement, but the new company has given notice that these and fifteen additional will be put in operation immediately.

The Overland Railway company has been reorganized and the line is to be converted into an electric line immediately. The deed to the road and the franchises was made by the clerk and master to Fred W. Hunter, and the new electric light company owned by the Thomson-Houston company will furnish power for the road and its future branches and extensions. The line at present extends to Glendale Park, six and one-half miles from the public square.

The $200,000 worth of income bonds insured by the United Electric Railway company is being placed quite readily at 85 cents on the dollar. The coupons are receivable for fares on any of the company's lines.

Nashville has been made the distributing point of supplies for the Western Union Telegraph company in the central southern states.

B.

PERSONAL.

Dr. Louis Bell has resigned his position as editor of the *Electrical World*, and Carl Hering has been appointed as his successor.

C. A. Daigh of the Electrical Engineering & Supply company was at the Chicago office of his com-

pany for several days last week, returning to St. Paul Wednesday night.

C. D. Crandall, general manager of the Western Electric company, Chicago, returned from the Buffalo convention Friday of last week. He is much pleased with the results attained at the convention.

The sad announcement comes from Tokio, Japan, that Prof. R. Shida, of the electrical department of the engineering college, Imperial University of Japan, died on January 4th. Prof. Shida took great interest in electrical affairs and kept abreast of the times.

NEW INCORPORATIONS.

Marseilles Electric Light & Power company, Marseilles, Ill.; capital stock, $25,000; to operate an electric light and power plant; Clarence Griggs, Ottawa, Ill.

Merchants' Lighting company of Santa Rosa, Santa Rosa, Cal.; capital stock, $50,000; operating electric light and gas plants; T. P. Keegan, Santa Rosa, Cal.

Oak Terrace Cold Storage company, Jacksonville, Fla.; capital stock, $25,000; generation of electricity for light and other purposes; T. H. Butler, Jacksonville, Fla.

Hollister Light & Power company, Hollister, Cal.; capital stock, $25,000; to maintain electric light plants, and furnish light and power; Scott & Dooling, Hollister, Cal.

Canton Waterworks & Electric Light company, New Orleans, La.; capital stock, $50,000; operating waterworks and electric light plants in the city of Canton, Miss.; Irwin Jamison, New Orleans, La.

Roseburg Electric Light company, Roseburg, Ore.; capital stock, $20,000; to carry on an electric light plant, or plants, for lighting streets, houses, buildings and offices; L. L. Hurd, Roseburg, Ore.

Warren Investment company, Indianola, Ia.; capital stock, $500,000; buying, improving and selling real estate; building of an electric road from Des Moines to Indianola, Ia.; H. McNeil, Indianola, Ia.

Mineral Ridge & Niles Electric Street Railway company, Mineral Ridge, O.; capital stock, $50,000; constructing and operating an electric street railway between Mineral Ridge and Niles, O.; Edward Blunt, Mineral Ridge, O.

South Bethlehem & Saucon Electric Street Railway company, South Bethlehem, Pa.; capital stock, $100,000; operating an electric street railway in South Bethlehem, Saucon and Saulbury, Pa.; Edwin Laufer, South Bethlehem, Pa.

Paso Robles & Cayucos Railroad company, Paso Robles, Cal.; capital stock, $700,000; to build and operate a railroad 30 miles long by steam or electricity; also telegraph lines, wharves and steamships; Chas. W. Dana, San Luis Obispo, Cal.

Curtis Electric company (incorporated in W. Va.), Brooklyn, N. Y.; capital stock, $500,000; producing and furnishing electric light and power, manufacturing and dealing in electrical appliances; Jas. C. Foley, 206 Broadway, New York, N. Y.

Carbon Incandescent Gas Tip company (incorporated in W. Va.), New York city; capital stock, $500,000; to manufacture and sell gas tips, gas burners and fixtures of every kind for gas or electricity; H. M. Minsell, 45 Broadway, New York city.

ELECTRIC LIGHTING.

An electric light plant at Marion, Va., is talked of.

A new company is to be organized for the erection of an electric light plant at Piedmont, Ala.

The Titusville, Fla., Electric Light company is reported as erecting a new electric light plant.

The Edison General Electric company will probably erect an electric light plant in Berkley, Va.

The Greeneville, Tenn., Electric Light company will build a new power house, and put in additional machinery.

A proposition has been made for the organization of a $16,000 stock company to erect an electric light plant at Brenham, Tex.

The Georgia Electric Light company of Atlanta, Ga., has completed the erection of an electric light plant. H. M. Atkinson is president; J. H. Porter, vice-president, and W. S. Garfield, secretary.

The electric light plant of the Edison Electric Illuminating company of Atlanta, Ga., has been completed. H. M. Atkinson is president, R. C. Saussure, vice-president, and W. H. Rhett, secretary of the company.

ELECTRIC RAILWAYS.

The new electric railway in Mobile, Ala., will be ten miles long. Twelve cars will be operated.

An electric railway is contemplated at Quintana, Tex. Perry Bryan and Guy M. Bryan, Jr., are the promoters.

A bill has been introduced in the Maryland legislature to charter the Annapolis, Eastport and Bay Ridge Electric Railway & Power company.

J. G. White & Co., of New York, have the contract for the overhead and track work for the new electric railroad of the Wilmington, N. C., Street Railway company. Work has been commenced.

The Ashland & Catlettsburg Street Railway company, of Ashland, Ky., which proposes to extend its road to Catlettsburg and adopt electricity as a motive power, has acquired the right of way between the two cities and will take immediate steps to carry out its plans.

The Montgomery & Cloverdale Electric Railway company of Montgomery, Ala., has awarded the contract to F. B. Pickering for the construction of its road. The line will be about seven miles long. A. W. LeBron is president and general manager of the company.

The Alexandria, Va., & Fairfax Passenger Railway company will build an electric railroad on the principal streets of Alexandria and to Mount Vernon, about ten miles in all. Surveys are now being made and contracts will be let soon. L. W. Spear is the secretary of the company.

The Tacoma, Wash., & Edison and Point Defiance Street Railway companies have been consolidated under the name of the Point Defiance, Tacoma & Edison Railway company. The capital stock of the company is $500,000. The consolidation of the two systems makes a through line from the smelter at Point Defiance to the Northern Pacific car shops at Edison.

ELECTRIC MINING.

The Memphis Mining company of Ouray, Colorado, has introduced electric drills and machinery. It is boring into the mountain at the rate of twenty-six inches every six minutes in solid quartz in search of the "Bright Diamond" ore body.

The Virginius Mining company of Colorado is reported to be saving $36,000 yearly in fuel expenses by the addition of electrical power to the working of the mine, to say nothing about the saving in light expense, as the mine is lighted throughout by the dynamo furnishing the power.

TELEGRAPH.

A cable dispatch from London dated Feburary 20th gives an account of a blizzard that played havoc with English telegraph wires. Communication with America was practically cut off for a time, because the land wires were down between London and Land's End. Commercial dispatches were sent across the English Channel, through France and Spain to Lisbon, whence they were transmitted through the eastern cable back again across the Bay of Biscay to Penzance, and thence forward to America. Newspaper messages were subject to twenty-four hours delay. Two cable companies refused to accept any press messages whatever. Dorsetshire, Devonshire and Cornwall were practically cut off from communication with the rest of England.

MISCELLANEOUS.

The Mulhouse Industrial society, Alsace, has offered a premium of $500 for the best scheme of utilizing natural water power, especially applicable to the needs of Upper Alsace. Projects, accompanied by sealed envelope containing name, must reach the society by May 15th.

At a recent ball at a private residence near London electric light tinted by colored glass of different shades was thrown on the dancers. The effect, as a whole, was very pretty, but some of the ladies complained that the colors did not harmonize with their complexions and costumes.

The annual meeting of the stockholders of the Edison General Electric company will be held at the office of the company, Edison building, Broad street, New York, at noon on Wednesday, February 10th.

At a late trial of the Sims-Edison torpedo it is reported that two runs were made and a speed of over twenty-six knots obtained and kept up against a strong tide, the machinery working without a hitch. A torpedo boat passed through the bay as the second run was being made, and Sims made the torpedo circle round her in a marvelous manner, pass the stern of the boat, and then return as if to strike her on the beam.

TRADE NEWS.

The directors of the Deane Steam Pump company, Holyoke, Mass., chosen at the recent annual meeting, are as follows: Theophilus Parsons, president; C. H. Heywood, treasurer; Charles P. Deane, Stephen Holman, Emerson Gaylord, Geo. W. Prentiss, Philander Moore.

The Lunkenheimer Brass Manufacturing company Cincinnati, O., is distributing a neat little calendar which illustrates in an ingenious manner the operation of the "Handy" gate valve. The calendar carries on its face what is nothing more nor less than a model of the "Handy" valve in paper.

The Bain Manufacturing company has recently built for the Patton Motor company a 20 horse power generator to be run at slow speed, not exceeding 600 revolutions, for a new exhibition car to be shown by the Patton company. This machine is to be used alternately as a generator and motor.

The Page Belting company of Concord, N. H., reports a very promising opening for the year 1892. Among the orders filled recently are the following: Geo. O. Sanders, Nashua, N. H.; G. H. McDowell & Co., Cohoes, N. Y.; J. G. Bryson, Brazil, Ind.; Chattanooga Powder Co., Chattanooga, Tenn. The Page company has equipped the plant of the Peninsula Electric Light & Power company, at Newport News, Va. This outfit included four "Acme" link belts and two "Eureka dynamo" belts The Page company also furnished the complete outfit for the Penacook Electric Light company, Penacook, N. H. A large business is reported in special electric belts, the "Acme" link and "Eureka Dynamo" and "Dynamo Double."

The Southern Electric company, Lynchburg, Va., announces that on and after February 1st it will conduct business under the name of The Poole Electric company. This change was deemed advisable in order to preserve individuality and to avoid its being confounded with other companies which include the word "Southern" in their titles. The Poole company will discontinue keeping a stock of general supplies, and will only keep on hand the celebrated Economic incandescent lamps, together with the following specialties: Moore's wires and lamp cords; Zurn's dynamo and engine oils, and the Poole arc lamps. The specialties made to order will be railway generators, arc and incandescent dynamos, and constant potential motors.

BUSINESS.

The Electric Merchandise company, Chicago, has just issued a pamphlet on "Electric Heating." The little book is a work of art and its circulation will do much toward removing whatever doubts may exist regarding the economy, convenience and efficiency of the Burton heater.

Robb MacKie, for the past two years electrical engineer of the Allied Electric Light companies of Cincinnati, has resigned that position to establish an office as consulting engineer in that city. Mr. MacKie was formerly general superintendent of the Fort Wayne Electric company and is widely and favorably known to the profession.

Julius Lefmann, 2200 North Second street, St. Louis, is offering to the electric trade a "three-jointed" iron pole and is pushing its sale with commendable energy. Mr. Lefmann for many years held a prominent position with a leading street car manufacturing company in St. Louis, and is well known to the trade.

The Bain Manufacturing company has just built for the Dupont Powder works, Wilmington, Del., one 100 horse power generator, 500 volts, constant potential, and two motors, one of 75 horse power and one of 25 horse power. This apparatus is to supplant steam in the powder mill, the object being to lessen the risk incidental to this business.

L. Blatz, 107 West Monroe street, Chicago, has recently enlarged his facilities and is now prepared to turn out rapidly any order for brass castings, such as commutator strips, etc., however large, that may be given him. Mr. Blatz would also like to be put in communication with persons having electric specialties that they desire to have manufactured on a royalty.

The Ries Electric Specialty company, Baltimore, Md., will shortly increase its capital stock to $150,000. Some valuable specialties have been lately acquired by this company, and in order to increase the facilities to meet the rapidly increasing demand for the goods, it was decided at the last meeting of the board of directors of the company to issue stock to the above amount. Fifty thousand dollars' worth of the stock will be preferred and will bear interest at 6 per cent. Most of the new issue, it is stated, has been already subscribed for.

A contract has been made between the Engineering Equipment company of New York and the Gould & Watson company of Boston, by which the former concern takes the agency in the East for "G. & W." line materials. Purchasers of these materials will find the Engineering Equipment company prepared to give manufacturers' terms, and to fill orders from stock without delay. W. F. D. Crane, M. E., has charge of this department at the Engineering Equipment company's New York offices, 143 Liberty street, and at 126 Pearl street, Boston. F. A. Magee, M. E., represents the company in all its lines of electric railway materials.

An interesting little circular on "Tested Fuse Wire" has just been issued by Manager W. R. Goodman of the fuse department of the Sperry Electric Mining Machine company, Chicago. This pamphlet contains, in addition to a very complete price list, the article on "Fuse Wire," recently read before the Chicago Electric club by Elmer A. Sperry. The Sperry Mining Machine company, it may be stated, was among the first to advocate the use of a tested fuse wire, and it has, from time to time, made improvements in the composition and the methods of manufacture of this important adjunct to electrical appliances. But it is only recently that the company has been able to fully satisfy itself regarding the action of fuse wire under all conditions, and place before its customers the results of its labors in the shape of a correct system of "tested fuse wire."

ELECTRICAL STOCK MARKET.

Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, February 27th, in New York, were:

	Bid.	Asked.	
Edison General Electric company, Capital $15,000,000	98	98½	
Edison Illuminating company of New York	82½	82½	Ex. Div.
" " " Brooklyn	72½	77½	
" " " Boston	105	110	
" " " Chicago	130	140	
Edison Ore Milling company	15	20	
United States Electric company of New York	15	25	
United States Illuminating company of New York	30	40	
Brush Electric company of Cleveland	30	40	
Brush Illuminating company of New York	30	40	
Thomson-Houston Electric company	58	50	
" Preferred "	28	28½	
Westinghouse Electric company	14¼	15	
North American Phonograph company	4½	6	
New York " "	2½	5	
Automatic Exhibition company	2	3	

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

RAILWAY FEEDER AND TROLLEY WIRE,
ELECTRIC LIGHT LINE WIRE,
Incandescent and Flexible Cords,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES,
FARADAY CABLES.

NEW YORK OFFICE, P. C. Ackerman, 10 Cortlandt Street.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

Electric Specialties Wanted.

I will manufacture one or two good electric specialties on royalty. Have unexcelled facilities for putting on market. Correspondence with inventors solicited.

L. BLATZ, 107 W. Monroe St., Chicago.

WANTED—FOREMAN

In Electric Light and Motor Factory, bright, intelligent, experienced young man, one who understands shop management. Must have executive ability. Technical knowledge not necessary.
Address, "EMPLOYMENT," Care WESTERN ELECTRICIAN.

FOR SALE.

Electric Needle Annunciator Patent, Issued June 21st, 1887.

Device Simple, Reliable and Inexpensive. Cheap to Manufacture.

Address, "Annunciator," Care WESTERN ELECTRICIAN.

WANTED.

A competent Electrician and Dynamo Tender who understands the handling of engines, and is competent to take complete charge of a large plant.

Address, Dr. C. F. Wright, Supt. of the Central Indiana Hospital for Insane, Indianapolis, Ind.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

HENRY A. CLARK, Treasurer and Gen'l Manager.
HERBERT H. EUSTIS, President and Electrician.

WANTED.

First-class man as foreman in Central Station. Must be sober, reliable, good mechanic; neat and handy at all sorts of repair work on machines and lamps. Nice position, and permanent. Good pay to right man.

Give reference, state experience, salary expected, etc.

Address, "MANAGER," Care WESTERN ELECTRICIAN.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery, Chicago, Ill. 10 So. 18th St., Philadelphia, Pa.

See our full page advertisement in issue Sept. 12, for illustrations, prices, etc.

43 and 45 Franklin St. CHICAGO.

For Sale Cheap, Second-hand Machinery, Arc and Incandescent. Also Motors. All Apparatus Guaranteed.

The Electrical Construction Co.

WM. S. TURNER, Pres. GEO. A. BELL, V. Pres. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

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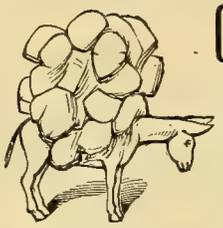
ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. NEW YORK.



Overloaded

and Disordered Batteries are a common and painful sight.

WHY?

BECAUSE they are not built to work, but to sell. Are you a sufferer? Then substitute the Law Battery, and suffer no more.

SOLE MAKERS,
Law Telephone Co.,
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MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,
218 Water St., New York.

IRON POLES.

For Iron 3 Joint Poles, Write To

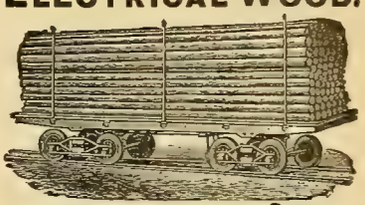
JULIUS LEFMANN,
2200 N. Second Street, ST. LOUIS.

SOMETHING NEW!

An improved 4 or 6 volt Combined Storage Battery especially for Dentists' use at very low price. Purchasers can exchange discharged for charged cells, without extra cost, beyond expense for charging the batteries. Manufactured by

J. K. PUMPELLY,
Room 301, 205 S. Canal St., Chicago.

ELECTRICAL WOOD.



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OCTAGONAL PINE AND STEEL POLES.

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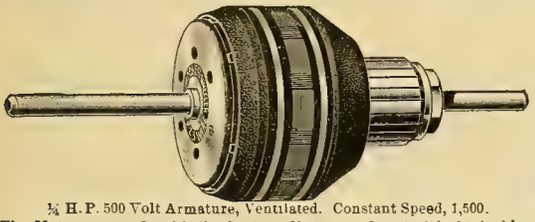
SYNOVIAL DYNAMO OIL.

Second to None. Free from Gum or Acids.

By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

Write for Prices and Samples. S. TAUSSIG, Agent, 45 River St., CHICAGO.

CROCKER-WHEELER ELECTRIC COMPANY,



SLOW SPEED MOTORS.

¼ H. P. 500 Volt Armature, Ventilated. Constant Speed, 1,500.

The Motors are made with the best appliances and material obtainable, and embody every improvement of merit, with the intention that they shall be the Standard of their class.

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Offices, Covington, Ky. Factories, Muncie, Ind.

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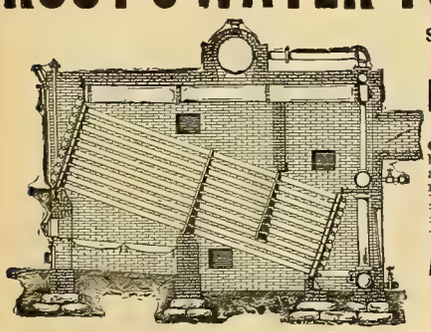
Glass Break Knobs, Floor Insulators, Battery Jars.

ARC LIGHT GLOBES FOR ALL SYSTEMS.

WORK ON SPECIAL DESIGNS SOLICITED.

ROOT'S WATER-TUBE BOILER.



Root's Sectional Safety Boiler.

SAFE. ECONOMICAL. DURABLE.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the **Electric Light Companies** of Detroit, St. Paul, Columbus, Cincinnati, Louisville, Jersey City and a great many others; also by the Armington & Sims Engine Co., Providence, R. I.; the Lynn Belt Line Street Ry. Co., Lynn, Mass. and the Thomson-Houston Electric Co., Lynn, Mass.

Abendroth & Root Mfg. Co.,

28 Cliff St., New York.

BRANCHES: Chicago, Boston, Philadelphia, Dallas, Rochester.

TO MAKE A STATION PAY

Buy only the best quality of goods. This you can do by sending your orders to us.

Prompt Shipment. Reasonable Prices. Full Measure. No Charge for Boxing or Cartage.

WE ARE HEADQUARTERS FOR

National Alternating and Direct Current Dynamos, Generators and Transformers;
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Save time and money by placing your orders with

The Electrical Engineering and Supply Co.,

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GAS AND ELECTRIC FIXTURES.

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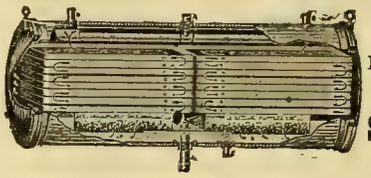
Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

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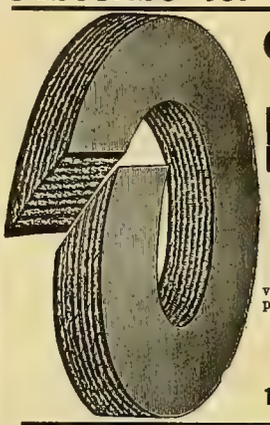

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All Orders Guaranteed.

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Civil and Topographic Engineer,
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Topographic Surveys of any extent and character organized and executed.

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Electric Railways.
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Electrical Machinery designed for special applications, plans, specifications and supervision.
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EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

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Of Low Voltage.

Over 40 New Styles of Lamps
For the first time on the market.
Catalogue, Part I, Ready.
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EXPERIMENTAL LAMP WORK
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Write for prices and illustrations.

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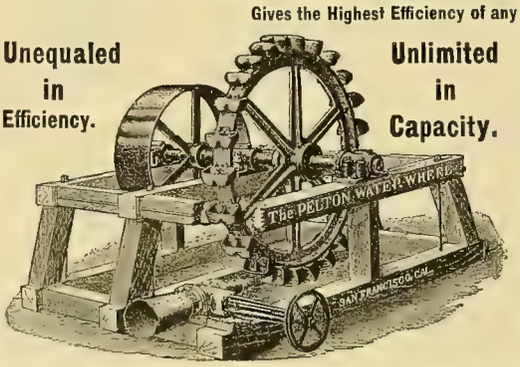
THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency.



Unlimited in Capacity.

Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 20 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

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☞ It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞ Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.

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MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

Manufacturers of
OCTAGONAL AND CEDAR
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Bare and Insulated Wire.

Underwriters' Copper Electric Light Line Wire, Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Bound and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

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For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the Washington Carbon Company. Carbons for Arc Lighting.

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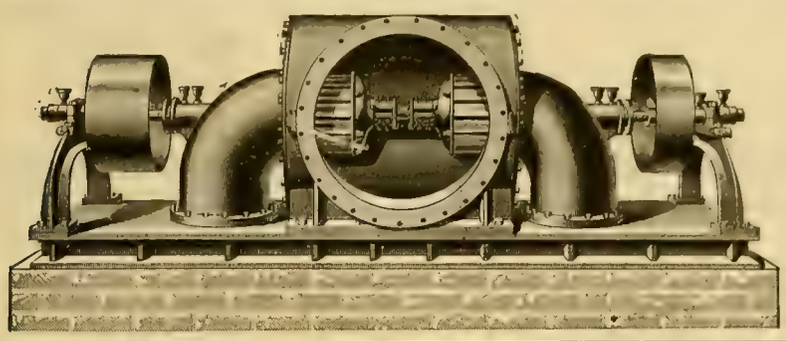
VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL**, as particularly adapted to their use on account of its **remarkably steady motion, high Speed and great Efficiency**, and **large Capacity** for its **diameter**, being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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The accompanying engraving represents a pair of 12 inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

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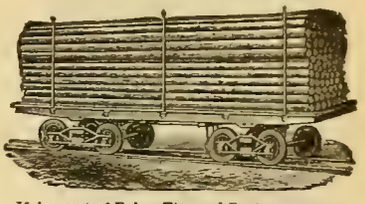

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Are Standard. Only One that is Guaranteed.

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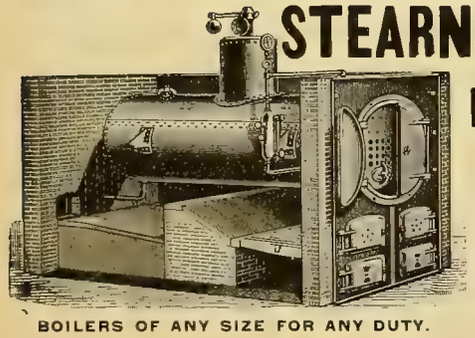

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COMPLETE POWER PLANTS FOR

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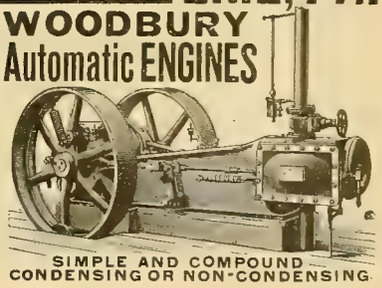

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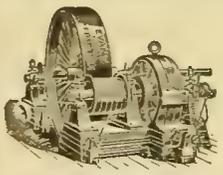

For Driving Dynamos.

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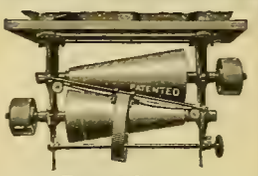

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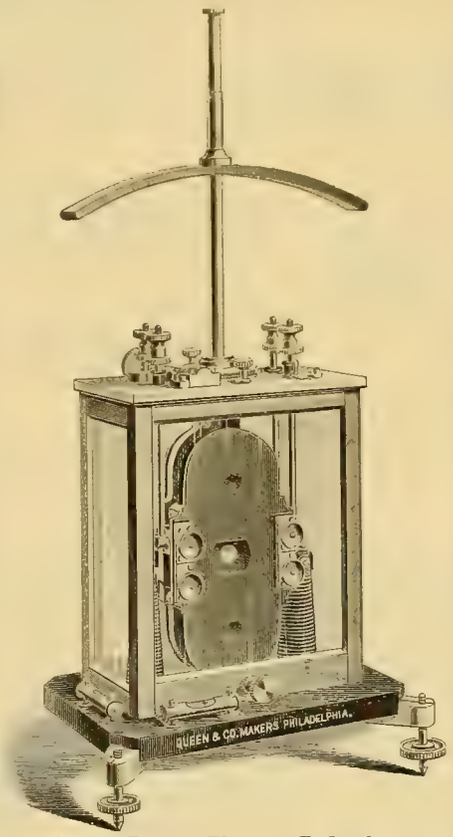

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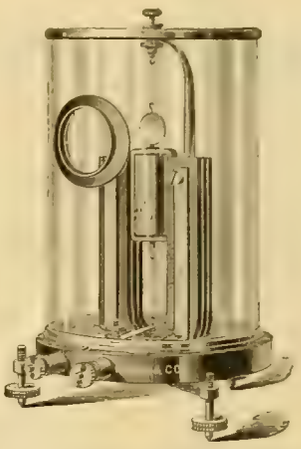

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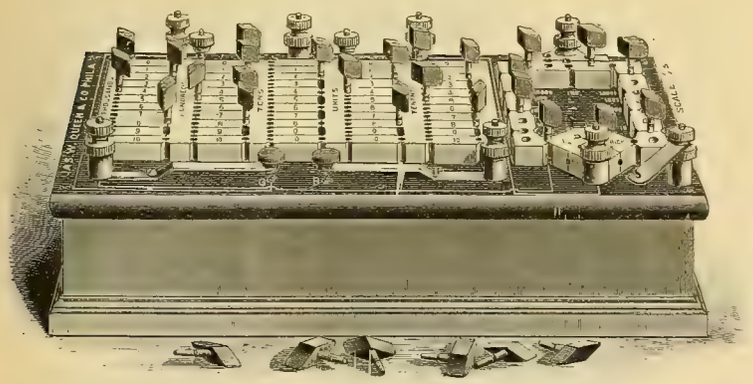

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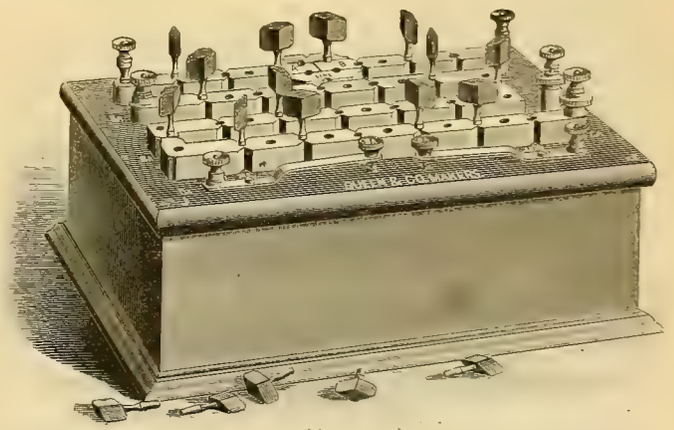

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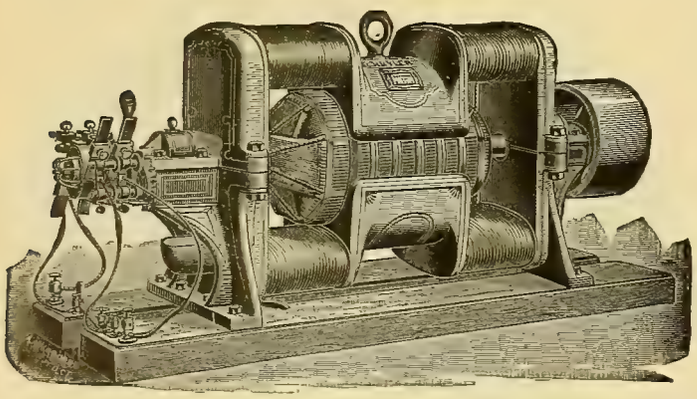

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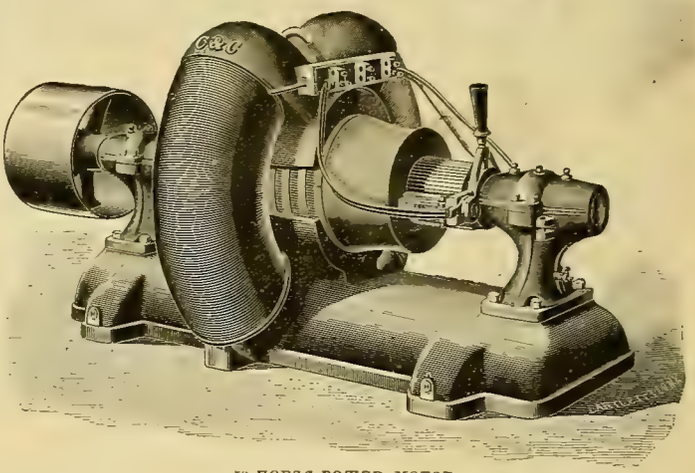

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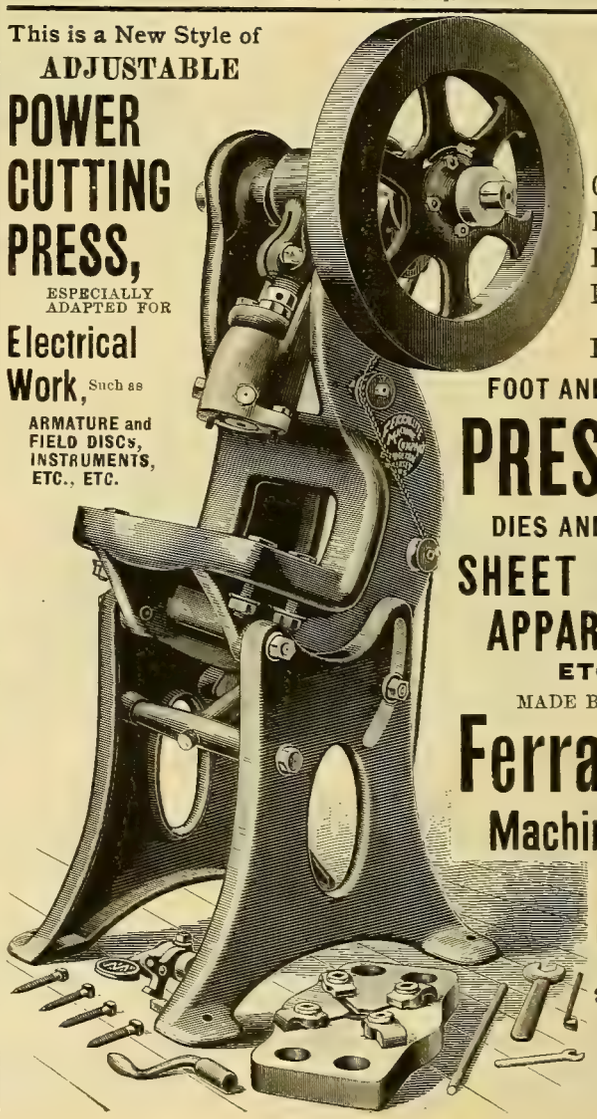

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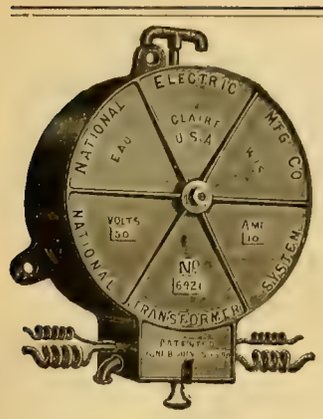

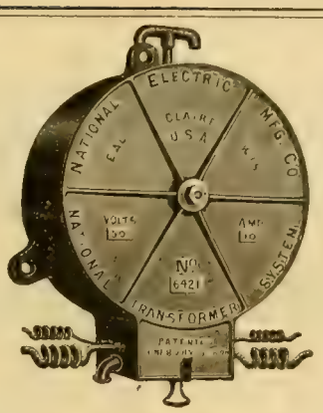

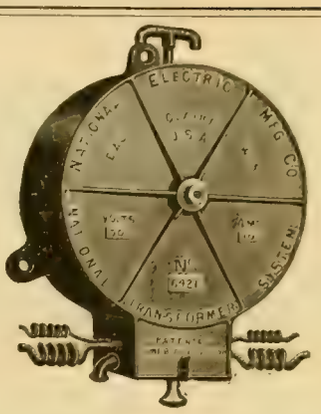

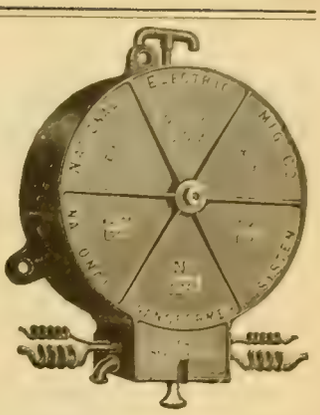

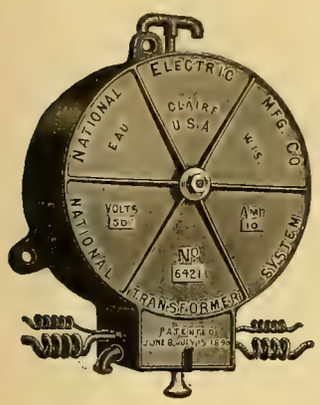

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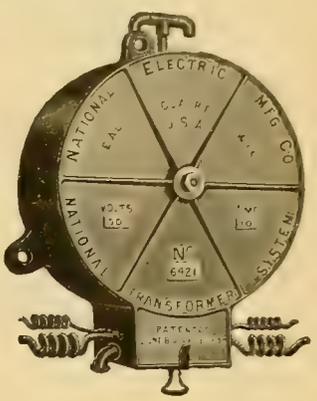

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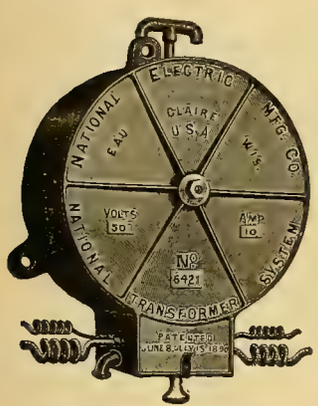

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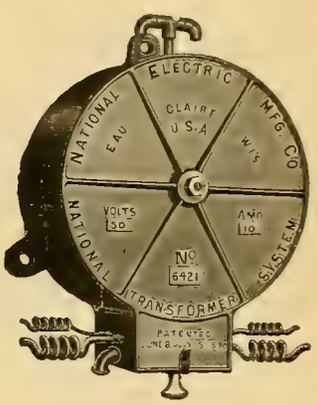

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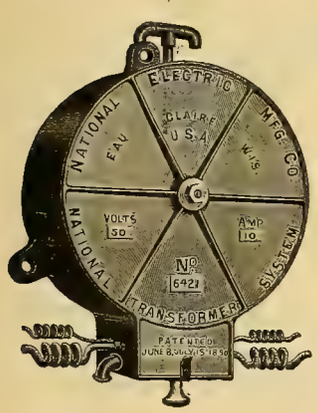

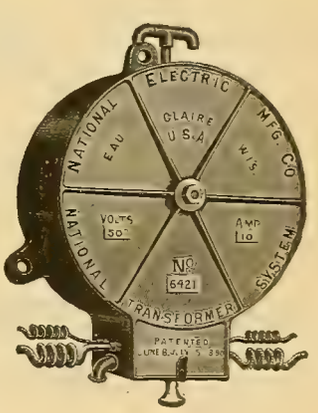

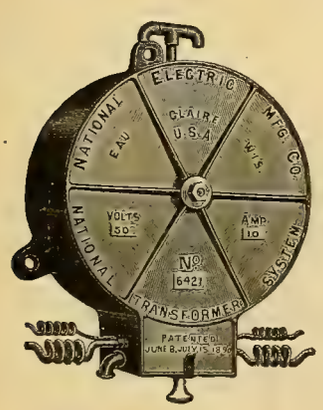

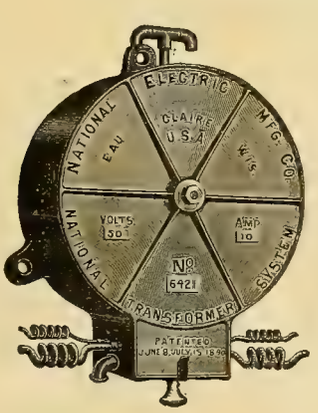

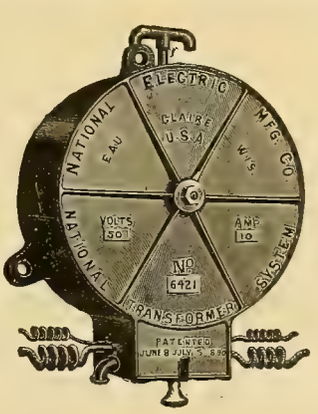

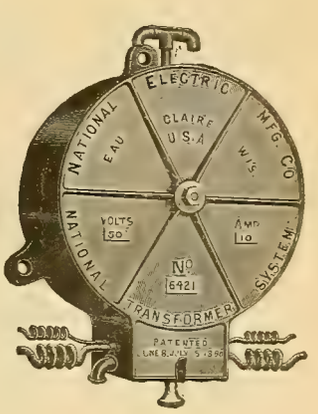

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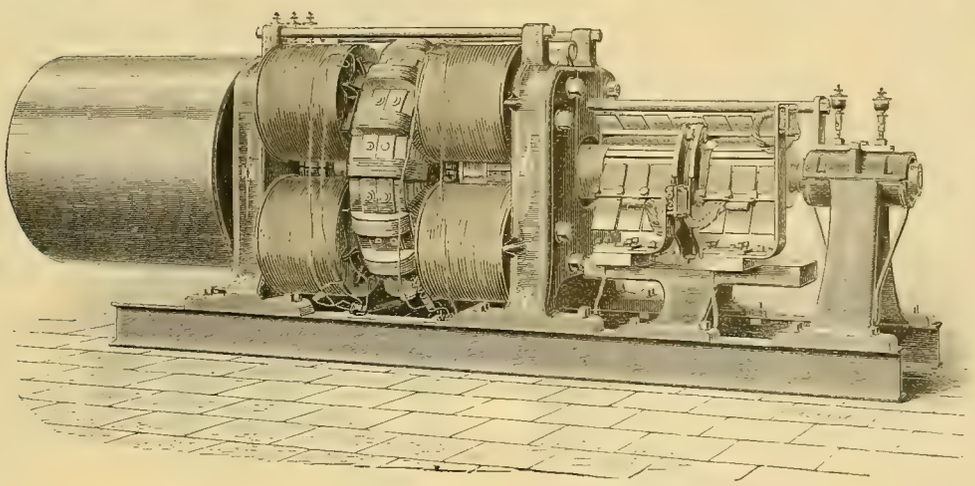

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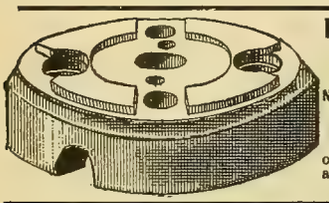

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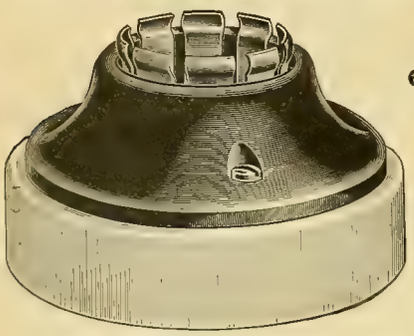

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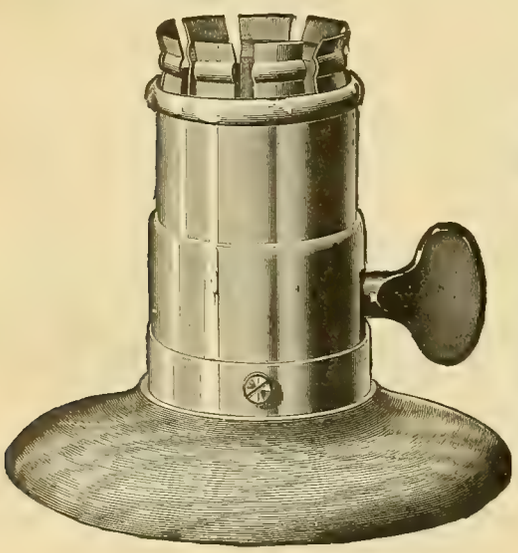

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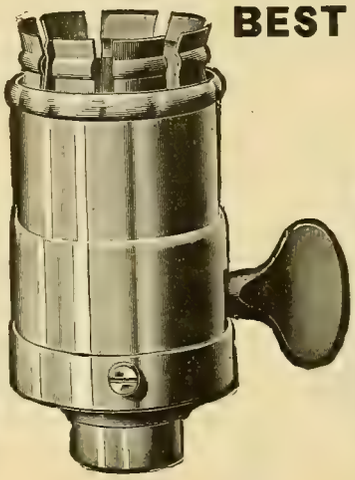
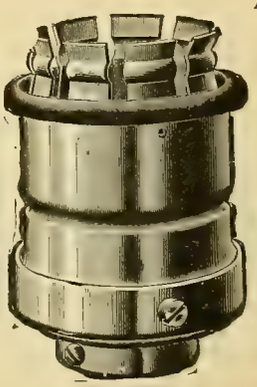


No. 110. Key Socket.



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ALSO—

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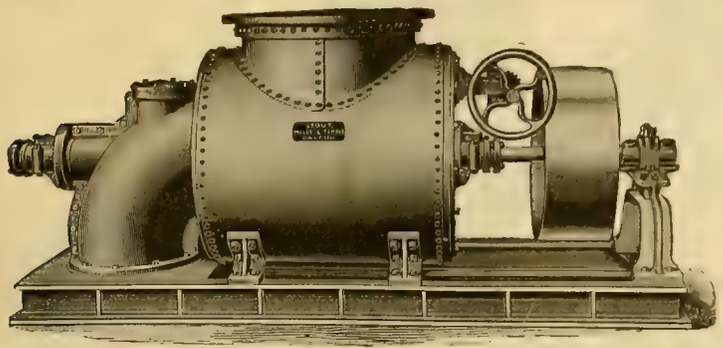
No. 145. Keyless Socket for 75, 100 and 150 c. p. Lamps.

No. 150. Waterproof Socket.

No. 140. Attachment Plug, with Fuses.

The New American Turbine Water Wheel.



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On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

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STEAM PLANTS

INSTALLED BY

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Three 8 H. P. Vertical.
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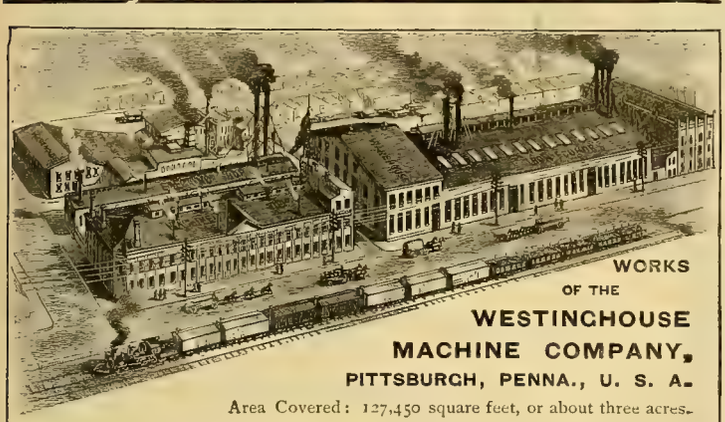

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PITTSBURGH, PENNA., U. S. A.

Area Covered: 127,450 square feet, or about three acres.

WESTINGHOUSE STEAM ENGINES alone are produced, to wit:—Junior Automatics, in 7 sizes, from 5 to 75 H. P.; Westinghouse Standard Automatics, in 13 sizes, from 5 to 250 H. P.; Westinghouse Automatic Compounds, in 11 sizes, from 8 and 13 x 8 Cylinders to 23 and 40 x 20 Cylinders; all of which are manufactured in quantity to hardened steel templates, and carried in stock, ready for shipment.

REPAIRS ARE ALSO MANUFACTURED in quantity to templates, and carried in stock.

THE COMPANY MANUFACTURES, for its own use, all Iron and Brass or Bronze Castings, as well as all its own Iron and Steel Forgings, from the smallest to the largest; thus controlling, in a measure, the quality of the materials entering into the Engines which it produces.

THE PRODUCING CAPACITY OF THE COMPANY'S WORKS is equal to about four (average) Steam Engines per diem, or about 5,000 H. P. per month, or about 60,000 H. P. per annum.

OVER 6,000 OF THESE ENGINES HAVE BEEN SOLD during the past ten years, with constantly increasing orders.

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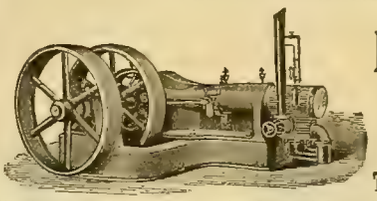

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The Pond Separator is guaranteed to relieve the steam of all entrained water and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

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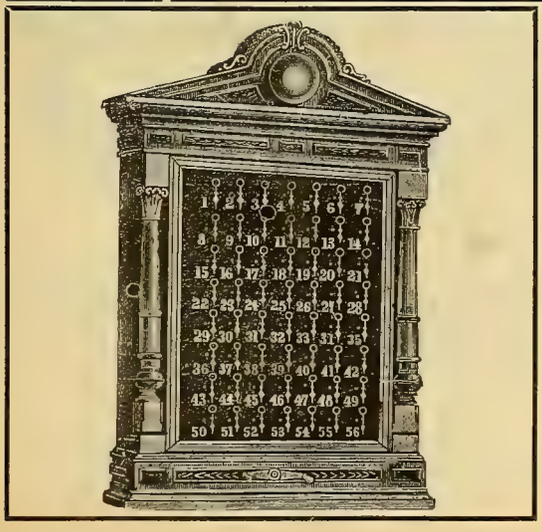

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Manufacturers of and Dealers in all Kinds of

ELECTRICAL SUPPLIES.

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AGENTS: { The Toronto Construction and Electrical Supply Co., Toronto, Canada. Northwest Electric Engineering Co., Portland, Oregon.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of Application and Business Card.

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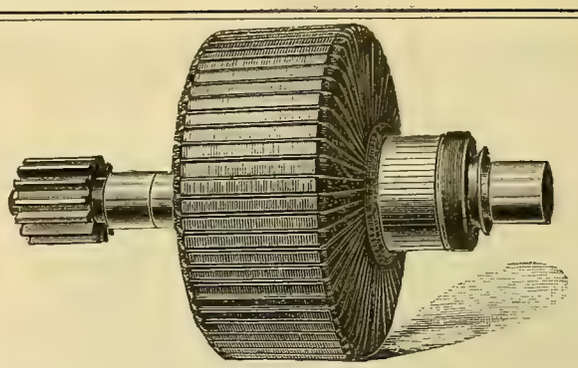

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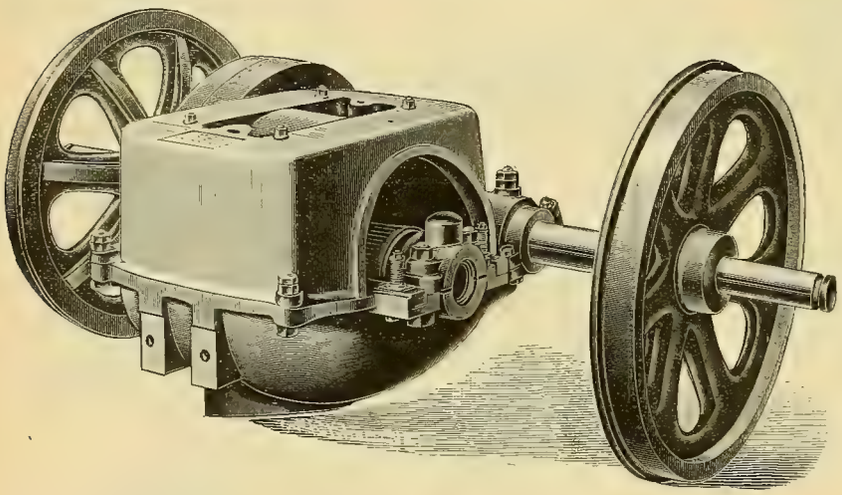
HAVE PLACED UPON THE MARKET A

NEW STREET RAILWAY MOTOR.



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$10 per Year for Renewal of Pinion and Gear.

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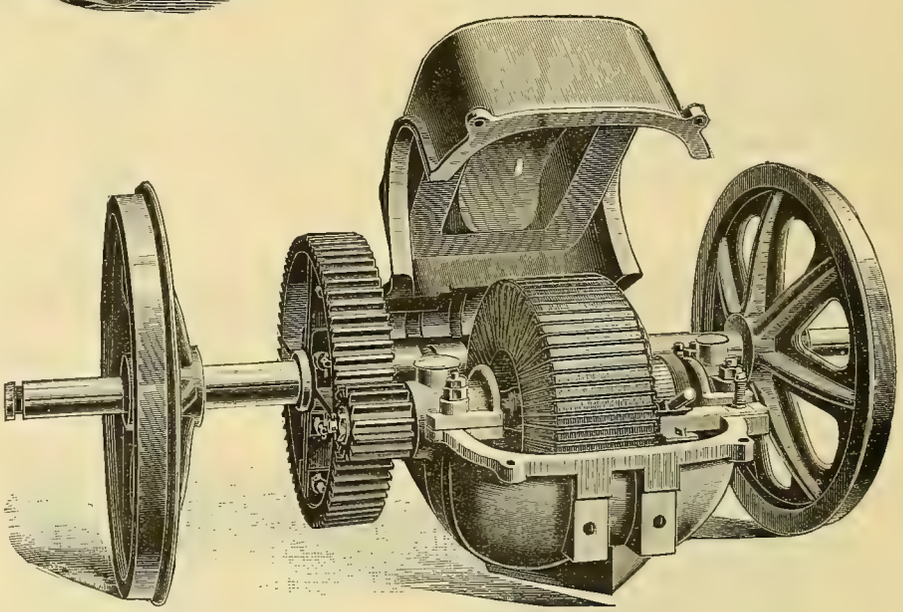
Strong Indorsements from those using it.

Send to us for Prices and Information.



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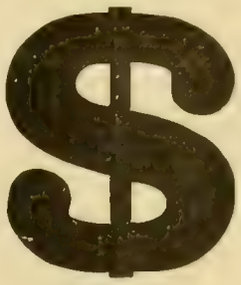

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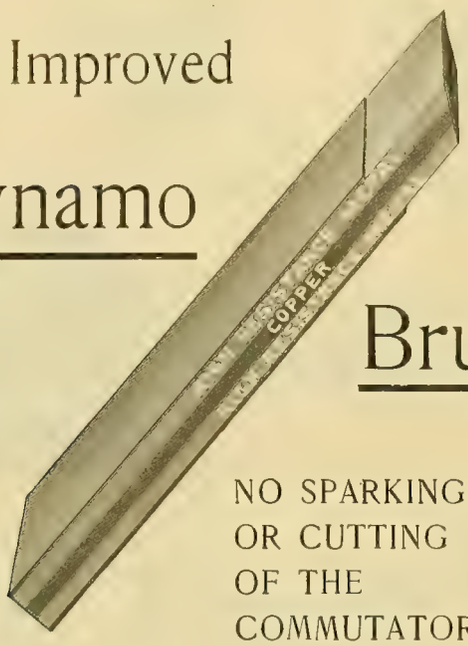
Your dollars are good—
We want them.
Our lamps are good—
You want them.
Why can't we trade?
We give you **PERKINS LAMPS,**
The best on the market,
For your dollars.
We have lots of things
To trade for dollars.

WRITE FOR OUR CATALOGUE.

THE KNAPP ELECTRICAL WORKS,

CHICAGO, ILL.

The Wirt Improved Dynamo Brush.



NO SPARKING OR CUTTING OF THE COMMUTATOR.

READ WHAT PRACTICAL USERS SAY ABOUT IT.

OFFICE OF
THE CHICAGO COPPER REFINING CO.,
Office 620 and 621 Phenix Building,
138 Jackson Street.

CHICAGO, Jan. 20, 1892.

THE ELECTRICAL SUPPLY CO., City.

GENTLEMEN:—We have been using four No. 32 Wirt Dynamo Brushes for about a month. We find that they do not spark at all and cause but little wear on the commutator, keeping the surface of the latter smooth. The Wirt Brush is entirely satisfactory, and superior to any we have used. Yours truly,

THE CHICAGO COPPER REFINING CO.,
W. I. HITT, Sec'y.

THE COLUMBIA.
LEADING THEATER OF CHICAGO.

THE ELECTRICAL SUPPLY CO., Aug. 23, 1891.

GENTLEMEN:—The brushes are running with much less sparking than any I have ever tried. Evidently they are an improvement.

Respectfully, GEO. CARSON.

CITY HALL, CHICAGO, Aug. 27, 1891.

THE ELECTRICAL SUPPLY CO.,

GENTLEMEN:—We have been running your brushes on our Edison Dynamo for two months and find they are a decided improvement.

HENRY MUNSTERMAN,
Chief Engineer.

CHICAGO, Aug. 22, 1891.

THE ELECTRICAL SUPPLY CO.,
Michigan Avenue and Randolph Street, Chicago.

GENTLEMEN:—We have used a set of your Wirt Brushes on our dynamo, and have had no sparking and scarcely any attention required during that time. The brushes furnished by the makers of the same dynamo were always more or less troublesome, and required frequent resetting and dressing of the commutator. I would now consider it a hardship to be obliged to use the old brushes.

Yours truly, (Signed) R. C. PAGE,
Engineer Libby Prison Museum.

MARYSVILLE, O., Jan. 2, 1892.

THE ELECTRICAL SUPPLY CO., Chicago, Ill.

DEAR SIRS:—The brushes came in good order, and after giving them a trial I find them to be the best brushes we ever used, as they run smooth and do not cut the commutator, or spark. We will order more. Very truly, R. TURNER,
Chief Engineer Marysville Light & Water Co.

WEST KENTUCKY INSANE ASYLUM,

HOPKINSVILLE, KY., Dec. 20, 1891.

THE ELECTRICAL SUPPLY CO., Chicago.

GENTLEMEN:—Having used your Wirt Brushes for over a month, I am satisfied they are all that you claim for them. Please send me your general catalogue. Yours respectfully,

JNO. G. LUTZ.

CHICAGO, Nov. 19, 1891.

THE ELECTRICAL SUPPLY CO., Chicago, Ill.

GENTLEMEN:—After trying one set of your Patent Dynamo Brushes, I have put them on all three of our incandescent dynamos, and like them so well that I would not be willing to use the old style of brush again. Yours truly,

D. B. RAMSEY,
Chief Engineer Union League Club.

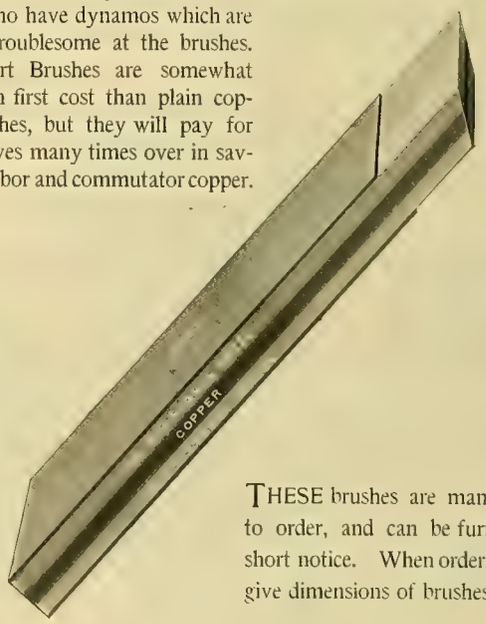
DENVER, COLO., Nov. 27, 1891.

THE ELECTRICAL SUPPLY CO., Chicago, Ill.

GENTLEMEN:—I am much pleased with the Brushes. I gave them the most severe test I know of, placing them on a commutator where *even carbon* brushes were not successful in reducing the sparking, and where there was a very heavy current at high potential, with a constant "chewing" up of the copper. Your Brush has eliminated all trouble, and I have asked our Company to order a number of them, when I shall use them on our other dynamos.

Yours truly, R. H. STERLING,
Electrician, Denver Consolidated Electric Co.

WE invite correspondence from those who have dynamos which are at all troublesome at the brushes. The Wirt Brushes are somewhat higher in first cost than plain copper brushes, but they will pay for themselves many times over in saving of labor and commutator copper.



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VULCANIZED INDIA-RUBBER Cables, to any Specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES and CABLES, very pliable. Every variety of INCANDESCENT CORES.

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RUBBER COVERED

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CABLES AND CORES.

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High Insulation and Long Life. all milage

If you are not acquainted with the merits of Habirshaw Insulation we shall be pleased to send you samples upon application.

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INCANDESCENT LAMPS OF SUPERIOR QUALITY.

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SLATTERY INDUCTION AND WOOD ARC SYSTEM

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ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

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REPAIRS Form the Uncertain Element In Operating Expenses.

The "Incidentals" (Loss of Revenue, Labor, Extras, etc.,) Cost More Than Material.

KANSAS CITY, KAN., Feb. 2, 1892.

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Gentlemen:—In reply to yours of the 29th of January, would say that we have been through four severe storms this winter. In some of the snow storms we were forced to run the cars forty-three hours without stopping, but in no storm have we had a car disabled.

We push a salt car with two motor cars; the first car does very little work, merely breaking the track for the rear car. Our salt car loaded will weigh about 5 tons, subject to the ordinary passenger traffic, probably having on 20 or 30 people.

Our worst grade is a very long 6 1-2 per cent.; our heaviest grade being 8 1-4 per cent., 760 feet long.

In regular service we at times carry as many as 75 people on a car. Do not pull trail cars.

In snowstorms, the use of sand is forbidden except when absolutely necessary. Sand used by careless men is the cause of a great deal of trouble.

If there is anything further we can do for you, or any further information desired, please advise us.

Yours very truly,
(Signed) C. S. CLARK, Manager,
The West Side Railway Co.

Detroit Electrical Works,

DETROIT, MICH., U. S. A.

431 "THE ROOKERY" Chicago, Ill.

Correspondence Solicited.

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Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. X. CHICAGO, MARCH 12, 1892. No. 11

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ANY CAPACITY UP TO 1,000 HORSE POWER.

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Always Ready For Use.

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Every Electric Light Plant should have it.

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THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery.

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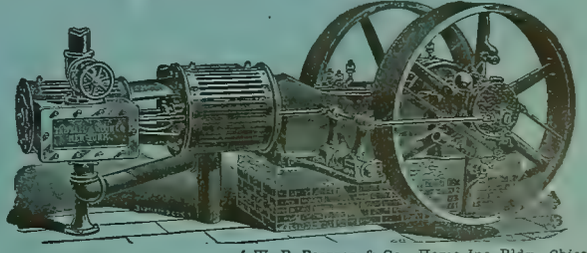

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Detroit Electrical Works.
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Electrical Supply Co., The.
Great Western Elec. Supply Co.
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Knapp Electrical Works.
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Partrick & Carter Co.
Union Electric Works.
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Great Western Elec. Supply Co.
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Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
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Knapp Electrical Works.
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Detroit Electrical Works.
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Law Telephone Co.
Pumpelly, J. K.
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Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co., W. R.
Partrick & Carter Co.
Union Electric Works.
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Central Electric Co.
Detroit Electrical Works.
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Knapp Electrical Works.
Partrick & Carter Co.
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Jewell Belting Co.
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Page Belting Co.
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Pond Engineering Co.
Stearns Mfg. Co.

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Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

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Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Schindel & Schindel.

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Hill Clutch Works.

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Samson Cordage Works.

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Central Electric Co.
Electrical Supply Co, The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Washington Carbon Co.
Western Electric Co.

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Electric Cons. & Supply Co.
Electric Supply & Contracting Co.
Electrical Construction Co., The.
Knapp Electrical Works.
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Smith, Thos. G. Jr.
Union Electric Works.
Western Electric Co.

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Brush Electric Co.
Chicago Electric Mfg. Co.
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Diamond Electric Mfg. Co.
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Electric Cons. & Supply Co.
Electric Supply & Contracting Co.
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La Roche Electric Works.
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Pearson & Co., W. B.
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Taylor Engine Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
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Woodbridge & Turner Eng. Co.

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Detroit Electrical Works.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Roebling's Sons Co., J. A.
Sperry Elec. Mining Machine Co.
Western Electric Co.

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Andrae, Julius.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
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Schuyler Electric Co.
Thomson-Houston Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

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Detroit Electrical Works.
Edison General Electric Co.
Rae, Frank B.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

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Pierce, Josiah.
Rae, Frank B.

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Greeley & Co., The E. S.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

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Knapp Electrical Works.
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Crown Electric Mfg. Co.
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Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
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Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
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Partrick & Carter Co.
Penn. Elec. Eng. Co.
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Cushing, F. W.
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Electric Merchandise Co.
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Partrick & Carter Co.
Security Insulator Co.
Standard Paint Co.
Vulcanized Fibre Co.
Western Electric Co.

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Central Electric Co.
Chicago Insulated Wire Co.
Cushing, F. W.
Cutter, Geo.
Day's Kerite Insulation.
Detroit Electrical Works.
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Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
International Okonite Co., The.
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Knapp Electrical Works.
New York Insulated Wire Co.
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Sperry Elec. Mining Machine Co.
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Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
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Great Western Elec. Supply Co.
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Penn. Elec. Eng. Co.
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Ferracute Machine Co.

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Detroit Electrical Works.

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Westinghouse Electric & Mfg. Co.

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Crocker-Wheeler Electric Co.
C. & C. Electric Motor Co.
Chicago Electric Motor Co.
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Diamond Electric Mfg. Co.
Easton Electric Co.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
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Rockford Electric Manufacturing Co.
Royal Electric Co.
Thomson-Houston Electric Co
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Schindel & Shindel
Western Electric Co.

Platinum.
Schawel & Co., Jas.

Poles.
Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Lefmann, Julius.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Schindel & Schindel.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Detroit Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co., The.

Securities, Electrical.
Gilman & Co., E. R.
Perry & Noyes.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Silk Braid.
Boston Braid Mfg. Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway.
Detroit Electrical Works.
Electric Merchandise Co.
Schindel & Schindel.

Tapes, Insulating.
American Electrical Works.
Andrae, Julius.
Central Electric Co.
Chicago Insulated Wire Co.
Cushing, F. W.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Standard Paint Co.

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Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Detroit Electrical Works.
Western Electric Co.

Test Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

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Knapp Electrical Works.
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* * * * * * * * * * * * * * * * * * *

On Sunday morning last it commenced snowing very hard, and so continued all day Sunday, Sunday night and Monday. We were obliged to put forth every effort to prevent blockading of the road, which we succeeded in doing.

* * * * * * * * * * * * * * * * * * *

On Sunday morning we started your Generator No. 2 at 6:30 a. m., and continued to use the same until Tuesday morning at 3:30 a. m., when we shut it down. This Generator was in continuous service during the entire time, and was not even sanded, nor the brushes touched. It did not use to exceed one-half quart of oil. We consider this remarkable because of the hard work the Generator was doing. * * * * * * * *

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CARBONS

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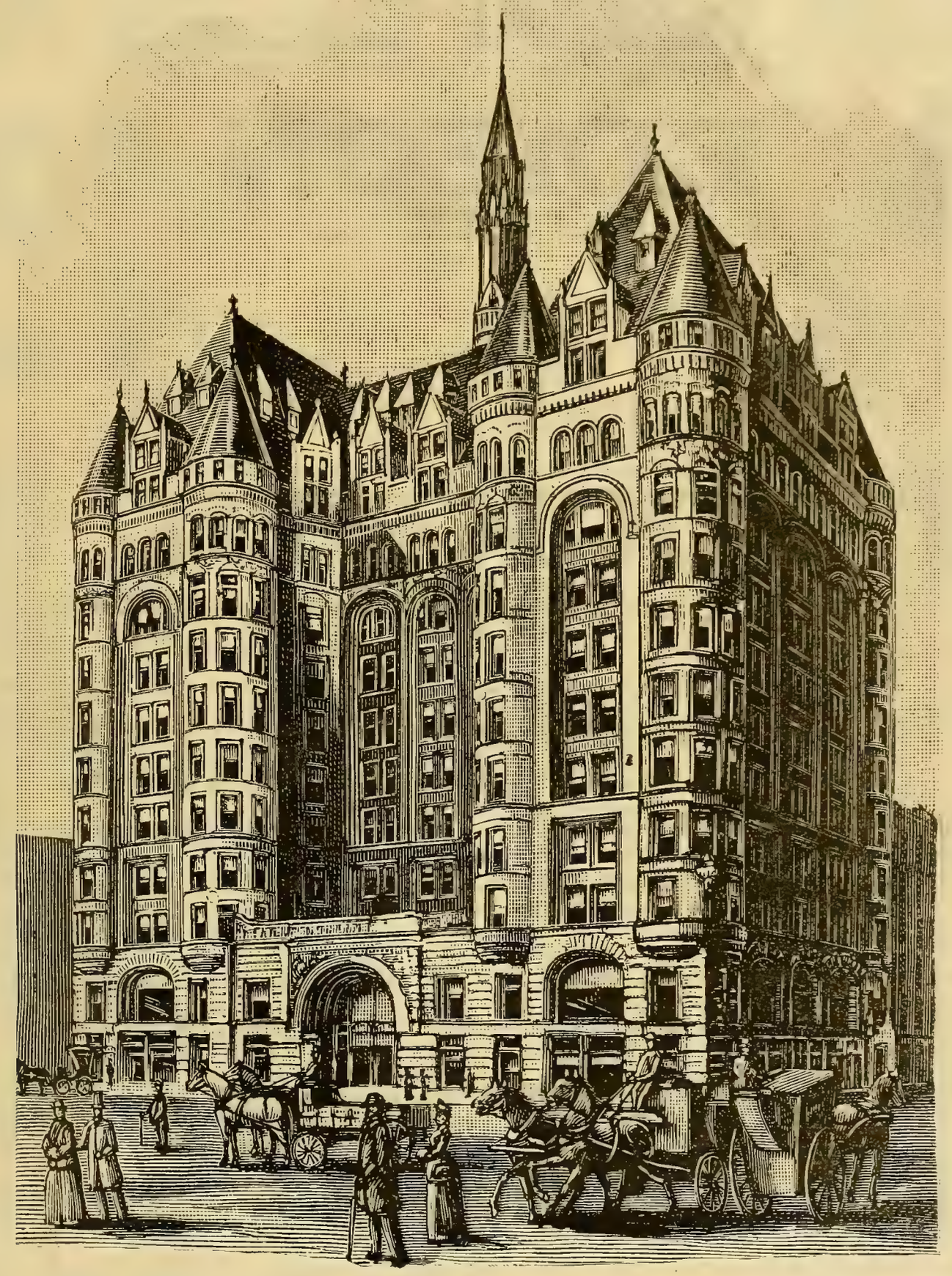

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6305–6311	8	Fancy Key Receptacle (porcelain or wood base)
6271–6277	3	Standard Keyless Receptacle (porcelain or wood base)
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666	666	Hard Rubber Weatherproof Socket
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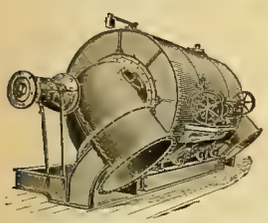

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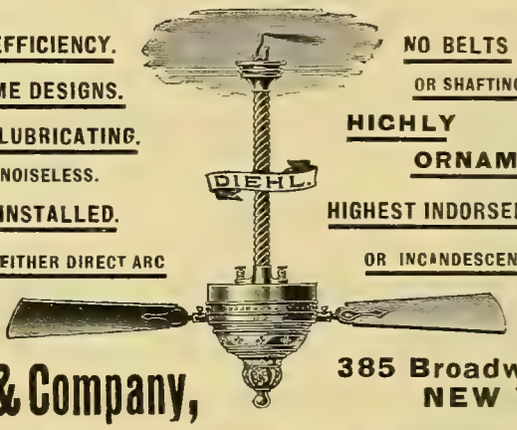

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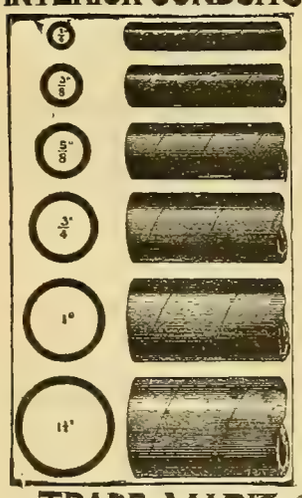

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We are reliably informed that agents and representatives of two large electric lighting companies are attempting to control trade in the street car and lighting lines by stating that the Westinghouse Electric & Manufacturing Company is to be forced, or in some way taken into a huge combination having an enormous capital, and that purchasers should therefore only deal with the representatives of the combination.

We desire to state that the position of this company is independent in every respect, and that it can, by reason of its comparatively small capitalization and its low scale of expenses, sell all competing apparatus at lower prices than can be afforded by any combination having to provide earnings for fifty million dollars capital.

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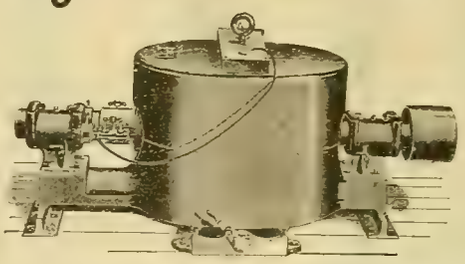

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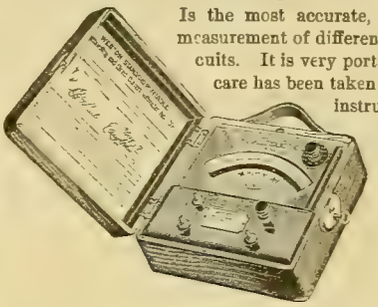

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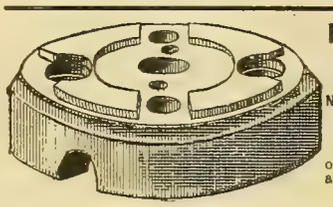

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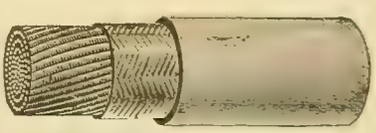

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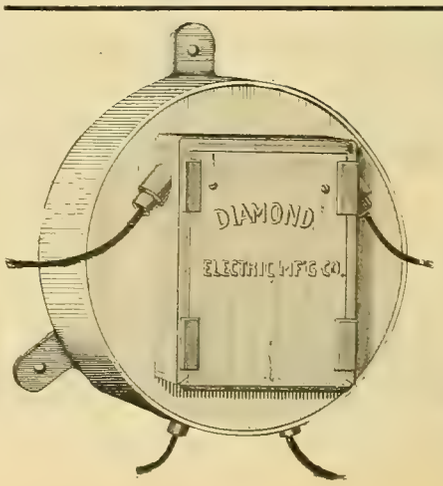

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EVERY SATURDAY.

Vol. X. CHICAGO, MARCH 12, 1892. No. 11

Isolated Storage Battery Lighting Plant.

Electric lighting for country residences may be considered a luxury which few men in the country can afford, yet according to the report of the cost of operation and maintenance of the plant herewith illustrated a comparison favorable to the electric system may be made with the cost of gas lighting based on the prices charged in many large cities.

The Electro dynamic company of Philadelphia in the fall of 1889 installed for Frank Thomson, vice-president of the Pennsylvania Railroad company, a storage battery plant for lighting his residence at Marion, Pa. This is one of the most complete installations for light and power ever supplied for a country residence, and it has now been in use for more than two years.

The power plant, Fig. 1, is situated about two thousand feet from the house in one of the outbuildings on the property. Fig. 4 shows the point at which the overhead line meets the underground cable leading to the house. The dynamo is one of the slow speed type of the Electro-dynamic company, the armature of which runs at the rate of 350 revolutions per minute. The engine makes 200 revolutions per minute.

The batteries, Fig. 2, and switch-board, Fig. 3, are placed in vaults under the veranda of the house. The former until recently, consisted of two sets of fifty-two cells each of the "15 L" type of the Accumulator company. A third set has now been added to supply additional power for small motors to run elevators, pumps, etc. The batteries are charged as often as required, the average in summer being twice a week, and in winter every other day. The capacity from the batteries alone is about two hundred and fifty lights at one time. On occasions when all the lights on the premises are required the dynamo is run, and, in connection with the batteries, will supply over five hundred 16 candle power lamps. It has cost practically nothing to maintain the battery during the last two years, either in labor or material. The cost of lighting is covered by the cost of coal consumed and the wages of the engineer, who is occupied with the electric plant less than half the time, and when not so employed is at work regularly elsewhere. A careful comparison of the cost of the light for a period of three months with the price of gas at city rates for an equivalent amount of illumination shows that electricity is much the cheaper. This system is especially adapted for large country houses like Mr. Thomson's, where light and power are required at all times during the day or night, while a direct system would be not only uneconomical but well-nigh impracticable.

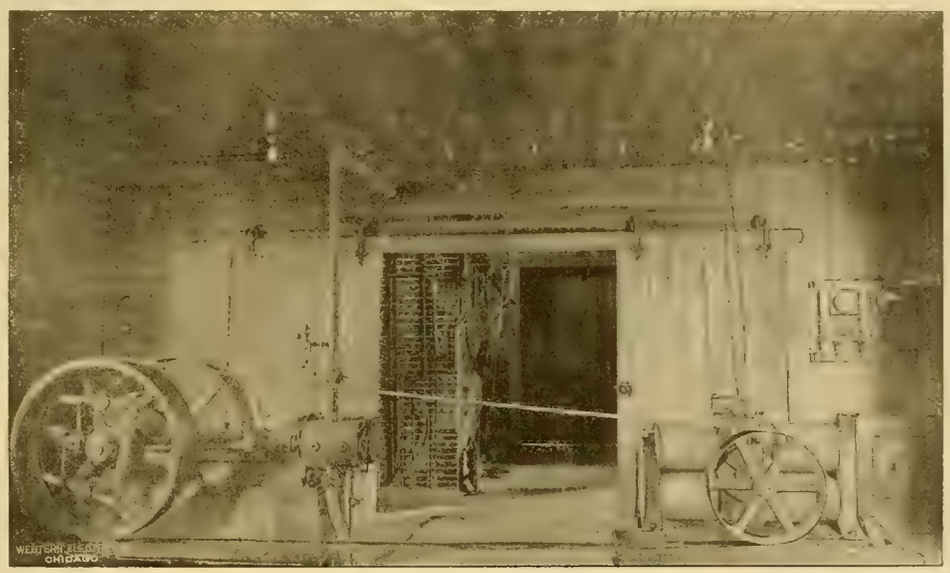


FIG. 1. ISOLATED STORAGE BATTERY LIGHTING PLANT.

Municipal Lighting in Milwaukee.

Municipal lightiing was made an issue in the spring campaign in Milwaukee. At the Republican city convention a platform was adopted which pledges the support of that party to the introduction of a municipal lighting system. "We believe," reads the platform, "that the city should own and furnish its facilities for the lighting of streets and public places." For a number of months there has been a rapidly growing sentiment in favor of municipal lighting, which means lighting by electricity, of course, and the success of the movement appears to be only a matter of time. The contract with the Badger Illuminating company, at $110 per lamp per year, runs for three years. At the end of that period it is quite probable the city will own and operate its own electric light plant.

Establishment of a Siemens & Halske Factory in Chicago.

On Friday of last week an announcement was made in Chicago that will excite great interest throughout the entire electrical fraternity of the country. It was to the effect that Siemens & Halske, the important German firm of electrical manufacturers, had concluded arrangements whereby their apparatus was to be manufactured and sold in the United States by a branch company that will make an active effort to secure a portion of the American trade.

The German firm took out patents in this country as far back as 1878, but made but little effort to secure business here, evidently under the impression that the electrical development of such a backwoods region as America was hardly worth cultivating. With this idea in mind the firm entered into contract with the Edison General Electric company by which the latter concern was given the exclusive right to manufacture and sell the Siemens cables in the United States. This is an important branch of Siemens & Halske's business, and it is said that the firm regrets its bargain now that it is to have a factory of its own in this country.

The World's Fair is given the credit of opening the eyes of the members of the house to the development and resources of America, and to the desirability of entering the electrical field here. Carl Vogel, manager of the works at Charlottenburg, came over here first to confer with the exposition authorities in relation to the firm's proposed exhibit, and he was shortly followed by Arnold von Siemens, a member of the firm. The firm demanded many concessions on the part of the World's Fair people which the latter did not see their way clear to grant, and the negotiations are still pending. In the meantime Messrs. Siemens and Vogel and their associates of Siemens & Halske became convinced, as the result of their visit, that America offered a field of sufficient importance to justify the founding of a branch establishment, and they therefore determined to take the step. Mr. Vogel and other members of the firm were acquainted with O. W. Meysenburg and A. W. Wright of Chicago, and they entered into an arrangement with these gentlemen by which the latter became the American partners in the new company. Wright & Meysenburg are well known in Chicago as contractors and cable railway engineers, and are also heavily interested in the Wells French company, which manufactures cars. A company has accordingly been organized, with a capital stock of $500,000, under the laws of Illinois, and known as the Siemens & Halske Electric company. It is officered as follows: President, O. W. Meysenburg; secretary, A. W. Wright; directors, Arnold von Siemens, George William von Siemens, O. W. Meysenburg, A. W. Wright and Alexander von Babo. The company will be simply an American branch of the Siemens & Halske company under the direct management of Mr. Meysenburg and Mr Wright. Alexander von Babo is a German residing in New York, and is American representative of the parent company in a number of other interests. C. H. Benjamin of New York will have charge of all matters relating to patents and patent litigation. George and Arnold von Siemens are the active members of the firm of Siemens & Halske, as Dr. Werner von Siemens has retired from active business and Herr Halske is dead, his interest having been purchased by the Siemens family.

The new company will begin operations at once, and will locate its plant in connection with the shops of the Wells-French company at Blue Island avenue and Paulina street, Chicago, on the Chicago river. Plans for the building are now being prepared, and the drawings and patterns necessary for beginning the mechanical work are now on their way from Germany. About two hundred men will be employed in the factory at the start, but it is expected that this number will be largely increased as the company's business grows. Emil Berliner will be the chief electrical engineer of the works. Dr. Berliner is now in Europe, but will shortly return and locate permanently in Chicago. He will be a notable addition to the electricians of this city, and will be warmly welcomed by the fraternity.

The promoters of the new company expect that it will in time become a formidable rival to the consolidated Thomson-Houston-Edison company. They say that it will be backed to the fullest extent by the Siemens & Halske company, which, they assert, has a financial strength of $40,000,000. There is no intention, however, to enter into any throat-cutting competition or to plunge into litigation with the established American companies, although Mr. Benjamin claims that Siemens & Halske have American patents that will allow them to manufacture any or all of their apparatus in the United States. At first, however, the company will devote itself almost entirely to the manufacture of large power generators and motors, turning out the former in capacities up to 1,500 horse power, and the latter up to 1,000 horse power. Particular attention will be paid to electrical transmission plants for the centralization of power in large factories. The company will not go into the manufacture of lamps, supplies or specialties—for the present, at least—and, as has already been stated, the Edison company has a contract to manufacture the Siemens cables in the United States. It does not intend to do construction work, Mr. Benjamin says, but simply proposes to sell dynamos and motors to consumers on a commercial basis—that is, it does not intend to install entire plants, but simply to sell its machines as steam engines are sold. Mr. Benjamin has great faith in the new enterprise. In conversation with a representative of the WESTERN ELECTRICIAN he made the sweeping statement that the company had already received orders sufficient to keep seven hundred men constantly at work for two years. These orders, he said, had been received since the first intimation got out that Siemens & Halske were to establish an American branch, about two months ago.

The company expects to do considerable street railway work. Indeed it was in examining the Siemens & Halske

underground conduit system at Buda Pesth, Austro-Hungary, that Messrs. Wright and Meysenberg first came in contact with the house with which they are now connected. Wright & Meysenberg have been negotiating for some time with C. T. Yerkes, the Chicago "street car baron," for the construction of a similar electric line with underground conduit in West Twelfth street, but the matter still hangs fire, although at one time Mr. Yerkes was on the point of consummating the bargain.

It is said that none of the stock of the branch concern will be held outside of the persons mentioned. It is also

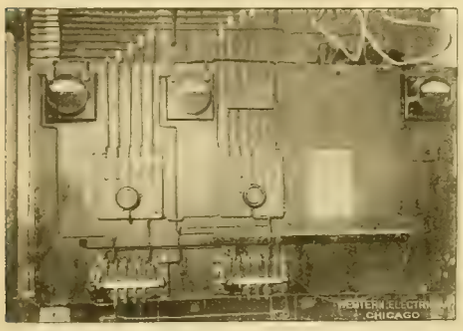


FIG. 3. ISOLATED STORAGE BATTERY LIGHTING PLANT.

stated that the co-operative plan may be adopted in the factory, giving the employes a percentage of the profits of the business. The new company is certainly an important addition to the electrical enterprises of the United States, and it may have an important effect on the business.

Electricity as a Safeguard.

George P. Low, electrical inspector of the Pacific Insurance Union, recently read a paper on "Electricity as a Safeguard," before the Fire Underwriters' association of the Pacific, in which he described the fire alarm telegraph service and numerous auxiliary devices of an electrical nature. This paper concluded a series of able addresses by Mr. Low, in which he presented the advantages of electricity, and the comparative danger to life and property of the several systems. The articles were published in

FIG. 2. ISOLATED STORAGE BATTERY LIGHTING PLANT.

the WESTERN ELECTRICIAN and presented a very fair review of the situation. They were interesting to electrical engineers and insurance men. In closing the series Mr. Low said:

Electricity is among the foremost of all the agencies at our disposal for preventing or combatting fire. In it is realized a light whose safety is second only to that of the sun, hence through it the enormous hazard attending the use of the older forms of artificial illumination may be averted. Then the electric motor has supplanted the use of thousands of stationary steam engines and boilers, which obviates another prolific source of loss, while now electric welding machines, stoves, soldering irons, heaters and kettles are working their way into use to the discomfiture of those diligent fire-bugs, the forge, the fire pot, the kitchen range, the car stove, and the basement furnace. It must be remembered, too, that none of these possess a hazard from fire which cannot be nearly, if not totally, eliminated. Are not the benefits accruing from these applications of that mysterious force thrice compounded by the inestimable value of the services rendered in the prompt discovery of fire and in the instant summoning of assistance to combat it? Again, in the face of all this, can the fire underwriter begrudge the few millions it cost in learning to control this most wonderful yet most subtle agency, or can he but say and believe "In electricity I have a friend—not a foe?"

Combination Fuse.

When fuses of the ordinary character are employed in connection with circuits carrying currents of considerable quantity, they must be of very large cross-section. Consequently when such a fuse is suddenly traversed by a very heavy current, such as would occur during a short circuit, the time required to heat the large mass of metal is considerable and often sufficient to allow serious damage to the system before the circuit is ruptured. It is also found that the character of some of the metals employed for this purpose is subject to change with age or by reason of the extreme changes of temperature, so that their subsequent melting point is liable to differ from that which they originally had.

To overcome these objections C. F. Scott and Alex. Wurts of Pittsburg have recently devised the fuse shown in the cut, which consist of a combination of a fusible rod of lead or alloy of low melting point with a strand of cop-

COMBINATION FUSE.

per. The two metal fuses are connected in close proximity to each other and in such a way that they both have the same or nearly the same temperature, and each carry its share of the current.

The action of the fuse is explained as follows: As long as the combination remains intact the current is divided, each strip taking a certain proportion of it. The heat developed in the copper conductor, while not sufficient of itself to melt that conductor, adds to that developed in the lead conductor, and the latter is caused to fuse quickly by reason of the small mass and great heat. When the lead or alloy has melted, the entire current is thrown on the copper wire, which instantly melts and ruptures the circuit.

Advance of Electricity.

In a recent address before the English Institution of Electrical Engineers Prof. William Crookes, the president, said:

We have have happily outgrown the preposterous notion that research in any department of science is mere waste of time. It is now generally admitted that pure science, irrespective of practical applications, benefits both the investigator himself and greatly enriches the community. "It blesseth him that gives, and him that takes." Between the frog's leg quivering on Galvani's work table and the successful telegraph or telephone there exists a direct affiliation. Without the one we could not have the other.

We know little as yet concerning the mighty agency of electricity. "Substantialists" tell us it is a kind of matter. Others view it, not as matter, but as a form of energy. Others, again, reject both these views. Prof. Lodge considers it "a form, or rather a mode of manifestation, of the ether." Prof. Nikola Tesla demurs to the view of Prof. Lodge, but thinks that "nothing stands in the way of our calling electricity ether associated with matter, or bound ether." High authorities cannot even yet agree whether we have one electricity or two opposite electricities. The only way to tackle the difficulty is to persevere in experiment and observation. If we never learn what electricity is—if, like life or like matter, it should remain an unknown quantity—we shall assuredly discover more about its attributes and its functions.

Experimentalists are reducing the wave lengths of the electrical rays. With every diminution in size of the apparatus the wave lengths get shorter, and could we construct Leyden jars of molecular dimensions the rays might fall within the narrow limits of visibility. We do not yet know how the molecule could be got to act as a Leyden jar, yet it is not improbable that the discontinuous phosphorescent light emitted from certain of the rare earths when excited by a high tension current in a high vacuum is really an artificial production of these electrical rays, sufficiently short to affect our organs of sight. If such a light could be produced more easily and more regularly, it would be far more economical than light from a flame or from the arc, as very little of the energy in play is expended in the form of heat rays. Of such production of light nature supplies us with examples in the glowworms and the fireflies. Their light, though sufficiently energetic to be seen at a considerable distance, is accompanied by no liberation of heat capable of detection by our most delicate instruments.

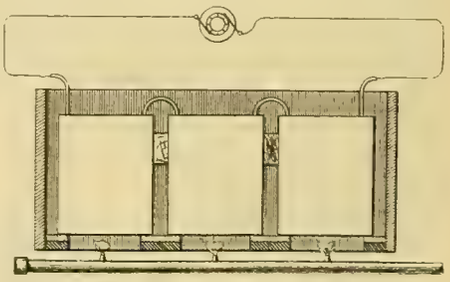
Alternating currents have at the best a rather doubtful reputation, but it follows from Tesla's researches that as the rapidity of the alternation increases they become not more dangerous, but less so. It further appears that a true flame can now be produced without chemical aid—a

FIG. 4. ISOLATED STORAGE BATTERY LIGHTING PLANT.

flame which yields light and heat without the consumption of material, and without any chemical process. To this end we require improved methods for producing excessively frequent alternations and enormous potentials. Shall we be able to obtain these by tapping the ether? If so, we may view the prospective exhaustion of our coal fields with indifference. We shall at once solve the smoke question, and thus dissolve all possible coal rings... Electricity seems destined to annex the whole field not merely of optics, but probably also of thermotics.....Rays of light will not pass through a wall, nor, as we know only too well, through a dense fog. But electrical rays of a foot or two wave length of which we have spoken will easily pierce such mediums, which for them will be trans parent.

Application of Heat During the Process of Charging Storage Batteries.

To render electrolytic action uniform, and thus produce such advantages as increased capacity, longer life, more rapid charging, and general improvement in the action of a storage battery, is the object of the method the apparatus for which is shown in the cut. The process consists simply in applying heat to the cells, preferably at the bottom, while they are being charged or discharged, thus setting up a circulation of the electrolyte. Gas burners or steam



APPLICATION OF HEAT DURING THE PROCESS OF CHARGING STORAGE BATTERIES.

coils may be employed as heaters. It is stated by J. B. Entz and W. A. Phillips of New York, who devised this method of treating cells, that the action of a battery is greatly improved by the application of heat. The internal resistance is lowered, the plants have a longer life, and the cells will take a more rapid charge. When cells are charged without the application of heat the electrolytic action is more prominent on the lower half of the electrodes, which would indicate that the metallic solution used was denser in the lower portions of the cell than nearer the sur-

face. It is on this account that it is believed that the application of heat to the lower parts of the cells overcomes this defective action by establishing a circulation in the solution, thus insuring a uniform action on the plates. The circulation may be maintained by mechanical agitators with good results; but heat is preferred because it lowers the resistance of the battery, and causes the plating actions to take place more easily.

It will be observed, however, that this process is confined to batteries containing a metallic solution and that the method is practiced after the cells are entirely completed and in working form.

Snow Fighting in Ottawa, Ont.

The question of successfully operating electric roads during heavy snowstorms is of great importance to every one interested in the subject of electric traction, and especially to the managers of existing electric roads in locations where a rapid fall of snow is likely to take place many times during the winter season. The method pursued by the Ottawa Electric Railway company to keep the streets occupied by its tracks free from snow will show what has been done during the present winter in a city where the average fall of snow is probably as great, if not greater, than in any other city operating electric roads.

The road, which consists of eight miles of double and four miles of single track, was constructed in seven weeks, and cars were put into service in the latter part of June last year. The climatic difficulties made the question of running in winter a subject of much discussion. Yet throughout the winter the cars have never lost a trip, and their warmth and comfort, combined with their smooth running, has made the service a luxury, one of the most satisfactory features being the excellent condition of the streets which the railway follows, sleighing on them being better than upon the other streets of the city. This good record in the face of frequent and long continued snowstorms has been most carefully watched by other Canadian cities in the same latitude.

The equipment consists of sixteen cars of the vestibuled type. The electric system employed is that of the Westinghouse Electric & Manufacturing company, single reduction motors of 20 horse power each being used on each car. The dynamo room is located at the famous Chaudiere Falls, where two turbine water wheels drive two 100 horse power Westinghouse compound dynamos and a third machine is kept in reserve. The difficulty in supplying steady current by water wheels was at first a matter of serious difficulty as, owing to the frequent stopping of all or nearly all the cars at the same instant, the water wheels were liable to race. By an ingenious mechanical arrangement the water wheel gates are now raised and lowered instantly, and by the introduction of a novel electric device sufficient load is kept on the dynamos at all times to keep down the speed of the water wheels. This device consists of several coils of iron wire, which are connected in shunt to the trolley circuit, and are so arranged that any current from 12 to 72 amperes may be made to flow through them. The wire is kept cool by being immersed in water, which is changed as it becomes warm. This useful device was designed by T. Ahearn of of the firm of Ahearn & Soper, the builders of the road and its principal owners.

The arrangements and facilities of the Ottawa electric railway for battling with and removing the heavy snow falls are of the most complete character. The snow is swept off the tracks by a Lewis & Fowler electric sweeper, and two Walkaway snow plows drawn by horses follow the sweeper and remove the snow bodily to the curb; a third Walkaway shoves the snow between double tracks on to the unswept track, which is immediately gone over by the electric sweeper, and in turn is followed by the Walkaways. In this manner snowfalls of nine to twelve inches have been handled in half a night throughout the whole length of the line. The snow is then shoveled into large boxes, mounted on double runners, and drawn away. A second sweeper will be in readiness in a few days. Preparations for winter were commenced as early as August. All the ordinary platform cars were converted into vestibule cars to make them comfortable for the motor men. Heavy duck canvas is fixed all around the trucks and almost reaches the rails. This prevents snow from reaching the motors and contributes to the comfort of the passengers. Special track sweepers and brooms are used on each car. The whole outfit is complete, and a more efficient service probably does not exist anywhere in America. The successful and profitable operation of a winter electric railway service has been so convincingly demonstrated that the influence upon other Canadian cities will no doubt be immediately felt. Much of the success of the road, especially under the severe conditions of the present winter, is due to the efforts of Superintendent J. E. Hutcheson, who, as an employe of the Canadian Pacific railway, acquired an experience in snow lighting which has been made use of on this road. The excellent construction of the Westinghouse motors has contributed to no small extent to the regularity and success of the service. The officers of the electric railway are J. W. McRae, president; G. P. Brophy, vice-president; J. D. Fraser, secretary and treasurer.

Electricity at the World's Fair.

The manner of providing for exhibits of electric railway systems in actual operation is still under consideration by the World's Fair authorities. As has been before stated, Siemens & Halske are desirous of showing their various overhead, underground and accumulator systems on one track, and offer to construct such a railway entirely at their own expense if the Exposition company will allow them the use of a site. So far as known no other foreign or American company is willing to make a similar offer to exploit its particular system, but it is thought possible that an arrangement can be made whereby the four or five big American companies can operate their systems on one line, to be divided into sections. Such a railway would be built by the exposition authorities and operated by the exhibiting companies in common, each exhibitor showing his cars in operation on a portion of the road set aside for his use. This plan is open to some objections and can only be accomplished by the mutual agreement of competitors, but it is thought that it can be made practicable, although there are many details still to be considered, relating to line construction, feeders and generating plant. It is now proposed to build such a line parallel to the steam railroad tracks in the southwestern portion of Jackson Park and to allow Siemens & Halske to construct another for their own use adjacent to it. Both roads would be about 2,000 feet long. If any other company should offer to build its own line an endeavor would be made to find room for it in some space adjoining. This proposition is now under advisement by the committee on grounds and buildings.

It is gratifying to observe that an effort is being made in England to arouse the manufacturers of electrical machinery to a proper sense of the importance of the World's Columbian Exposition and to the necessity of sending exhibits to it. W. H. Preece, chairman of the electrical committee of the Society of Arts, has issued a circular in which he says:

The electrical committee is anxious that the electrical department of the exhibition should contain a good representation from this country. The British exhibit will include a historical collection as well as the contributions which will be sent in by commercial firms. In addition, it is hoped that a portion of the electric lighting of the exhibition may be carried out by some British firms, and the committee thinks that the arrangements of a complete lighting station on the English method could advantageously be shown at Chicago. From the English point of view it is especially desirable to show how large a share English electricians have had in developing electrical science and its practical applications. It is hoped that arrangements may be made for showing the fine collection of historical apparatus in the possession of the postoffice, and this will be supplemented by contributions which will be sought from many other sources. On the commercial side, while there is no disputing that practical electric lighting has made greater progress in America than in this country, there is yet much that England can show electricians on the other side of the Atlantic. The domestic uses of electricity and its artistic application are matters in which they confess themselves to be less advanced than we are, and probably many firms who make this a specialty will find it to their interest to show in the exhibition electrical fittings and the manner of their application. It is especially to be remembered that the exhibition will be visited by numbers of foreigners, and especially by many persons from our own colonies, and it is important that English electricians should not miss this opportunity of strengthening and increasing their hold on colonial trade, since it is quite certain that a strenuous effort will be made by American manufacturers to get this important source of revenue into their own hands. Another department in which the United States exhibit will certainly be deficient is that of electric railway signals. The methods on which American railways are worked, do not, as is well known, require the very complete system of signaling apparatus employed in European countries, but this system is now being introduced into America, and will probably supplant the method now in use. There is, therefore, a very favorable opportunity for manufacturers of this class of apparatus to bring themselves before the notice of American customers. Another important department which ought not to be neglected is that of electro-metallurgy. Here, also, English inventors will probably find it to their advantage to bring their inventions under the notice of American metallurgists.

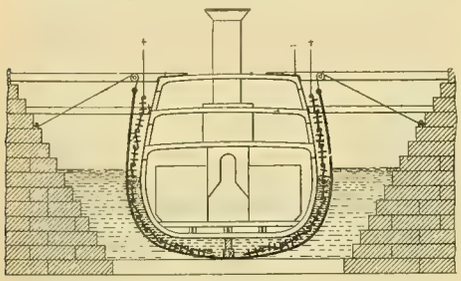
SNOW FIGHTING IN OTTAWA., ONT.

England's contributions to the science and practical development of electricity have been so important that a meager showing on its part at the Chicago exhibition would be accepted by many as a retrograde movement. It is to be hoped that Mr. Preece's appeal will meet a hearty response.

No arrangements have been made for lighting or supplying power to the electricity building because it is thought that nearly, if not all, of this service will be supplied by exhibitors without charge to the World's Columbian Exposition. Novel and beautful lighting effects are expected

But two bids were received by Chief Burnham, of the bureau of construction, in response to his advertisement for tenders for the construction and operation of an elevated intermural railway in Jackson Park. This railway will be at least five and a half miles long and is intended to carry passengers around the grounds during the World's Fair. One of the bidders was the Multiple Speed & Traction Railway company of Chicago, more commonly

known as the Movable Sidewalk company. The other was the King Iron Bridge Manufacturing company of Cleveland. Each bid was accompanied by a certified check for $25,000. The former proposes to put in a plant costing $750,000 and operate it to the close of the fair. It offers to give the exposition management 37 per cent. of the gross receipts after deducting therefrom the cost of the plant and its operation. It promises to transport 40,000 passengers an hour, charging 5 cents a ride, the passenger to remain on the cars or sidewalk as long as he may see fit. This system consists of two moving platforms, one propelled at the rate of three miles an hour and the other at six. Electricity is used as the motive power. The King company, on the other hand, proposes to run electric cars on the unicyle system. The company offered to put



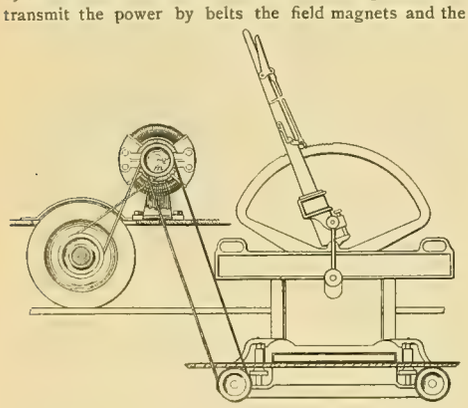
ELECTROPLATING THE HULLS OF VESSELS.

on thirty motor cars and thirty trailers, making thirty trains of two cars, each car to accommodate forty passengers. It proposes to charge passengers five cents each way. It is willing to give the exposition company one cent for each passenger. None of the leading companies manufacturing electric railway supplies put in bids, and both of those received may be rejected by the committee on grounds and buildings.

A recent note sent out by the department of publicity and promotion says: In the electricity building there will be 40,000 panes of glass, or more than in any other exposition structure. This building will be especially conspicuous at night as, owing to its extensive glass surface, the brilliancy of its electrical exhibit will be strikingly visible from the outside.

Apparatus for the Electric Illumination of Cable Cars.

C. E Scribner and E. P. Warner of the Western Electric company, Chicago, have recently devised an ingenious arrangement of a dynamo to run automatically in connection either with the constantly moving cable or with the car axle, and thus furnish a constant supply of current, keeping the lamps burning whether the car is in motion or not. To attain this desired end a pulley is provided in connection with the car axle, or with a separate wheel rolling upon the track, which, through intermediate gearing, serves to communicate rotary motion to the dynamo while the car is in motion. A second pulley in connection with a wheel bearing upon the cable gives motion to the dynamo while the car is at rest. Where it is preferred to transmit the power by belts the field magnets and the



APPARATUS FOR THE ELECTRIC ILLUMINATION OF CABLE CARS.

armature of the dynamo are both constructed so as to be capable of independent rotation. The field magnets are belted to one of the pulleys and the armature to the other, as shown in the cut. The belts are arranged so that the field magnets and armature shall revolve in opposite directions. It is plain that while the car is not in motion the pulley which bears upon the cable is kept in continuous rotation by the passage of the cable over it. This motion is communicated to the field magnets of the dynamo. On the other hand, while the car is securely gripped to the cable there is no rotation of the wheel bearing upon the cable, and the field magnets remain stationary. The armature, however, is now kept in motion by the rotation of the car wheels as they roll upon the track.

In the case when the car is not securely gripped to the cable, there may be some relative motion between the car and the cable and some relative motion between the car and the track. In this case the field magnets are revolved in one direction with a speed depending upon the relative motion between the car and cable, and the armature is revolved in the opposite direction with a speed depending on the relative motion of the car and track.

In this arrangement the dimensions of the driving and driven pulleys must of course be chosen so as to secure a constant relative speed of rotation between the armature and field magnets of the dynamo, whether the car be in motion with the same speed as that of the cable or with less, or be standing still, and thus a constant electromotive force or current may be maintained.

Electroplating the Hulls of Vessels.

In carrying out this method, which was devised by A. D. Buchanan, Long Island City, N. Y., the vessel to be plated is sailed into a lower lock, similar to the lock of a canal, and is then placed in an upper lock, so that the bottom of the vessel will be on a line with the highwater mark. The vessel is then encased in an envelope, which is held to the bottom of the dock by means of a timber extending longitudinally through the envelope and is firmly fastened to the dock bottom. The edges of the envelope are left free, so that they may be conveniently raised when necessary.

The envelope is made of canvas, and is provided with a wire warp to make it sufficiently strong.

The plating is accomplished in the following manner: The vessel is floated into the dock and lowered by letting out the water, so that her keel will rest on the central timber. After having been properly stayed and scrubbed for the deposit by emery wheels, wire brushes, etc., the envelope is then raised around the hull of the vessel, the water siphoned off, and the envelope is filled with a pickle of water and sulphuric acid. The water is let into the dock at the same time that the pickle is pumped into the envelope, so that the pressure of the water will make the envelope conform to the shape of the vessel, and very little pickle will then answer to fill the space between the envelope and the hull. In filling the envelope it is better that the water be kept slightly in advance of the pickle, as shown in the cut, so that it will not be necessary to use too large a quantity of the pickle. The envelope is alternately pulled taut and relaxed, so as to keep the solution in motion, and after a thorough agitation the sides of the envelope are pulled out so that the sides of the vessel may again be scrubbed. The pickle is then withdrawn and clean water supplied in its stead to thoroughly wash the vessel's hull. The water from the envelope and dock is now withdrawn and the copper solution is let into the envelope, and water is let into the dock, so that the envelope and dock will fill up together, as already described. The anodes are placed in the solution, and are made long enough so that they will extend nearly to the keel of the vessel. The hull of the vessel is connected with the negative pole of a dynamo, and the anodes are immersed in the bath, which is placed in the envelope. The anodes are made up of a series of large copper links, which are hinged together at the ends, as shown in the cut, so that they will readily conform to the shape of the vessel. At frequent intervals upon the links are insulating washers, which prevent the anodes from contacting with the hull of the vessel, or with the envelope.

Electric Mining Installation at Ouray, Colo.

An excellent example of power transmission in mining is presented in the plant at the Virginius group of mines near Ouray, Colo. It is one of the largest purely mining plants in the world, and every difficulty likely to be met with in work of this nature was encountered in this installation. The pipe line was laid along the side of a rocky canon; the wires from the power house to the mine were strung partly through dense timber, as shown in Fig. 1, where they were exposed to damage from falling trees, and partly above timber line, over rocks and snow banks, Figs. 2 and 3, where the poles and wires were liable to be carried away by snow slides, and where lightning storms were frequent and violent. The line is nearly four miles long, and the pressure is maintained at 800 volts. The relative advantages of the ground return and complete metallic circuit are illustrated, and switches are so arranged that either

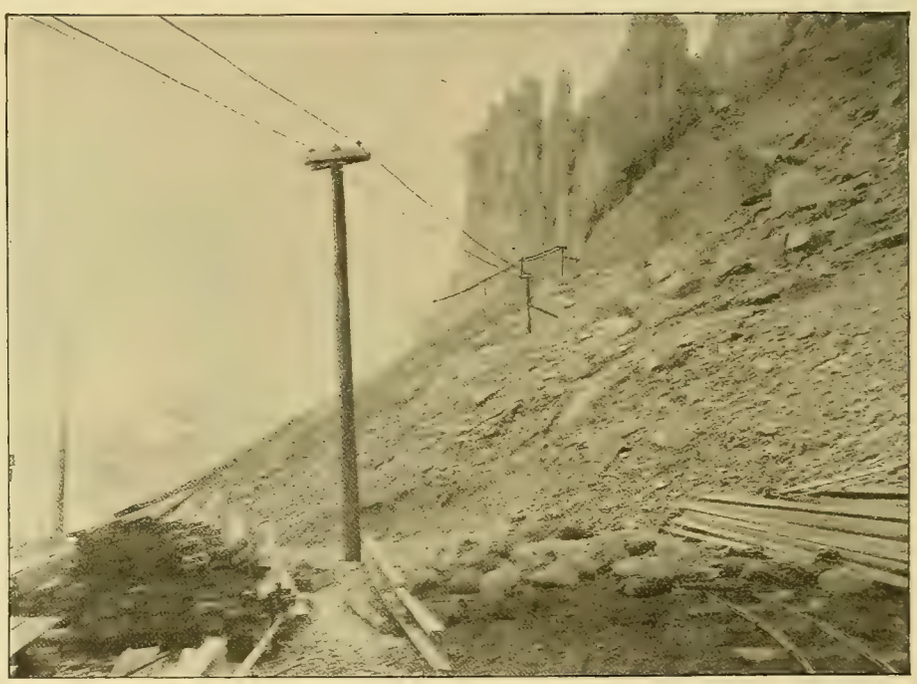


FIG. 2 ELECTRIC MINING INSTALLATION AT OURAY, COLO.

may be employed, the metallic circuit being used at present. The plant includes a variety of machinery, comprising two pumps, one hoist, one blower, and two motors running mills; indeed, almost everything except locomotives and drills, and these will probably be added shortly. Lastly, the enormous saving that can be effected, in many places by the utilization and transmission of water power by means of electricity is strikingly manifested. Coal at the mines costs eighteen dollars per ton, and before the installation of this plant was made, the cost of the power amounted to nearly $40,000 per year. This sum is saved by the adoption of electric power. Some of the mines in this group are rich enough in metal to repay working under the most adverse conditions, but there are others of lower grade which would have been shut down in case the electric plant had proved a failure, but which, with the plant, will now yield a satisfactory profit.

The Virginius and neighboring mines, owned by the Caroline Mining company, are situated near the summit of Mt. Sneffles, in the region of perpetual snow at an altitude of 12,700 feet above the sea and about 5 000 feet higher than timber line. They are reached by a wagon road, open in the summer, but impassable in the winter, when the only route to the mines is by a difficult trail, the lower part of which, denominated the "zig-zag," winds up a declivity so precipitous that burros with their packs, slipping from the trail frequently roll down past several branches of the zig-zag before they are stopped by a tree or rock. The upper part extends over a rocky plateau, Fig. 3, above timber line, and along cliffs where the snow is frequently over twenty feet deep on the level, and where

terrific wind and lightning storms are frequent. The lower half of the line from the power house to the foot of the zig zag extends up a deep canon through a forest of dense timber. The danger of breakage and grounds from falling trees which are frequently blown down by storms and rest on the wires for some time before they can be removed, is continually present. The construction of heavy line work over nearly four miles of such ground is an undertaking, the difficulty of which is evident, but which can be fully appreciated only by an actual examination. But although the difficulties attending the maintenance and operation are exceptionally great, the enormous expense of transporting fuel to the mines rendered the advantages of an electric transmission plant so very striking that the management was induced to make the trial.

The water power utilized for the plant is in Red Canon creek, nearly four miles from the mines. The water power plant consists of a small dam, an iron pipe line, extending along the side of the canon, a distance of about 4,000 feet, giving an effective head of 485 feet, and two Pelton wheels, one five feet, the other six feet in diameter, capable of developing under that head 500 horse power and 720 horse power respectively, or a total of 1,220 horse power, the two wheels being connected to separate shafts, so that either wheel may run the entire station. The electric generating plant shown in Fig. 4 comprises, at present, one 100 kilowatt Edison dynamo and two 60 kilowatt Edison dynamos, giving a total output of 293 electric horse power. The length of the line, as previously described, is a little over 19,000 feet. The electric machinery operated at the mines consists at present of two pumps, 60 horse power and 25 horse power respectively; one hoist (25 horse power) two Edison motors, each of 60 horse power, running concentrators and stamping mills, and a 15 horse power blower. The large pump which was erected when the plant

FIG. 3. ELECTRIC MINING INSTALLATION AT OURAY, COLO.

was first installed, raises 150 gallons of water 700 feet per minute, and is of the Knowles duplex type. An Edison standard motor is geared to it by a double worm, one right hand and one left hand, working into two spur gears that mesh into each other and operate the pump, the object of the two worms being to neutralize the longitudinal thrust. The smaller pump, which was installed a few months ago, is somewhat similar, the motor, however, being mounted over the pump, with its armature vertical, the weight of the armature counteracting the thrust of the single worm employed. Both pumps have been working steadily and smoothly for several months, and have satisfactorily filled requirements.

The hoist consists of an Edison motor of standard type, but of street car winding and controlling switch, geared to the drum through the medium of a friction clutch. By means of the controlling switch and clutch, the hoist is under more perfect control than a steam hoist. The motors for the mills and blowers are of the standard type, and present no exceptional features.

The most serious troubles have been caused by lightning, electric storms in that section of the country being frequent and very violent. This has formed the subject matter of particular study and special lightning arresters have been devised that give excellent protection. Since their adoption little or no trouble has been experienced from this source.

That difficulties were encountered in the early operation of the plant is not surprising, and the fact that these difficulties have been overcome and the entire plant is operated successfully and satisfactorily under conditions that for severity are not likely to be exceeded anywhere, demonstrates the practicability of electric power for mining, and guarantees its success in this field.

Electric Lighting in Chicago.

Commenting on the city electric lighting plant of Chicago M. A. Mikkelson of the Johns Hopkins University, in a paper before the American Academy of Political and Social Science, says:

FIG. 4. ELECTRIC MINING INSTALLATION AT OURAY, COLO.

"From the figures given above it is evident that a saving will accrue to Chicago by the adoption of her electric lighting system. She will be better lighted and her actual expenses lessened. While she has been paying $600,000 annually to private gas companies for lighting her streets, she will in the future be able to light the same territory for a third of that sum

Taking it for granted that public lighting is cheaper than private, for no private corporation will be found to undertake the enterprise without profit, two points remain to be considered. It has been objected that municipal ownership of electric lighting systems breeds corruption and encourages inefficiency. Both of these objections may, in view of the results in Chicago, be dismissed."

Courtesies Acknowledged.

Delegates to the recent National Electric Light association at Buffalo received many courtesies at the hands of the railroad men. This was especially true in the case of the eastern delegates, who had what became special cars at their disposal from New York to Buffalo. The treatment afforded on this occasion was fully appreciated, and will be remembered. Cyrus O. Baker, Jr., master of transportation, has issued the following letter in this subject: "On behalf of the National Electric Light association I desire to tender thanks through the electrical press to the following named gentlemen for the very efficient service rendered and the numerous courtesies extended to our delegates during the recent convention at Buffalo: M. C. Roach, general eastern passenger agent, N. Y. C. & H. R. R. R.; Edson J. Weeks, general agent passenger department, Buffalo, N. Y.; H. H. Parry, city ticket agent, Buffalo, N. Y.; J. C. Yager, division superintendent Wagner palace car company, New York."

The eastern delegates were placed under further obligations to the New York Central, which extended the time on their tickets, making them good to return on the late trains Friday and Saturday.

Chicago Electric Club.

The last meeting of the Chicago Electric club was on Monday evening, March 7th. According to the literary programme which had been arranged for this meeting, Prof. Sidney Short was to read a paper on "The Gearless Motor," while the "Single Reduction Motor" was to receive the attention of G. K. Wheeler. Alex Kempt, who presided, announced, however, that Prof. Short was unable to be present, and on that account the literary committee had decided to postpone the discussion on railway motors. Prof. Louis Bell was then introduced and gave the club a talk on power transmission.

Previous to the literary entertainment the club took action indorsing the work of the committee in reorganizing the club on a stock basis, and it was voted that the committee proceed with the revision of the constitution and by-laws preparatory to submitting its work for the club's final approval.

FIG. 1. ELECTRIC MINING INSTALLATION AT OURAY, COLO.

An electric light plant is projected at Bastrop, Tex. J. W. Kennedy is the promotor of the scheme.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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PHILADELPHIA might be called the home of the storage battery, for it is there that some of the best work in this line has been accomplished. In and about the Quaker City there may be found installations which illustrate to a striking degree the fact that this appliance, much maligned at present, has a distinct field of usefulness that has not yet been fully appreciated, at least in this country. The leading article in this issue is an illustration of the fact that for country residence lighting it would be difficult to find a more desirable system to employ. Besides this the fact that a man with Vice-president Thomson's characteristics should decide to equip his home with a storage plant and rely on the "unreliable" for light is an indorsement that should have its proper weight with those influenced by adverse comment and distorted facts.

IN a paper presented elsewhere in this issue Lieut. F. Jarvis Patten describes "A Proposed System of Alternating-Direct Current Transformation." Lieut. Patten, referring to the experiments at Frankfort, says: "While it is not my desire to detract in any way from the known merits and beauty of multiphase systems, I have always maintained that two wires ought to be sufficient for all purposes, and the system here presented is simply offered as a solution of the problem of obtaining electrical energy in any desired form from a single high tension alternating current."

It should be noted that the proposed system has not yet been tested in its completed form, but the paper is nevertheless attractive, and will no doubt receive much consideration from engineers engaged in the study of multiphase currents.

THE prominence given the discussion of the subject of capital punishment in New York state growing out of the law providing for secret executions by electricity has had the effect that might have been anticipated by the advocates of the new method—the introduction of a bill providing for the abolition of capital punishment. Such a measure is now under consideration at Albany, and should it pass, its success would be due largely to the public sentiment called forth by the secret executions which disgrace the records of the Empire state.

At present the outlook for the electrical execution law is not all that its advocates could wish. One assemblyman has introduced a bill providing for the substitution of hanging for electricity, while the opponents of capital punishment, encouraged by the sentiment against the present law, are earnestly advocating the substitution of life imprisonment for execution of any kind.

RESIDENTS of Indiana avenue, Chicago, and the adjacent territory, will be obliged to continue patronizing the low-going horse car line that is now operated on that thoroughfare. This is due to the fact that one of the aldermen on the committee of the city council to which the question of substituting electrical equipment on this line was submitted, was opposed to the overhead system. The Chicago City Railway company expressed a desire to substitute electricity for animal power on this line, but the alderman objected. It is the first time this particular city father has displayed any opposition to the Chicago City Railway company, and it is generally supposed that he is one of the "friends" of the company. It is a question whether the ordinance was introduced in good faith. The council will probably allow several cross-town lines to be equipped with electricity, and why there should be objection to giving Indiana avenue improved service is not clear.

IT cannot be doubted that Chicago is destined to become one of the greatest electrical manufacturing centers of the country. Already the Western Electric company has a great factory on the West Side. The Thomson Houston company proposes to establish a large munufacturing concern at Pullman and supply its western trade with goods manufactured a thousand miles nearer the point of delivery than at present. The new Siemens & Halske Electric company, also, has selected Chicago as the base of its operations and will have a plant on the Chicago river, at Blue Island avenue and Paulina street. Here are three large electrical manufacturing concerns, premising that the last named company attains the importance that its backing and the scope of its operations seem to warrant. In addition there are at least a score of smaller factories and shops where the manufacture of electrical goods is carried on. Taken altogether it will be seen that the output of Chicago's electrical factories is already considerable and that every indication points to a very marked expansion within the year. The outlook for electrical development in the rapidly growing West and Northwest is promising, and there is no doubt that a constantly increasing proportion of goods made in Chicago will go to meet this demand.

AS the veterans of the early telegraph service in the United States pass away, attention is forcibly directed to the really marvelous growth of this world-wide method of communication and to its comparatively recent introduction. So strongly entrenched is the telegraph and so much a part of our every-day existence that it is difficult for the younger generation to realize that this indispensable necessity of modern life has been developed almost entirely within the last half century. The death of Stafford G. Lynch recently in Chicago at the age of sixty induces a train of reflections like these. Col. Lynch was still in the youth of old age at the time of his death, but he nevertheless entered one of the first telegraph offices in the country west of the City of New York a short time after its establishment, and he worked in the office in Philadelphia when but two instruments sufficed for the entire business. In view of the magnitude and importance of electrical communication nowadays, this seems almost incredible. That it is true is a most impressive illustration of the progress of the nineteenth century. Col. Lynch bore his part in this development, as is shown by a brief biographical sketch published on another page. He was widely known and his comparatively early death will be deeply regretted.

IN the *Chicago Herald* of March 31 there appeared an editorial on "No Trolleys for Chicago." The production was below the average attempt of the daily papers to dissertate on subjects about which they have no knowledge whatever, and on this account might be passed without notice; but inasmuch as it has occasioned considerable comment, a glance at some of the extravagant statements of the *Herald's* electrical expert may not be inappropriate. He refers to "the cheap, clumsy, untrustworthy and unsightly trolley electric system" that "is without exception the least reliable and the most dangerous of all surface means of transportation."

This is pretty strong language and if it was not apparent that the writer of the *Herald's* editorial had no knowledge whatever of the subject it might prove injurious to the electrical interests. But another glance at the article relieves any apprehension. It is but necessary to quote the young man's description of a trolley system to show how little the writer knew about the subject. He says:

'It is practically heavy cars suspended from wires that must be run all over the town, and have only the guarantee derivable from experience that they will put surface transportation out of order oftener and longer than any other system yet devised by baffled ingenuity."

Another quotation from this expert opinion will suffice: "No brake has yet been manufactured that can be relied on always to stop an electric car, and runaways with fatal consequences are among the noted achievements of trolley electric systems."

WHEN electrical engineers read in the daily papers about the abatement of smoke in Chicago by the introduction of a compressed air system they will be tempted to smile. The Chicago city council has just granted what is called the Smoke Abating ordinance, which authorizes the exploiters of the above mentioned scheme to manufacture and sell compressed air for power, heating and ventilating purposes, and the people at large are just awakening to the fact that the franchise was a reckless gift. To anyone who has studied the question of power distribution and its relation to the smoke nuisance in the World's Fair city, the looseness of the claims of the Chicago Power Supply & Smoke Abating company will be evident. It is only necessary to quote the president of the concern to show what the city may expect from the "Smoke Abating" company President J. P. Bacon, during a recent interview was asked: "How do you guarantee the abatement of the smoke nuisance?" His reply was, "We will use fuel that will not smoke to any extent. We will fit out our main plant with smokeless furnaces." This is to the point. Undoubtedly President Bacon has made a discovery. He will use the ideal fuel in the ideal furnace. But the city fathers would have acted less like grandfathers had they, before granting this franchise, required the "Smoke Abating" company to build one of its "smokeless furnaces," and show that it could burn fuel that would not "smoke to any extent."

Of course, the "Smoke Abating" company will do what it has promised—companies receiving franchises permitting them to tear up Chicago's streets always do. But if this company can produce its power without smoke why cannot the same type of furnace it will employ be set under existing boilers? Surely here is a great opportunity for President Bacon. Does he not know that power is already being distributed throughout the business section of Chicago and all existing demands fully supplied by the electric system? And if he would consult some reliable engineer his eyes would be opened as to the possibilty of compressed air apparatus competing in Chicago with electrical appliances for supplying power, heat and air. President Bacon should awaken. When he enters the field against the electric motor he will realize that his company would have been more successful in abating the smoke nuisance had it devoted its energies to selling "smokeless furnaces" rather than transmitting compressed air.

Death of Col. Stafford G. Lynch.

The announcement of the death of Col. Stafford G. Lynch in Chicago on March 4th will be received with much regret by many friends in electrical circles, particularly by those familar with the history of the telegraph before and during the war. Col. Lynch caught a severe cold a week before his death, and it rapidly developed into pleuro-pneumonia, with typhoid symptoms. His condition was not alarming until Wednesday of last week, when he began sinking rapidly and continued to fail until death occurred.

Stafford G. Lynch was born in Waterloo, N. Y., September 9, 1832, and, after receiving a common school education, he learned the art of printing. In 1846 young Lynch entered the telegraph office at Auburn as a messenger and in course of time became an expert operator. He afterward worked in Little Falls, N. Y., Cleveland, O., Detroit, Mich., and Philadelphia, Pa., and was well known to the old-time telegraphers. In Philadelphia Mr. Lynch was employed under James D. Reid, the patriarch of telegraphy, now occupying a responsible position in the consular service. At that time but two instruments were used in the Philadelphia office. Shortly after this Mr. Lynch returned to Cleveland, and in 1853 he became chief clerk and casbier in the postoffice in that city—a position he held until the breaking out of the war.

Col. Lynch did useful service during the rebellion. He early proffered his services to Gen. Anson Stager, who was at the head of the military telegraphs, which were included in the quartermaster-general's department. For a time in the early part of the war he was stationed in the telegraph office in the war department, where he saw Lincoln and Stanton almost daily. He did much toward perfecting the cipher used in military dispatches. Afterward he served as an aide on Gen. Stager's staff with the rank of captain and assistant quartermaster. He proved an invaluable assistant to the head of the department. Large amounts of money passed through his hands, and he discharged his duties with fidelity and ability. Plum, in his "Military Telegraph During the Civil War," says that "Perhaps no greater trust devolved upon any assistant officer of the corps than that which was so honorably and ably executed by Capt. Lynch." At the close of the war Lynch was commissioned a brevet lieutenant-colonel.

After the war Col. Lynch settled in Chicago. He became private secretary to Gen. Stager, who was then vice-president and general manager of the Western Union Telegraph company, filling the position now held by Col. R. C. Clowry, also an ex military telegrapher and an intimate friend of Lynch. Col. Lynch remained with Gen. Stager for many years. During this period he was, at various times, superintendent of the Metropolitan Telegraph company, general agent of the Gold & Stock Telegraph company and secretary and treasurer of the American District Telegraph company. Later he was for two years superintendent of the supply department of the Western Union company. After this he was for some time secretary of the Western Electric company, which Gen. Stager was largely instrumental in establishing. In 1884 Mr. Lynch withdrew from the electrical business and became a member of the Stock Exchange, in which business he continued until the time of his death. He was very familiar with electrical securities in particular and acted as broker for many prominent citizens of Chicago. At the time of his death he was president of the National Panorama company. The Chicago Stock Exchange adjourned out of respect to his memory and adopted appropriate resolutions

Mr. Lynch was popular with his acquaintances, and possessed the esteem of all. He leaves the record of an honorable career. Two adult children survive him.

Wisconsin Electric Club.

The Wisconsin Electric club recently celebrated the successful completion of the university extension course of lectures on electricity, delivered by Prof. Loomis under the auspices of the club. Refreshments were served and short speeches were made by Prof. W. S. Johnson, Secretary Boggis, Prof. A. S. Rogers, F. E. Parker and Messrs. Bradshaw, Fountain and others. It was reported that after having paid all of the expenses of the university lectures, the sum of $75 remained. With this money and an appropriation of $25 from the club treasury, it was decided to purchase books for the club library. Already the organization has the nucleus of what in time is destined to be a valuable collection of scientific works.

Electricity in Mining as Applied by the Aspen Mining and Smelting Company, Aspen, Colo.[1]

By M. B. Holt.

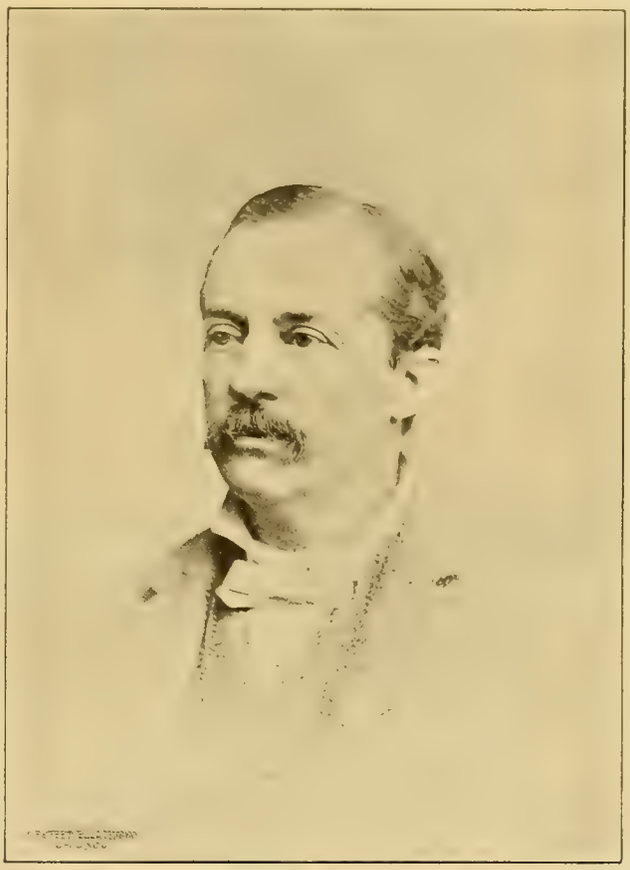
At this time, when electricity in its various applications is attracting so much interest, and with such good reason, it has been suggested to me that, as the Aspen Mining & Smelting company, of Aspen, Pitkin county, Colorado, was the first mining company in America to apply electrical power for hoisting, a record of what has been accomplished by this company would be of interest.

Early in the year 1888 the questioa of power for the development of the ore-horizon lying below the level of the tunnel through which the property is worked became one of importance. The conditions under which it was proposed to use power were as follows: The company's mines lie upon the northwestern slope of a mountain, the ascent of which is at an angle of 28° from the horizon. The ore, consisting of argentiferous galena and other silver-bearing mineral, is found at or near the plane of contact of a superincumbent mass of blue limestone, with an underlying bed of dolomite. This contact plane dips north 30° west, at an angle of 60° with the horizon.

A tunnel 1000 feet in length, driven south into the mountain near its base, penetrates this ore-mass at a vertical depth of nearly 500 feet, and through this the ore and the waste material are brought to the surface. For the purpose of drainage and transportation, the tunnel has received a grade of 3 per cent. toward its mouth, while from its breast, or inner extremity, level branches or drifts are run both to the right and left, following the strike of the ore-bearing plane, and developing it in its lateral extent. The development below the tunnel-level was begun by sinking two inclines, which were intended to follow the ore-plane in its descent, and which, it was contemplated, might acquire considerable depth. One of these inclines began near the inner extremity of the tunnel, and the other was started 300 feet distant in the drift toward the north. Both desended below the tunnel-level at an angle of 60°. Power, applied to hoisting machinery of some kind, was necessary to bring up the ore and waste material from these inclines, and from the levels that would be driven in the future.

The first plan conside ed was the use of steam-power; that of compressed air was then discussed. Both of these plans were finally laid aside for weighty reasons, although the latter offered several advantages over the use of steam in the inside workings. It then occurred to Fred G. Bulkley, the manager of the company, to duplicate the operations of the Compagnie de la Ferroniere, on a larger scale; to use electrical power, utilizing, for the generation of the current the power daily going to waste through the channels of mountain streams in the vicinity. Accordingly a flume was constructed, with ample capacity, giving an effective head of 63 feet, and a Pelton water wheel, having a diameter of 5 feet, was selected for the motor. A 50 horse power 500 volt constant potential Edison dynamo was then set up and run under the direction of the Roaring Fork Electric Light & Power company. This machine generated a current at a distance of 6,000 feet from the mouth of the tunnel.

1. Read before the American Institute of Mining Engineers.



COL. STAFFORD G. LYNCH.

After long delays and by constant importunity, attended with more than one failure, Mr. Bulkley succeeded in securing the attention and aid of a manufacturer of electrical machinery to provide the hoisting plant for the mine, and there in July, 1888, the first electrical hoister used in mining work in America was placed at the head of the Veteran tunnel, and successfully used for hoisting from the incline near this point. The same motor, by engaging with a second drum, draws the empty cars in the tunnel by a tail rope system, the loaded train running out by gravity. This hoist consists of a 7½ horse power Sprague street car motor. This motor proved the success of the plant from the start, notwithstanding the trying conditions under which it was at first used—one of which was the great amount of moisture in the workings, which condensed upon the machine. Later, the iron pinions on the armature-shaft were exchanged for rawhide pinions, diminishing the noise when running, and also the liability of any leakage of current to the levers and other parts of the machinery. The working of this motor was so successful that during the same year a similar hoist was placed at the head of the incline 300 feet to the northeast. Each of these hoisters was designed to raise 250 tons 250 feet up a 60° incline every 24 hours, estimating 16 hours of actual working time.

The first motor has been in constant use for hoisting for three years, during which time the cost of repairs has been as follows:

Replacing field-magnet coils,	$ 43 00
Rewinding one armature,	80 00
Replacing commutator	75.00
Total repairs	$198.00

This does not include the cost of commutator brushes, which have to be replaced from time to time—which is, however, a small item. The first item of expense above given was necessitated by the burning out of the insulation on the wires of the magnet coils, which might have resulted from one or more of the various causes. The second item was due to the bursting of the binding wires on the armature. This, had it been anticipated might have been guarded against. The last item, caused by the wearing out of the commutators, was due to the natural wear between the commutator and the copper brushes which were originally employed.

Recently the company has put carbon brushes upon all of the motors, and also uses them upon the dynamos. Since this change has been made, the motors have run without sparking, and wear upon the commutators is inappreciable.

The company has an extra armature that can be used in either motor hoist, so that, in case of accident, very little time need be lost in repairing the damages. In the case of the accident to the field-magnet coils, the burnt coils were replaced without much delay by others bought in Aspen. The total time lost, due to accidents or repairs during the time the hoist has been in use, amounts to twelve hours.

In the latter part of the year 1889 the company, having available water power not in use, decided to have its own generating plant. Previous to this it had been supplied with power from the Roaring Fork Electric Light & Power company. Work was soon begun and by July, 1890, the company was generating its own power. This plant has a capacity of 100 electrical horse power, which is generated by two 50 horse power Thomson-Houston type dynamos, wound for a constant potential of 500 volts. These are run from two double Pelton water wheels, 42 inches in diameter, *i. e.*, four 42-inch wheels, two being paired together on each shaft. Each of these four wheels is impelled by the force of the water issuing from two nozzles and applied to the wheels.

A pressure of about 35 pounds per square inch, as indicated by a gauge at the foot of the main column pipe, is obtained from an effective fall of a little over 80 feet. This fall is obtained by fluming for a distance of 1,300 feet.

The flume has a capacity of 1,000 cubic feet of water per minute.

The requirements for greater or less power are met by deflecting the nozzles, which work on a ball and socket joint, by means of a Woodward governor, set to maintain a constant speed of the water wheel shaft from which it is actuated. The wheels are inclosed in an iron hood, 4 feet by 4 feet, which can be taken off with little trouble, the joints being kept tight with rubber gaskets.

The adjoining ends of the water wheel shafts carry a friction clutch, by means of which the shafts can be run as one shaft when it is desired to throw the output of both dynamos on one common line.

The electrical connections in the generating station are as simple as possible, the dynamos being connected with the switch-board by overhead wiring hung from the trusses.

The generating station is situated 6,000 feet from the entrance to the tunnel. The stationary motors now in use are situated at distances of 1,800 feet, 1,200 feet and 1,000 feet from the entrance underground. From the power station to the tunnel the current is carried by bare 00 copper wire, except for a distance of about 300 feet at each end of the line, where an underwriters' insulated wire of the same size is used. Inside the mine the current is carried to the two main hoisting stations at distances of 1,000 and 1,200 feet by kerite seven-strand conductors, having a heavy insulation $\frac{14}{32}$ inch in diameter. Okonite or Grimshaw insulated wires are used on all the other circuits inside the mine, where the insulation must necessarily be of the best. On none of the circuits inside the mine is there a loss exceeding 5 per cent. Along the outside circuit there is at present, when the wires are carrying their maximum load, a loss of from 5 to 6 per cent.

The cost of generating, as obtained by dividing the cost of labor and lubricants (interest and depreciation not included) by the horse power demanded, amounts at present to two-thirds of one cent per horse power per hour; and greater amounts of power could be furnished at a lower rate per horse power, as up to 100 horse power no increase of plant would be necessary, the cost for labor would remain the same, and the cost of lubricants would advance but little.

In July, 1890, the company received from the Sullivan Diamond Prospecting company of Chicago, an electric diamond prospecting drill. This was the first drill of its kind, and was built for the company at the request of Fred G Bulkley, with the understanding that it should have a thorough trial, and be retained if satisfactory. It is operated by a three horse power Thomson-Houston motor, and has a capacity of 400 feet, taking out a core $1\frac{5}{8}$ of an inch in diameter. The drill was first set up on the surface, and experiments were made with it by drilling into an immense granite boulder. It was found that, in this kind of rock, it would drill, taking out a core of the above diameter 2 inches per minute. It was then put in the mine, where it has been used steadily for the last 12 months for exploring the hanging and foot walls of the mineral deposit, which are respectively a hard blue and often a silicified limestone, and a brown dolomitic limestone. In these rocks the machine drilled at the rate of $1\frac{1}{2}$ inches to 2 inches per minute; or, in a shift of 8 hours, allowing for all delays essential to diamond drill work, the progress made varies from 6 to 32 feet, depending upon the character of the rock. The average per shift, allowing for time lost in moving, setting up and drawing cores, is 15 feet, one drillman and one helper being employed. About 4 400 feet have been drilled to date of writing, July 6, 1891. The exact cost, including all expenses, has been 68 cents per foot. This is rather higher than was expected, and it is thought that it can be reduced.

Recently finding that the $7\frac{1}{2}$ horse power hoist at the head of one of the inclines was getting too small for the work required, it was removed to another part of the mine, where it could be advantageously employed, and a 25 horse power C. & C. electric motor put in its place. This large motor is geared so as to raise a load of 3,000 pounds up a 60° incline 275 feet per minute. It is capable, by actual timing, of making the round trip from a depth of 550 feet, with a load of 3,000 pounds, in 3 minutes.

At the time of writing, the company is about to apply electrical power for running a small machine shop and its timber room and carpenter shop. It is also proposed, in the near future, to employ an electrical locomotive for surface tramming.

A contract has been made with the Thomson-Van Depoele Electric Mining company by which this company is soon to receive, upon trial, a Thomson Van Depoele electric percussiom drill and a motor transformer for supplying the drill with a current of 220 volts from our 500 volt [illegible].

FIG. 2. ELECTRIC TRAMWAY OF THE PIONEER FIRE-PROOF CONSTRUCTION COMPANY, OTTAWA, ILL.

The main working galleries of the mine are lighted by electricity, the current for which is taken from the power mains, and five 100 volt incandescent lamps are connected up in series. As the light produced is found to be sufficient, and the life of the lamp is thereby prolonged, six of these lamps are, in most cases, placed in series with each other. Eight horse power of electrical energy is now employed for lighting purposes.

The recognized advantages of electrical power for mining operations may be briefly summarized as follows:

1. It can be transmitted long distances with small loss, thus making it possible to use power at such a distance from its source as would render it otherwise unavailable, as in the case before us.

2 The conductors for conveying electrical power from one point to another require less space, are more easily put in place and repaired, are easily tapped for branch circuits, and form a more flexible system throughout than any other mode of transmission permits.

3. The electrical system is ideal, viewed from the standpoint of cleanliness.

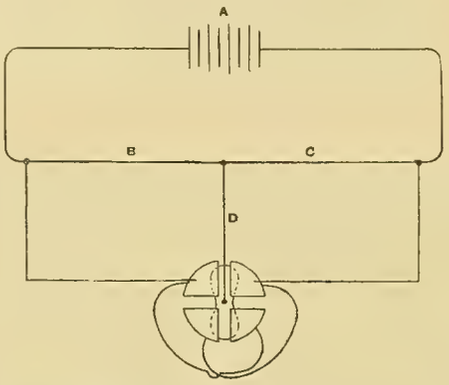
4. The station for utilizing electrical power can be made to occupy a minimum space.

5. If this system does not assist ventilation, it does not, on the other hand, vitiate the air in the mine workings.

After three years' use under the varying conditions of mining work, the electric current of 500 volts has proved itself free from danger to life, and has caused no inconvenience further than one or two severe shocks Even the risk of receiving a shock has proven insufficient to suppress the spirit of investigation with which some men are endowed. The best illustration of the convenience and flexibility of the system is the diamond drill, where the conductors are unwound and strung up as the drill moves along, or taken down and coiled up, as may be desired.

Method of Comparing Very High Resistances.

Major Cardew, of England, has recently introduced a method of comparing very high resistances, such as millions of megohms. Referring to the annexed diagram, *A* is a battery giving some 100 or 200 volts, *B* and *C* are two very high resistances. The quadrants of the electrometer are connected up as shown, the needle being connected to the point between *B* and *C*. If *B* is to be measured, *C* is altered until the needle comes to zero. It is then clear



METHOD OF COMPARING VERY HIGH RESISTANCES.

that the fall of potential over *B* is equal to that over *C*, so their resistances are equal. This method will show when two resistances are equal, however high they may be, provided they are low in comparison with the leakage resistance of the electrometer itself. The cut is from London *Industries*.

No Transfers in Milwaukee.

The people of Milwaukee will have to wait some time before they can ride on the street cars from any part of the city to any other part for one fare. During the present year, at least, they will have to pay another fare whenever they board a car which does not belong to the same division of the Villard system as the one which they leave. When the Cream City and Milwaukee City lines were consolidated it was expected that the syndicate would adopt a system of transfers which would allow passengers to ride wherever they pleased for one fare. Henry C. Payne, however, states that the one-fare-transfer system will not be considered until the syndicate takes possession of the West Side railway, which will probably be in October. It is desired, he states, to get the entire system complete and running with electricity before determining what transfers shall be used. "If we are treated by the common council in the future as we have been in the past," he remarks, "we shall consider it notice that we have got to run our lines as they are, and run them so we shall." The public is very anxious to have the general transfer system adopted and there is some talk of the business men taking hold of the matter. With such a system in use, and with such a network of electric lines as Milwaukee is to have, the city would have as cheap and perfect a system of rapid transit as could be found anywhere in the universe. The last payment on the West Side railway will be made in October.

Action of Direct Current.

To the Editor of the WESTERN ELECTRICIAN:

In the very interesting discussion of Mr. Kammeyer's paper before the Chicago Electric club, which appeared in your issue of February 27th, Mr. Armstrong presented a very interesting theory as to the cause of the "viciousness" spoken of by Mr. Kammeyer in connection with the direct current. The examination of the Burton Electric Forging company's plant by the committee of the Franklin Institute, however, gives evidence which seems to be contrary to Mr. Armstrong's theory. The committee found that in some cases the interior of a bar would be in a molten state while the exterior retained its normal shape. While this may show that the exterior of the bar was the better conductor and offered less resistance than the interior. it surely proves also that the current is not "confined to the outside" of the conducting metal. Specimens which illustrate the above statement may be seen at the hall of the Franklin Institute. I trust this evidence will aid in the formation of a correct theory, and as this very pronounced evidence of the action of the alternating current on metal bars seems indisputable, a new theory is necessary.

FRED HERBERT COLVIN.

Philadelphia, Pa.

Electric Tramway of the Pioneer Fire-proof Construction Company, Ottawa, Ill.

The ease with which electricity can be called into use to increase the capacity of manufacturing plants is very effectively illustrated by the tramway just installed by the stationary motor department of the Chicago office of the Thomson-Houston Electric company at the works of the Pioneer Fire-proof Construction company of Ottawa, Ill.

The Pioneer company takes its supply of clay from a point up the Illinois river, a mile and a half from the works. Previous to the introduction of electric motive power the clay was hauled by horses, but a short time ago a sudden demand for large quantities of fire-proofing material to be delivered in an extremely short time made it imperative that a better method be adopted for hauling clay. It was then that Mr. Johnson, general manager, decided to introduce the electric system.

With animal power the best record that could be made was to deliver 100 cars per day, and the work required twelve horses and nine drivers. By the use of electricity the capacity of the tramway was increased to 200 cars per day, and only three men were required. The electrical equipment consists of one locomotive, fed from an overhead conductor from a generator in the works.

The locomotive, shown in Fig. 1, is equipped with two 15 horse power Thomson-Houston motors, and the machine furnishing current is of 40 horse power, and operates at 500 volts. The generator is driven from a shaft in the works, which can be connected either with a water wheel or steam engine, as occasion may demand. The length of the trolley line is one mile and a half, and from it two spurs and one siding extend. At a point about a quarter of a mile from the works the track crosses the Fox river, ascending a grade of six per cent. On the other side of the river the company is permitted by the city to carry only four loaded cars at once, consequently the train of nine cars is divided and carried across in sections. In spite of this delay it is possible to make a round trip, running a mile each way, carrying out nineteen empty cars and returning with nine loaded cars, aggregating thirty-seven tons, in twenty minutes. Owing to the heavy clay of which the roadbed is composed, the horses could make but very slow time, especially in wet weather, and it took two horses an hour and a half to haul two cars over this distance, so that to haul the requisite number of cars to supply the works a large number of horses and attendants were necessary. The pictures show respectively a train of nineteen empty cars and nine loaded cars, and the old time method, Fig. 2, that has been displaced by the electric locomotive.

FIG. 1. ELECTRIC TRAMWAY OF THE PIONEER FIRE-PROOF CONSTRUCTION COMPANY, OTTAWA, ILL.

This plant was installed under the direction of Geo. P. Nichols, manager of the stationary motor department, by J. C. Hadley.

The telephone has been put to many curious and interesting uses, but it required a Tiffin, O., official to discover its adaptability to the dispensation of justice. A press dispatch from that town gives the following account of a unique trial: Fritz Grumel, who was recently tried in this city for disorderly conduct, can boast of being the first man on record who was arraigned, tried, convicted, sentenced, and ordered committed, by telephone. Mayor Abbott, who meted out the electric justice to the offender, has a telephone in his office connected with the police court, and adopted this convenient method of exercising his magisterial function to save a long walk through the street. It is a question whether this unique dispensation of justice can stand the test of legality.

Central Station Control of Lamps and Motors.

At the Buffalo convention a great deal of interest was aroused among central station men by the operation of the individual arc light and motor cut outs exibited by the Electric Secret Service company of New York. The apparatus was set up in the parlors retained by the company. One parlor was assumed to be a central station, from which wires led to a couple of Brush arc lamps placed in the regular city circuit on Main street, while on the walls of the room two groups of incandescent lights were also connected into the company's cut-out circuit. The illustrations give an idea of the arrangement both in and out of doors.

On a small table was placed the transmitter, which in practice is situated in the central station. From this instrument a single wire ran through the "locks," and returned to the transmitter. The main or lighting circuit ran through the switches, and each one of the locks was attached to a specially constructed switch with an alternating throw, so that one operation cut in the light controlled by it and the next cut it out, and so on alternately. Each lock was set to a distinctive combination, that is, the wheels on its shaft differed from all others in the sequence of notches. The construction of these locks is such that no one of them will operate so as to throw the working current into the switch attached to it and thus render the latter operative, unless the series of impulses going over the locking line, as distinguished from the regular lighting circuit, corresponds exactly with that particular lock.

Without entering into a detailed description of apparatus already familar to the reader, its operation may be thus explained: The arc lights in the street and the groups of incandescent lamps in the parlor were assumed to represent different classes of lights. The operator attached to the transmitter that disk which corresponded with the lock governing the class to be lighted or extinguished. On pressing a lever the self-winding transmitter rotated that disk, and sent out over the locking line its respective series of impulses. These impulses operated the armatures of all the locks, but only those of the lock corresponding in combination engaged with their wheels. It may be assumed that the combination sent was represented by 2-3-1-2, followed by ten straight impulses, to throw the switch. Passing idly through all the other locks these impulses bring

CENTRAL STATION CONTROL OF LAMPS AND MOTORS.

to work with entire precision and reliability. The action of the locks was methodically correct, and their cut-outs responded unfailingly to the transmitted impulses. It was observed that there was no occasion on which the locks selected failed to operate, or when a lock operated under any combination other than its own.

For the tests at the convention the hotel circuit of 110 volts was used on the locking circuit. For practical operation the locks and switches will be wound to accommodate any desired current. For circuits of varying length about 50 volts and one ampere are all that is necessary. The locking circuit is composed of a No. 12 wire. It may be either grounded or brought back to the central station as most convenient. In practice the instruments are mounted

CENTRAL STATION CONTROL OF LAMPS AND MOTORS.

the armatures of their particular lock into engagement with its combination wheels, rotating them to the point where contact is made with the switch, and then delivering into the switch the final impulses which operate it. With the last stroke the contact between the switch and its lock is broken, and the wheels of the lock revert instantly to zero, in which position they await the next sending of their individual combination.

In practice the various instruments of this system seem on slate bases and backs, and protected by weather-proof cases. Every precaution seems to have been taken to provide against any inconvenience from leakage or otherwise, and the company claims that the locks have been subjected to a service equivalent to three years' continuous use without failing or becoming disarranged in any respect.

The Titusville, Fla., Electric Light company has enlarged its building and will put in new machinery.

A Proposed System of Alternating Direct Current Transformation.[1]

By Lieutenant J. Jay I. Patten.

Recent German practice has given unforeseen importance to all devices for transforming and receiving alternating currents. The year just past has been fruitful in the development of multiphase systems, and the new departures are marked by novelty and ingenuity. I have followed these steps with close attention, for they open to the electrical engineer a comparatively new and very interesting field.

The system of transformation which it is the purpose of this paper to lay before you, has arisen mainly from my study of multiphase current developments, and I style it a proposed system, because I have not yet had an opportunity to test it in the completed form and can therefore give no data as to efficiency.

Quoting an author who has written interesting descriptions of multiphased apparatus for the *Electrical Review* of London, after describing the Shuckert motor transformer, which you will remember was brought to your notice by Carl Hering, in his interesting reminiscences of the Frankfort exhibition, the author in closing sums up as follows:

"The present importance of these currents (multiphased) may be greatly diminished by the discovery of an apparatus capable of transforming a single alternating current enconomically into a continuous current. It is also possible and even probable that multiphased currents will constitute merely a transitory system, as the Jablochkoff candle constituted a transitory system between the arc and incandescent lamp."

While it is not my desire to detract in any way from the known merits and beauty of multiphase systems, I have always maintained that two wires ought to be sufficient for all purposes, and the system here presented is simply offered as a solution of the problem of obtaining electrical energy in any desired form from a single high tension alternating current.

To merely reverse all the positive or negative impulses of a single alternating current would evidently not be a solution of this problem. The resulting current and the magnetism it produces are pulsating in character, having zero periods at each reversal of current. A useful direct current must be obtained, or one having a practically uniform electromotive force.

To explain the methods used, I must direct your attention briefly to a former paper, read about two years ago, describing an alternating motor which was new at that time, as well as to the Schuckert machine before referred to.

A combination of the functions of these two machines renders possible a number of singular and interesting transformations, which, if they are not entirely novel, any description they may have received has escaped my notice.

The essential features of what for convenience I will style the "Patten motor," are shown in Figs. 1 to 3 of the drawings, and the Shuckert machine is shown by diagram in Fig. 6.

To explain the former, Fig. 1 is an ordinary Gramme winding and collector, in which a direct current applied to the brushes would make, say, the poles indicated *n* and *s*. A source of alternating current connected to the brushes, however, would reverse the polarities of the ring at each reversal of current, and the tendency to motion would of course be reversed if the fields remained the same, but would continue in the same direction if the fields were also reversed by the same alternations of current. If, however, the fields *n* and *s* were maintained constant, and by some device the brushes b_1 and b_2, Fig. 1, could be made to change places at each reversal of current, then with an alternating current the polarities *n* and *s* of the ring would remain unchanged, and in a constant field the tendency to motion would still be continuously in the same direction.

It is not practicable to move the brushes mechanically, but the same effect is obtained by the system of armature connections shown in Fig. 2, where the odd numbered bars of the collector are connected to the winding in the usual way, but the intermediate even numbered segments are connected to points of the winding diametrically opposite to them.

Such an armature, supplied with an alternate current and placed in a two pole field, will turn through the arc covered by one collector bar at each reversal of current, the polarity of the ring remaining unchanged, as will be seen by tracing two successive impulses, shown respectively by the single and double arrows.

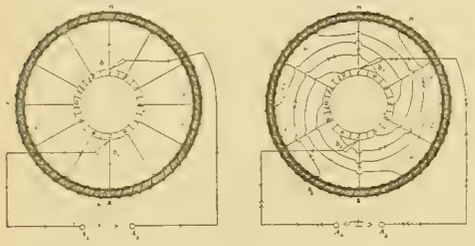
If, besides the collector just described, another be connected to the winding in the ordinary way, like the outer one in Fig. 3, where to avoid confusing the drawing, the source of alternating current is shown inside the collector, then evidently brushes bearing on the outer collector will give, as indicated, a current of one direction to any circuit connected to them, as that used for exciting the fields, *N*, *S*, Fig. 3. Thus connected, the machine starts itself as would a direct current motor, both fields and armature reversing, but it will continue gaining in speed until one segment of the collectors pass their brushes at each reversal of current, when it becomes a synchronous alternating motor, having a fixed and uniform speed—that of commutation. And it may be given almost any speed as compared to that of the generator and yet be in synchronism, by suitably altering the winding and giving the motor commutator a greater or less number of segments. Reference will now be made to what will be styled the "Shuckert" machine, a diagram of which is given in Fig. 6. It consists of an ordinary Gramme winding and collector, the latter shown for convenience outside the ring. There are three separate ring contacts, r_1, r_2, r_3, provided with brushes *a*, *b*, *c*, and the rings are connected each to

1. Read before the American Institute of Electrical Engineers, Feb. 16, 1892.

one of the three equidistant points of the armature winding, x, y, z.

Such a system admits of two important transformations, namely:

A direct current applied at the brushes b_1, b_2, bearing on the collector, causes the armature to turn, and triphased alternating currents can be collected in circuits connected to the brushes a, b, c. It may be noted here in passing, that these latter will reverse at each half revolution.



FIGS. 1 AND 2. PROPOSED SYSTEM OF ALTERNATING-DIRECT CURRENT TRANSFORMATION.

Or conversely, triphased alternating currents supplied at the rings through the circuits connected to the brushes a, b, c, will cause the armature to turn and (when in synchronism) a uniform direct current will flow in any circuit connected to the brushes b_1 and b_2 bearing on the collector. The machine thus transforms triphased alternating currents into a uniform direct current or the reverse. If the

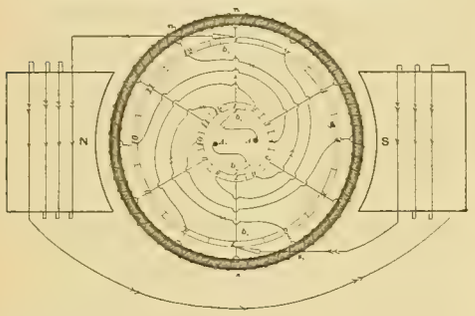
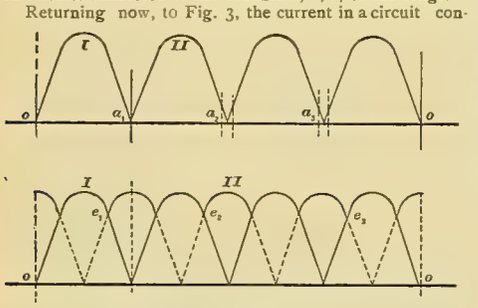


FIG. 3 PROPOSED SYSTEM OF ALTERNATING DIRECT CURRENT TRANSFORMATION.

functions of this machine and that previously described be combined, other novel transformations will result, as it is evidently only necessary to supply a current of approximately uniform electromotive force to the collector brushes in Fig. 6 to obtain triphased alternating currents in circuits connected to the brushes a, b, c, or the rings.

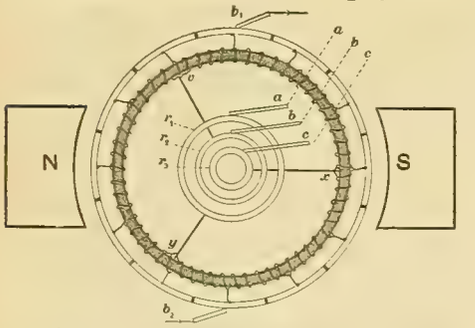
Returning now, to Fig. 3, the current in a circuit con-



FIGS. 4 AND 5 PROPOSED SYSTEM OF ALTERNATING-DIRECT CURRENT TRANSFORMATION.

nected to the brushes bearing on the outer collector will be a single alternating current, rectified like that shown in Fig. 4, and will have zero values corresponding to each reversal.

But if two alternating currents, having a quarter phase difference, be rectified and superposed, a comparatively uniform direct current like that shown in Fig. 5 will re-



FIGS. 6 AND 7. PROPOSED SYSTEM OF ALTERNATING-DIRECT CURRENT TRANSFORMATION.

sult. To obtain this, two armatures like that shown in Fig. 3, secured to a common spindle, are placed in the same field and are supplied with independent alternating currents differing in phase by a quarter period. This arrangement is shown by diagram in Fig. 7, where the fields are omitted, alternating currents differing by a quarter period being supplied at A_1 and A_3, a comparatively uniform current like that pictured in Fig 5, will flow in the circuit $D+$ $D-$. If, now, these terminals be connected to the brushes of an armature like that shown in Fig. 6, we will have the combination referred to, shown in Fig. 8, in which the middle armature has an ordinary collector shown outside the winding, and three rings with brushes connected to three equidistant points of the winding. The fields are omitted as before and all three windings will be supposed fixed to the same spindle and external circuits, a_1 b_1, c_1, are connected to the brushes bearing on the rings r_1, r_2 r_3 of the middle armature.

A single transformation is made possible by this device. Thus single alternating currents differing a quarter phase, supplied at A_1 and A_2, are transformed in the ring R_3 to triphased alternating currents, but a peculiar feature is here introduced which results from the fact that the triphased currents are only reversed at each half revolution of the ring R_3, the same as in Fig 6, while the alternating currents supplied at a_1 and a_2, as we have seen, are reversed as many times in a single revolution of the rings r_1 and R_2, as there are collector segments, or say, twelve times per revolution, as indicated by the diagrams, Fig. 8 and Fig. 3. As the currents differing a quarter period, supplied at A_1 and A_2, can be obtained on known methods from a single alternating current, we have then here presented the means of transforming a single alternating current of short wave length

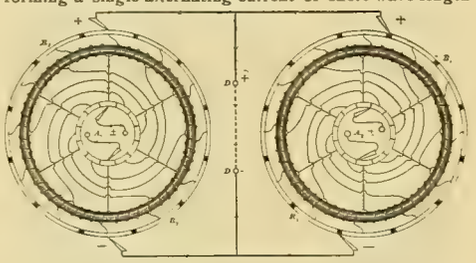


FIG 7. PROPOSED SYSTEM OF ALTERNATING-DIRECT CURRENT TRANSFORMATION.

or high frequency into triphased alternating currents of long wave length or low frequency.

Thus a single alternating current like that represented by the unbroken line 1 to 12, in Fig 9, making twelve reversals in the time t_0 to t_2, is transformed to triphased alternating currents, making but two reversals in the same time, these latter currents representing as they do the currents in the circuits a_1, b_1, c_1, Fig. 8, during one revolution of the armature.

The next step consists in changing these triphased currents to a uniform direct current on the plan used in the Schuckert machine, Fig. 6.

Thus, referring to Fig. 11, the winding of the ring R_3, instead of having three equidistant points connected to rings as before, has them connected to corresponding points of another winding, R_4, placed on the same core and provided with a separate collector, but to avoid confusion of the drawing the two windings are here shown separately, one inside the other.

Here, as in Fig. 6, a circuit connected to the brushes bearing on the collector of the ring R_4 will be supplied with a direct current of uniform electromotive force, resulting from the conversion to a direct current of the triphased currents delivered from the winding R_3 to the winding R_4.

Here, then, is the means of transforming a single alternating current to a continuous direct current of uniform electromotive force.

Machines like the last two described seem complicated, but approximate if not quite as good results can be ob-

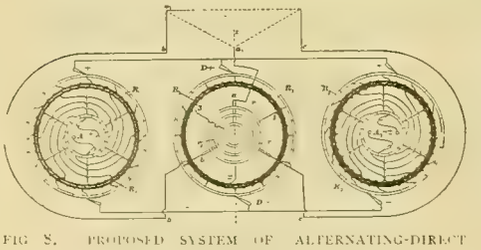


FIG 8. PROPOSED SYSTEM OF ALTERNATING-DIRECT CURRENT TRANSFORMATION.

tained from simpler devices. The preceding details were necessary to explain the consecutive steps taken.

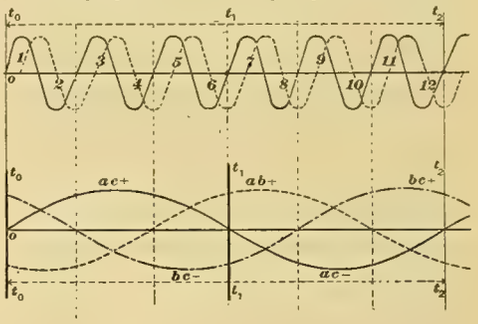
As simple a form as that shown in Fig. 12, will probably meet the requirements of practice. It represents two independent armature windings carried on the same core, but here shown apart for clearness of illustration. The inner winding, which has a collector directly and reversely connected, as in Fig. 2, is supplied with a single alternating current through the brushes at A. This winding is also connected to the outer one at three equidistant points, as shown, and the outer winding is provided with an ordinary Gramme collector, and if desired, three rings that are connected to three intermediate equidistant points of this winding.

This reduces the machine to a single armature with two windings and two collectors, or at least to two separate armatures and collectors, which form will doubtless be found preferable. The consumption circuit will be connected either to the brushes bearing on the collector or the rings of the secondary winding, according to which function of the machine it is desired to render operative.

Thus a single alternating current of ordinary period may be transformed either to triphased alternating currents of low period or to a direct current of comparatively uniform electromotive force.

If a three wire system like that shown in Fig. 13, is used throughout, giving triphased currents at the delivery end D, from the secondaries of the three converters, the transformation of these triphased currents to a single direct current of uniform electromotive force, or to triphased currents of a much lower frequency of alternation, can be accomplished on similar lines. It is well known that multiphase motors give better results with currents of comparativeiy low frequency, 40 to 80 per second being the reported practice abroad.

On the other hand, the converters for reducing potential increase rapidly in size as the frequency of alternation de-



FIGS. 9 AND 10. PROPOSED SYSTEM OF ALTERNATING-DIRECT CURRENT TRANSFORMATION.

creases, consequently very large converters are required for such systems. These features are antagonistic and render the conversion apparatus costly if low frequencies are essential to the proper working of rotary field machines.

The system shown in Fig. 14 admits of using high frequencies on the line and in the conversion apparatus at G and D, for raising and lowering potential, while the transformer, Fig. 14, changes these triphased currents of high

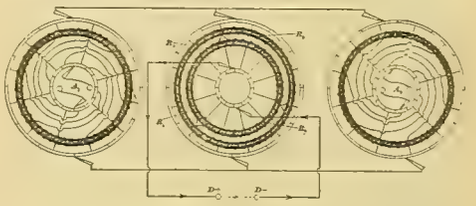


FIG. 11. PROPOSED SYSTEM OF ALTERNATING-DIRECT CURRENT TRANSFORMATION.

frequency either to a uniform direct current or to triphased currents of a lower rate of alteration.

At the delivery end D, Fig. 13, separate converters c_4, c_5, c_6 (not interlinked) are used, the secondaries having free terminals, as shown, which are taken to the brushes 1, 3, 5 and 2, 4, 6, bearing on the commutator of the ring R_2, the winding of which is connected at three equidistant points x, v, y of the ordinary Gramme ring and collector R_3, or to three ring contacts, as may be desired, according to whether a direct current or triphased currents are required, as a result of the transformation. The machine R_1 is simply a synchronizer, requiring only sufficient power

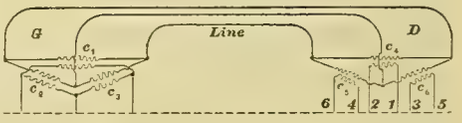


FIG. 13. PROPOSED SYSTEM OF ALTERNATING-DIRECT CURRENT TRANSFORMATION.

to drive the apparatus, and is supplied with one of the triphased currents only. This machine keeps the whole apparatus in synchronism, and the currents from all the secondaries are taken to the winding R_2, Fig. 14, which is direct and reversely connected as before explained.

The resultant current, flowing in the winding of this armature, R_2, will be like that shown in Fig. 15, which represents a triphased alternating current, rectified, and is already a very close approximation to a uniform direct

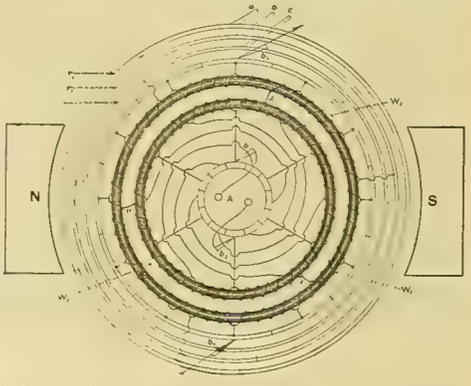


FIG. 12. PROPOSED SYSTEM OF ALTERNATING-DIRECT CURRENT TRANSFORMATION.

current, so that if the leads x, v, y, Fig. 14, connected to three equidistant points of the winding R_2, be taken through rings and rubbing contacts to three external interlinked circuits, as before explained, these circuits will be supplied with perfect triphased alternating currents, but of a lower frequency than those supplied to the brushes of the ring R_2. Thus, if the frequency throughout the system in Fig. 13 were 288 reversals per second, and there

be, say, twelve segments in the commutator of the ring R_2, there would then be developed in the circuits connected to x, v, y, triphased alternating currents having 48 reversals per second.

We have, then, here a means of changing at a single transformation multiphase currents of high frequency to similar multiphase currents of low frequency.

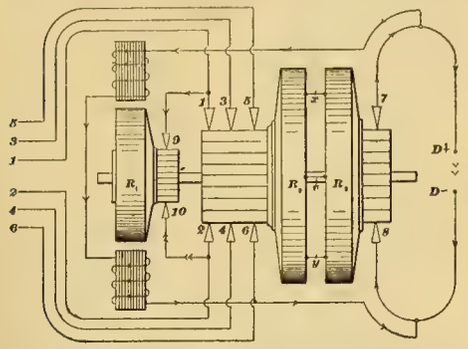


FIG. 14. PROPOSED SYSTEM OF ALTERNATING DIRECT CURRENT TRANSFORMATION.

This system admits of using high frequencies on the line, and in the conversion apparatus at both ends of the line, and low frequencies in rotary motors at the delivery end. If, instead of being connected to three rings; the leads x, v, y are connected, as shown in the figure, to another winding, a direct current of uniform electrical-

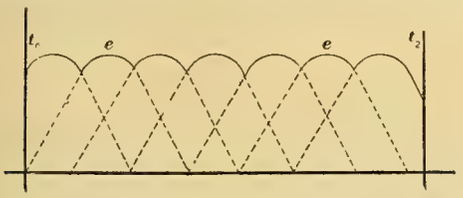


FIG. 15. PROPOSED SYSTEM OF ALTERNATING-DIRECT CURRENT TRANSFORMATION.

motive force will flow in the circuit $D+D-$. This transformer requires no further explanation here.

Fig. 16 shows a developed view of a part of the commutator of the ring R_2 and the relative positions of the brushes.

To prevent short circuiting, the segments are separated,

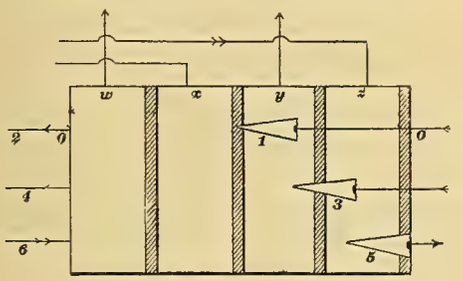
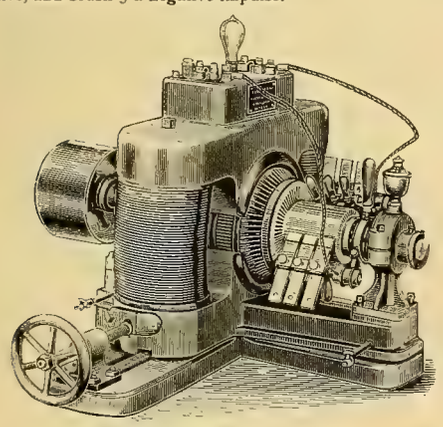


FIG. 16. PROPOSED SYSTEM OF ALTERNATING DIRECT CURRENT TRANSFORMATION.

as shown, so that a brush will not bear simultaneously on adjacent segments, and for obvious reasons, the brushes have a lag behind each other of one-third of a segment. The arrows show how the currents are flowing at the time being. Brush 1 has no current; brush 3 has a positive, and brush 5 a negative impulse.



DUPLEX INCANDESCENT GENERATOR.

If these transformations can be made on a large scale economically, it will be possible to supply not only alternating current apparatus of every description, including multiphase devices, but direct current apparatus as well, from a single high tension alternating current. When the original source of supply is a water power, and the distance is not too great the losses of conversion may well be brought within commercial limits.

The mayor of Winston, N. C., is ready to receive bids for the establishment of a fire alarm system.

The Germania Universal Shade-holder.

A shade holder so made that it can be used on varying sizes of lamp sockets is a very desirable fixture There are a number of sockets on the market, and of these the socket shell diameters are generally of two sizes, so two different clamping devices are necessary to adapt a shade-holder to them. The Germania Electric company, Boston, overcomes these difficulties with its universal shade-holder. Fig. 1 shows this device as used on the Thomson-Houston snd Westinghouse sockets. Figs. 2 and 3 show the method of applying the holder to the Edison socket, by unscrewing the rubber ring, inserting the prongs into the brass shell, as shown, and replacing the rubber ring. The Germania company claims for this shade-holder that it fits

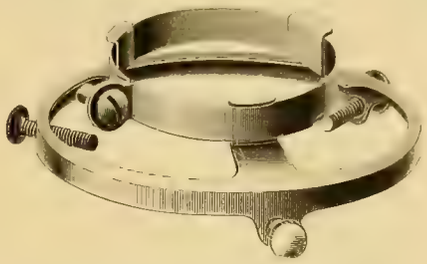


FIG. 1. GERMANIA UNIVERSAL SHADE-HOLDER.

all standard sizes of sockets, is simple, strong and artistic, and has no joints to work loose.

Duplex Incandescent Generator.

The new type of incandescent generator manufactured by the Duplex Electric company of Corry, Pa., is illustrated in the accompanying cut. These dynamos are built in sizes ranging from 15 to 500 lights capacity. The armature is a modification of the Gramme type. The core is a

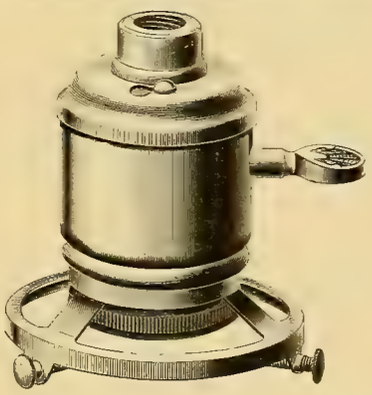


FIG. 2. GERMANIA UNIVERSAL SHADE HOLDER.

drum, built on a brass spider, of the best charcoal wire, wound on an iron frame which divides the core into four parts. The armature, is carefully balanced, the air space is reduced to a minimum, and the field magnets are close to the armature forming a highly efficient magnetic field. The commutator segments are of tempered copper, insulated by mica and firmly held in place by a fiber collar. The brushes are composed of thin strips fastened together at one end, and they do not require shifting, and are free from sparking under extreme variations of load, thus insuring their long life. The brush

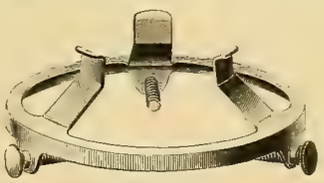


FIG. 3. GERMANIA UNIVERSAL SHADE HOLDER.

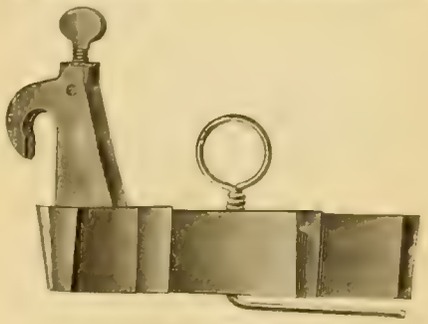
holders are simple in construction, of brass and thoroughly insulated. The bearings are made of the best anti-friction metal, while the boxes are attached to the pedestals by means of a ball and socket joint, which secures perfect alignment.

The New York Knapp Electric Motor.

The Knapp Electric & Novelty company of New York is about to place on the market a motor for running light machinery and toys. From the accompanying illustration the principal feature of the little machine can be seen. This motor is six inches high and weighs about four pounds. It is mounted on a mahogany base, and is finely finished in enamel with brass trimmings. This motor will operate a fan from six to ten inches in diameter and each machine is accompanied by a six inch fan.

The Delany Improved Crowfoot Zinc.

The E. S. Greeley & Co has become the sole agent for the manufacture and sale of the new device shown in this cut, the invention of P. L. Delany The use of it is just like the ordinary crowfoot zinc in common use, but



DELANY IMPROVED CROWFOOT ZINC.

there has been added a very simple and effective means for removing the spongy copper which forms on the under side and hangs down into the copper solution, thus setting up local action and causing great waste of zinc and blue-stone.

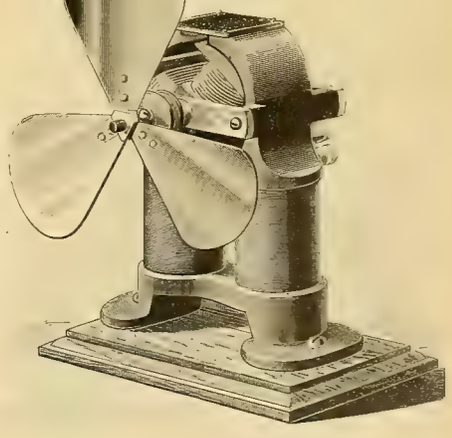
The device scarcely needs description. A glance at the cut will show a wire sweep through the central toe of the zinc. The wire is bent so that by touching the eye-end projecting above the solution, the sweep is free to brush the entire bottom of the zinc and send all the spongy coating to the bottom of the jar. The careful battery man, who has angled in a gravity cell with a piece of bent wire, smutching his fingers and twisting his neck trying to dislodge an inaccessible pendant, will welcome this simple improvement, which will enable him to clean off a thousand zincs in a few minutes without splashing the shelves or his clothes.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 5.—It is to be presumed that the Buffalo convention had something to do with it, but whatever was the cause, the electrical happenings of the week in and about the metropolis were not of an exciting nature.

Of course the telephone company finds business brisk, for, as was stated last week, the Telephone Subscribers' association is going to fight hard for lower rates. Now that Tammany influence seems assured and Richard Croker is in favor of the movement, the business community feels much encouraged. On Tuesday Secretary Gardner of the Board of Trade and Transportation called on Commissioner of Accounts Daly and was informed by him that Mr. Croker had looked over the bilis to reduce telephone charges and would forward them to Albany so that they would arrive there on Wednesday Now that the Tammany chiefs have decided to look after the intro-



NEW YORK KNAPP ELECTRIC MOTOR.

duction of the bills in the Legislature, Mr. Gardner will probably go to Albany to see what he can do to help them through the two houses.

At one time it looked as though the Brush company would confine its infringement suits to the western territory. But if encouragement is all that is necessary it now seems that the time has come to open fire on the eastern concerns who manufacture double carbon lamps. The hearts of the Brush people were once more gladdened last

week, and a decision by Judge Shipman of the United States Circuit Court, in which he handed down his opinion in the suit of the Brush Electric company against the United States Electric Lighting company was the cause. The suit turned on the ownership of the double carbon lamp. As is well known the Brush company, claims the exclusive right to use this device. Judge Shipman upholds this claim, and grants a perpetual injunction against the United States company restraining that corporation from using the double carbon lamp in the future. The defendant is also required to appear before United States Commissioner Shields to render an accounting of profits made on the use of the disputed patent in the past two years.

W. F. O.

Milwaukee, Wis

MILWAUKEE, Wis, March 5—O. E. Meyer, a real estate agent, proposes to utilize electricity for disinfecting and sterilizing garbage and sewage. By the aid of electricity he says he expects to treat 30,000,000 gallons of sewage in twenty-four hours, not only destroying the bacteria, but deodorizing the water. Apparently Mr. Meyer intends to have his system take the place of flushing tunnels.

President Wall of the Badger Illuminating company intimates that he does not care whether the city orders more lights or not. He says that the lights which his company furnished to Milwaukee were better than he saw on a recent eastern trip, not even excepting those in New York. He denies that his company is making large profits. Last year, he asserted, his company cleared only 2 per cent. on its investment, and the stockholders are disgusted. He declares that there is no money in city lighting and that his company derives its profits from the 300 or more private lamps which are burned for only a few hours each evening. The city lights are turned on about sunset and turned off about sunrise. The city within six months has ordered 95 new lights. Mr. Wall says the company is not particularly anxious to have the city order additional lamps because since January 1st all the new wires put in use must go underground, which is very expensive. Within five years all of the company's wires must be underground and within the next four years the company will spend $250,000 in enlarging its plant. The lights are widely scattered. On the south they extend to Lincoln avenue, on the west to Washington avenue, on the north to Burleigh street. The whole number of lamps in use by the city is 527, divided as follows: General, 4; First ward, 60; Second ward, 56¼; Third ward 11; Fourth ward, 49½; Fifth ward, 65; Sixth ward, 75¼; Seventh ward, 18½; Eighth ward, 28½; Tenth ward, 24¼, Eleventh ward, 10¾; Twelfth ward, 30¾; Thirteenth ward, 15½; Fifteenth ward, 23¼; Sixteenth ward, ½; Seventeenth ward, ½; Eighteenth ward, 12½. The appearance of fractions in these figures is accounted for by the fact that the expense of electric lighting is divided when the lamps are located on boundary lines. The Fourteenth ward is the only one without electric lights. Some of the poor outlying wards, like the Ninth and Twelfth, have many more lamps than the rich and aristocratic Seventh ward. The reason for this, Mr. Wall says, is that the poorer classes like the light, as it helps to protect them, is very cheerful when they go to work winter mornings and besides the very bright rays illumine their houses when situated near the corner. The wealthy people, on the other hand, object to the glare of the light which makes their rooms so bright that they cannot sleep. Many resolutions providing for new electric lights are pending in the Common Council.

The North Side aldermen have been petitioned by their constituents to attempt to compel the Milwaukee Street Railway company to extend its line on Holton street. They have also been requested to demand that a watchman be placed at the lower Walnut street railroad crossing all the time that street cars are running.

Wires are being strung on the North avenue line which was constructed last summer, but the operation of the system, which extends across the city on an east and west line, will not be commenced until next spring.

The electric light plant at Wauwatosa, which is to supply the Rapid Transit line with motive power, will be materially enlarged as soon as the weather permits. The old boiler house will be added to the engine room. A new brick boiler house, about 40 feet square, will be built and also a brick chimney 135 feet high. The boiler house will be supplied with a battery of three 125 horse power boilers. The engine house will be equipped with two Corliss engines of 150 horse power, each operating six generators, four dynamos, furnishing 1,600 incandescent lights and two generators to furnish motive powers for the Rapid Transit line, which will be operated by the Villard syndicate. It will be a new plant practically and one of the best of its size in the Northwest. The estimated cost is $10,000. The plant is expected to be in operation, and the Rapid Transit line as well, by June 1st. The new officers of the electric company are: Charles Stickney, president; Capt. Fred Pabst, treasurer; E. D. Hoyt, secretary and general manager and Charles Cuno, superintendent.

A motor man named Nichols, employed on the West Side Railroad, fainted and fell over the dashboard of his car while it was going at full speed a short time since. The passengers supposed that he had been killed, but he fell or was pushed sideways and was found lying between the two tracks absolutely unharmed, but in a dead faint. He was taken to a drugstore and thence home. It was afterward learned that he had been ill for several days, but nevertheless had resolutely stuck to his post.

Miss Helen F. Rousseau's suit against the West Side Railroad company has been settled out of court without cost to either party. She demanded $25,000 for personal injuries, alleging that her dress was caught while she was getting off the car and that she was dragged along the ground and her left foot and ankle bruised and sprained and her right leg broken. She is fifty-five years old. The accident, it was alleged, occurred on Monday, March 1st, 1891, and the conductor was accused of being negligent.

A suit for $15,000 damages has been commenced by Patrick McCabe, as guardian of William Hart, aged 10, against the West Side company. Young Hart fell under an electric car in January 21st and his arm had to be amputated. It is alleged in the complaint that the conductors and motor men on the line have been in the habit of permitting the boys to ride a block or so in return for turning the switches and that young Hart was thus engaged when he fell under the car.

John D. McLeod is now practically the business head of the Wisconsin Telephone company. On Tuesday last he was informed by President Payne that the board of directors had decided that in addition to filling the position of secretary, which he has held for a number of years, he should be general manager. Mr. McLeod has for some time done the work of both offices, and the action of the company simply makes his position as important in name as it has been in fact. The officers have moved into their fine new quarters on Broadway.

About 200 telephone wires were "knocked out" by the burning of a cable house at the corner of Second and West Water streets. The damage was done by a trolley wire coming in contact with one of the telephone wires. The accident happened on Thursday morning, and on Friday afternoon all the lines had been repaired and were in working order once more.

Frank E. Parker has resigned the general superintendency of the Wisconsin Telephone company in order to manage the business of the Johnson Electric Service company at St. Louis. Mr. Parker was one of the oldest employes of the Telephone company. He is well-known among electricians and well-liked, and his departure causes regret.

The Western Union Telegraph company has begun the work of stringing cables for its wires in this city. The aerial cable system was a compromise between the present overhead system and the underground system. In the business district the overhead wires will be removed from the streets and carried through the alleys by means of cables. Twenty experts arrived from Chicago early in the week and are hard at work. It will take about three months to make the change.

Henry Villard spent last Saturday and Monday in looking after his electrical properties in Milwaukee. He visited the power house, the new car house on National avenue and drove over all the street railway lines in company with Vice-president Payne and Manager Lynn. He was very much pleased with what he saw. On Saturday evening he was the guest of the Bankers' club at a dinner given at the Milwaukee club.

C.

Denver, Colo.

DENVER, March 5.—Creede, the booming new mining camp, is already illuminated by electricity. John H. Poole of Denver is in charge of the Creede Electric Light & Power company, whose plant is in operation. Light was turned on before the end of the fifth day after ground was broken for the plant. T. C. Brainard and Charles Boettcher are members of another company which is preparing to put in a plant.

The Denver, Lakewood & Golden railroad is to enter the city on Arapahoe street. According to the terms of the franchise this must be done by April 1st, and electricity must be employed as the motive power on the entire road by June 1st. Two stations will probably be required to furnish power for the whole line. The company may, however, lease power from the Tramway company, in which case only one other plant will be needed. The Villa Park branch of this road will, according to contract, be begun April 1st.

The Diamond Incandescent Lamp company has filed articles of incorporation with the secretary of state. The capital stock is $50,000. The principal business and office will be in Denver. The directors are W. H Brevoort, Samuel S. Campbell, D. D. Muir, John W. Flintham and Mosses L. Stern.

E. C. D.

PERSONAL.

Dr. Louis Bell is in Chicago.

Foree Bain returned from Pittsburg on Monday last.

C. A. Lathrop, western manager for Huyett & Smith, Detroit, returned from Minneapolis on Monday.

H. A. Royce, general manager of the Thomson Electric Welding company of Boston, was in Chicago last week.

The formal announcement has been made in the London *Gazette* that Sir William Thomson will be known hereafter as "Baron Kelvin of Largs, in the county of Ayr."

NEW INCORPORATIONS.

Ferguson-Ruthenberg company Louisville, Ky.; capital stock, $25,000; buying and selling electrical and other machinery.

Tremont Light & Water company, Portland, Ore.; capital stock, $10,000; to supply gas and electric lights, etc; Cake & Cake, Portland, Ore.

Longmont Electric Light & Power company, Highlands, Colo.; capital stock, $50,000; supplying the town of Longmont, Colo., with electricity for light and power.

Johnson Standardizing company, New York, N. Y.; capital stock, $10,000; to manufacture, sell, lease and use machinery appertaining to electricity, to carry on coal mining, etc.

Sanger Electric Light company, Sanger, Fresno county, Cal.; capital stock, $75,000; to deal in and operate electric inventions, light and power plants, street railroads, etc.; L. L. Cory, Fresno, Cal.

Tacoma Mint & Manufacturing company, Tacoma, Wash.; capital stock, $200,000; to operate railways, telegraph and telephone lines, and electric light plants; Erasmus Bennett, Tacoma, Wash.

Menominee Electric Light & Power company, Menominee, Wis.; capital stock, $30,000; to produce and transmit electricity for lighting and heating, and mechanical purposes; J. D. Hills, Menominee, Wis.

East Side Power company, Portland, Ore.; capital stock, $50,000; to manufacture, sell, purchase and deal in electricity, supply, furnish and sell power for all purposes in the city of Portland; G. A. Steel, Portland, Ore.

Union Electric company, Seattle, Wash.; capital stock, $1,000,000; to operate electric light and power plants, machinery, etc., acquire franchises, building engine houses, warehouses, etc., and do any other necessary things; E. C. Kilbourne, P. O. box 506, Seattle, Wash.

Columbia Electric Transmission company, Chicago, Ill.; capital stock, $500,000; to exhibit at the World's Fair long distance transmission of electric currents in large quantities, and to construct electric plants to supply light and power, etc.; Clarence Griggs, Ottawa, Ill.

Sioux City & Leeds Electric Street Railway company, Sioux City, Ia.; capital stock, $200,000; to locate, construct, build, maintain and operate or lease street or other railways within and adjacent to Sioux City, Ia., operated by horse, electric, steam or other power; Sioux Investment company, Sioux City, Ia.

Chicago & Edison Park Electric & Street Railway company, Chicago, Ill.; capital stock, $500,000; to build, construct, maintain and operate street railways embraced in the vicinity of the towns of Lake, Calumet, Hyde Park, South, North and West Chicago, Lake View, Evanston, Norwood, Maine, Cicero, Jefferson, etc.; N. H. Hanchette, 173 LaSalle street, Chicago, Ill.

ELECTRIC LIGHTING.

The Progress Electric Light & Motor company has received the contract to light the city of Mobile, Ala., by electricity.

A new 50 light Standard arc dynamo was added to the equipment of the Appleton, Wis., Edison company last week, giving it now a capacity of 110 arcs.

The Chicago city council has awarded a contract to the Chicago Arc Light & Power company for 280 street lamps for seven years at 50 cents per lamp per night. These lights will be placed in districts not now covered by the city's lighting plant.

ELECTRIC RAILWAYS.

R. E. Charlton, president of the Hamilton street railroad of Hamilton, Ont., was in Rochester, N. Y., last week, vestigating the electric car system.

Work on the electric street railway at La Crosse, Wis., will be commenced about April 1st. The franchise calls for five miles of road to be completed and in running order by Dec. 31, 1892. The officials of the road have not yet decided what system they will use.

Manager Geo. P. Nichols of the stationary motor department of the Chicago office of the Thomson-Houston

company is installing an electric tramway at the works of the Northwestern Terra Cotta company, Chicago. There will be furnished a six horse power motor car to run over a track a mile and a quarter in length.

An experimental car, equipped with storage batteries and motors of the Ford & Washburn Storage Battery company, has been making trial trips on the Woodland avenue and West Side Street Railway company's lines at Cleveland. Supt. Mulhern is very much pleased with the system, and says that it is very probable that it will be adopted by the company. The new car will be run on the Woodland line among the other cars for a few weeks as a further test. It will make all the regular stops to pick up and let off passengers, and if this proves satisfactory a large order for cars will at once be placed with the company.

The St. Louis *Globe-Democrat* prints the following special dispatch from St Joseph, Mo.: "A remarkable case of larceny occurred in the north part of this city. A gang of thieves went to Walker's addition, and climbing the poles on which are strung the wires of the Union street car line, tore them down, and made away with over two miles of the wire. It was very singular the affair was not caught on to, as the power was in operation and the wire was alive with electricity powerful enough to kill by simple contact. The stolen wire is valued at $1,500, and causes much annoyance to the company. Operation of cars in this locality will have to be suspended until the wire is replaced."

MISCELLANEOUS.

The Brotherhood of Electrical Mechanics of Chicago gave its second annual ball at Battery D on February 26th. In connection with the party there was an interesting electrical display, in which the McIntosh Battery & Optical company, the Central Electric company and George Cutter took part.

An interesting point was raised in a criminal action recently commenced in St. Louis by the Municipal Electric Light & Power company, which was prosecuting several persons charged with stealing current. It was claimed that the wires of the company leading to a consumer's residence were tapped before they entered the meter and of course the company did not receive pay for the service. The point was raised that electricity cannot be stolen, inasmuch as in order to constitute stealing there must be an asportation, a condition impossible in the case of electricity, which not being in any wise under control, is, therefore, not the goods, property or effects of any one. The judge abruptly adjourned the case until he could thoroughly investigate the question.

TRADE NEWS.

The Electric Engineering & Manufacturing company, Chicago, has just completed for Prof. W. D. Ewell of the Northwestern University an induction coil capable of throwing a 7 inch spark.

The capital stock of H. Ward Leonard & Co, New York, has recently been doubled, and the increase taken by gentlemen prominent in the railway, banking and gas interests of New York city.

The Writing Telegraph company of Baltimore will begin to string wires for a central station system at once, having secured 300 contracts. Work will be pushed rapidly, and it is expected that the system will be in full operation not later than April 1st.

Mr. Southard of the Chicago Motor company is preparing for an active trade in fan motors during the coming season. Heretofore this company has only manufactured a motor for 110 volt circuits but will now introduce motors for 500 volts and arc circuits.

Suit has been commeneed by the Builders' Insulating Tube company, of Lynn, Mass., and the Indurated Fiber Industries company, against the Interior Conduit & Insulation company, for alleged infringement of patents on pipes or paper tubing to carry electric wires.

C. E. Wilson, well known from his connection with the Knapp Electrical works, Chicago, has just made arrangements to represent the Electrical Merchandise company, Chicago. Mr. Wilson's long experience and large acquaintance will make him a valuable addition to the staff of the company.

George Cutter, Chicago, is finding a steady market for his fine street hoods, and has just finished a second batch of a special and handsome design. From the demand for these hoods and the Cutter lamp-supporting pulleys, Mr. Cutter's factory has been kept quite busy throughout the winter season.

T. J. Murphy of 136 Liberty street, New York city, is supplying large orders for slate for insulating purposes to electrical manufacturing concerns. Mr. Murphy has had extensive experience in handling slate and can furnish valuable information as to the durability and special fitness of the different classes for insulating purposes.

The city of St. Charles, Ill., is about to install an electric light plant of its own, and bids were opened on February 27th for the steam plant, and it is worthy of note that the contract for the steam plant was, after careful consideration, awarded to the highest bidders, W. B. Pearson & Co. of Chicago, agents for the Ball & Wood Co. of New York.

Extensive preparations are being made by General Manager Southard of the Chicago Electric Motor company, for the sale of the "Chicago" fan motors during the coming season. A large stock is being manufactured in advance. This company also keeps a number of men constantly employed on repair work, the rewinding and repairing of street railway motors, etc. By persistent hard work and a careful attention to details a very large line of this work has been secured.

The Buffalo Street Railway company has just ordered three 24-inch Underwood cotton-leather belts for its power station. These are in addition to the four cotton-leather belts of the same make and size now running at this station. The plants of the Iroquois and Broezel hotels are equipped with Underwood belts. The Buffalo belts were purchased through the Engineering Equipment company, 143 Liberty street, New York city, which has full control of the Underwood trade in New York state. F. P. Mack is the western representative, at 33 South Canal street, Chicago.

Brownlee & Co. have their new pole yard on the River Rouge nearly ready, and will start their new mill at the same place in about sixty days. This firm has unequaled facilities for the prompt shipment of any order, however large, that may be intrusted to them, and when the mill is fully completed they will be able to turn out octagonal poles and cross arms in large quantities and at short notice. The change in location enables Brownlee & Co. to ship poles and timber in rafts, instead of by rail as heretofore, and makes it possible for them to quote a material reduction in prices.

H. Ward Leonard's method of electric motor control, which he exhibited for the first time at the Montreal convention and upon which he has recently secured broad patents, has met with great favor at the hands of the electric elevator people. Licenses have been granted to the Otis, Crane, Hale, Stokes & Parrish and Whittier Elevator companies, and electric elevators operated under Mr. Leonard's method are being rapidly introduced. This system is very popular with the central station managers, as by its use the motor takes so small a current in starting up the elevator as to have no effect upon electric lights on the same circuit. By this method an electric elevator can be operated from a three-wire circuit, an arc circuit, a railway circuit or an alternating circuit.

The New York Insulated Wire company, since the establishment of its western branch at 78, 80 and 82 Franklin street, Chicago, less than a year ago, has experienced a healthy and continuous increase of business that cannot fail to gratify the stockholders of the company. This company manufactures and sells the Grimshaw white core insulated wire and the Vulca moisture-proof wire ducts, and the recent expansion of its western trade is due no less to the intrinsic merits of the goods than to the "hustling" abilities of the Chicago agent of the company, George H. Meeker. The prospects for a good season's trade, both east and west, are excellent, and Mr. Meeker feels confident that his company's legitimate business methods and reputation for straightforward dealing will insure a continuance of public favor.

BUSINESS.

The Phœnix Glass company, New York, is putting on the market some new styles of electric light globes.

The Densmore Typewriter company, New York, is encouraged by an increasing demand for its typewriter with its latest improvements.

The Crown Electric Manufacturing company, Bridgeport, Conn., reports that the sales of its new socket both in the East and West have been very satisfactory.

The Great Western Electric Supply company, Chicago, is finding a ready sale throughout the West for its new Hercules tape. This tape is manufactured in white, black and pure rubber.

The Indurated Fiber Pipe company of 143 Liberty street, New York, is running its factory both night and day in order to fill orders now on hand for indurated fiber pipe for electrical subways.

G. S. Neu, New York, is meeting with great success in the introduction of his wire tapper. The principal feature of this very useful tool is that one is able to test the electric circuit without destroying insulatton.

On another page in this week's issue is a cut of the finest of the modern office buildings of Chicago—the Woman's Temple. This building will have a large electric light plant of its own, and is wired throughout with Kerite wire.

The LaRoche Electric Works, Philadelphia, report that the sale of their alternators for central stations and their direct current dynamos for isolated lighting, during the month of February were far in excess of those for the same month in '91.

The Manhattan Electrical Supply company, 36 Cortlandt street, New York, sells the Mesco dry battery with the understanding that it will, upon being promptly notified, defend, without cost, any infringement suit that may be brought against customers for selling or using the cell.

Diehl & Co. of 385 Broadway, New York, are very busy at present manufacturing their electric fan, as they expect a large demand for it during the coming summer. The most noticeable feature of this fan is that it does away with shafting and belting, thus avoiding all annoyances and disfigurement.

The Cassier Magazine company of New York has prepared an envelope arranged for the filing of advertising contracts, on the outside of which is a list of prominent periodicals and blanks, in which the space to be occupied, time of beginning, number of times and amount to be paid for the advertisement may be noted, making a complete record of the contract.

The Knudson-Cuttriss Wire company, limited., is the name of a new company which has been organized in New York for the purpose of manufacturing a new insulating fiber. At the Buffalo convention this company had two large coils of wire insulated with its fiber submerged in water with 110 volt current passing through it without the slightest leakage. In the insulation there is no rubber or gutta-percha.

The plant erected by the Heisler Electric company for the corporation of West Toronto Junction, Ont., has been inspected and formally accepted by the town authorities. The Heisler company also reports a sale of plant at Constantine, Mich., made through its agents, Messrs. Rheubottom & Bond of Union City. These gentlemen are doing excellent work in their territory, and are meeting with deserved success.

Nothing would indicate more forcibly that the Electric Construction & Supply company, New York, was receiving the benefits of installations of the Ward lamp than the statement that during the month of February the shipments exceeded those of any three months since the company has been in business. Not a little credit for this success must be given to the company's efficient and popular manager, R. B. Corey.

The Great Western Electric Supply company, Chicago, is issuing a number of very neat circulars on the numerous specialties which it either manufactures or for which it is general agent. These circulars, printed in two colors, will undoubtedly attract the attention of buyers. The following specialties are among the ones referred to in the leaflets: Hercules tape, Bernstein series incandescent lamps, Chubbuck malleable iron brackets, etc.

The Hine Eliminator company, New York, has just issued a circular illustrating and describing its latest eliminator. The circular contains also an accurate report of the recent test, in which this appliance gave the most satisfactory results. During the past two weeks the Hine company has received orders for the separator from San Francisco, Terra Alta, W. V., St. Paul, Minn, Des Moines, Ia, and one for the new factory of the Shadbolt Manufacturing company of Brooklyn.

Since acquiring the American patents which control the Cardew voltmeter, Queen & Co., Philadelphia, have made extensive preparations to manufacture this instrument. Special tools have been procured so that the mechanical parts may be constructed in the best manner possible, and in the new Queen laboratory every facility is afforded for exact calibration. The Cardew instrument is dead beat, direct reading for both alternating and continuous currents, contains no permanent magnets nor parts liable to change, can be left constantly in circuit, and the indications will be correct within one per cent. under all circumstances, it is claimed. These qualifications speak for themselves and make the Cardew instrument one eminently suited for marine installations.

The Reliance Electric Manufacturing company of Waterford, Ontario, which is building the Rae system in Canada, has secured the contract for the equipment of the Toronto & Mimico electric railway. This road will start from the terminus of the Toronto City Railway company's lines on Queen street, and extend to the village of Mimico, and eventually to Long Branch, a total distance of about seven miles. The road runs along the lake shore the entire distance. The Reliance company has the contract for the entire equipment exclusive of track. The power station will contain one Armington & Sims engine of the compound condensing type, 125 horse power, and the Rae station railway apparatus consisting of one 85 kilowatt generator, and the necessary appliances. The motors for this road are of Mr. Rae's latest design of single reduction motors, which are at present only built in Canada.

Masters & Veneman, successors to A. J. Veneman, of Evansville, Ind., have just started a construction and supply business. They will carry a full line of supplies and will add and increase their stock as the demand justifies. They will contract for construction work of all kinds and install isolated and central station plants. E. L. Masters of this firm has been in the electrical business for about ten years. For the last three years he has held the position of superintendent of construction with the Evansville Gas & Electric Light company. A. J. Veneman has also been in the employ of Evansville Gas & Electric Light company but during the past year he has been with the Electrical Supply company, Chicago, as salesman, which experience has enabled him to attain a thorough knowledge of electrical supplies of every description. Masters & Veneman start out with a good motto "Good work by experienced and competent workmen."

C. A. Daigh, Morgan Brooks and other officers and stockholders of the Electrical Engineering & Supply company, Chicago and St. Paul, have bought a controlling interest in the National Electric Manufacturing company of Eau Claire, Wis. Mr. Daigh has been elected a director and vice-president and will be given the general supervision of the affairs of the company. The factory will be kept in Eau Claire with a general sales office in Chicago. The capacity of the factory will be doubled and a 250 horse power compound condensing engine will be put in at once for testing purposes. The most of the shafting will be taken out and the electric system of power transmission be installed at once. The policy of the company will be conservative, and with the 125 men now employed the greater facilities will increase the producing capacity of this number of men. The interest of the stockholders of the two companies will be mutual. The other officers of the National company will remain as before. In the Electrical Engineering & Supply company Mr. Daigh will

remain as president. Morgan Brooks, in addition to his position as treasurer, will become general manager of the company, taking the position now held by Mr. Daigh. F. J. Cram has been appointed general agent. C. B. Totman will be secretary in place of A. B. Sibley, who resigned some time since. In connection with the affairs of the National company it may be mentioned that Geo. B. Shaw will be a prominent candidate for a congressional nomination in the Eau Claire district this fall, and he retires from the National company to give his entire time to securing this nomination.

ELECTRICAL STOCK MARKET.

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, March 5th, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	98	98½
Edison Illuminating company of New York	81½	82½
" " " Brooklyn	72½	77½
" " " Boston	100	105
" " " Chicago	130	140
Edison Ore Milling company	15	20
United States Electric company of New York	15	25
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomson-Houston Electric company	58½	50½
" " " Preferred	28½	20½
Westinghouse Electric company	14¾	15⅛
North American Phonograph company	5	6
New York " "	2½	5
Automatic Exhibition company	2	3

ELECTRICAL PATENTS.

Issued Feb. 23 and March 1, 1892.

469,241. Molding for Electric Wires. Walter Gritten and Arthur Parmley, London, England.

This invention consists of a casing, beading, or molding made of thin strips of fibrous non-combustible non-conducting material held together by a suitable non-combustible non-conducting adherent and having longitudinal grooves therein for reception of the electric wires.

469,248. Electric Conductor for Metallic Circuits. Silas W. N. Holan, Newton, Mass.

469,253. Automatic Disconnector. Andrew J. Johnston, Richmond, Va.

469,257. Speed Regulator for Dynamos or Motors. Luther H. Leber, Pittsburg, Pa.

This invention consists of an arrangement by which, when the machine runs overspeed the governor rises and brings one side of the connected line upon the insulated portion of the governor-rod and thereby cuts out the current until the speed is reduced to the proper ratio, when the governor arms descend to bring the wire carried thereby into position to again restore the current.

469,262. Conduit for Cable or Electric Tramways. George S. Morrison, Chicago, Ill, and Charles Vogel, San Anselmo, Cal.

469,266. Electric Burglar Alarm for Windows. Friend C. Page, Creston, Iowa.

469,373. Electric Telegraph Apparatus. Joseph Robinson, London, England.

469,280. Electric Railway. William S. Smith, Berkeley, Cal.

469,281. Dynamo Electric Machine. Johannes Sohlman, Frederikshamn, Finland, Russia.

469,283. Electric Hose Coupling. Joseph B. Strauss, Cincinnati, Ohio.

469,319. Commutator Cleaning device. William J. Phelps, Elmwood, Ill.

Claim seven reads:
"7. The combination of a car with a rod there under, means at each end of the car for reciprocating the rod, and a commutator cleaning device consisting of a buffer and ribbon acting in conjunction with each other, connected with and operated by such rod."

469,347. Electric Arc Lamp. William D. Graves, Cleveland, Ohio.

469,349. Poison Cabinet. Edmond G. Kubler, Akron, Ohio.

469,353. Overhead Conductor for Electric Railways. Edward M. Bentley, New York, N. Y.

Claim sixteen is:
"A suspended electric conductor having interposed there in a spring to tighten the conductor."

469,361. Electric Elevator. Robert Watson, Brooklyn, N. Y.

469,362. Electric Arc Lamp. Frederick R. Boardman Manor Park, England.

469,365. Burglar Alarm. Levi Pentz, Canton, Ohio.

469,379. Fire Alarm System. Harvey Redding, Everett.

469,383. Brake for Electric Cars. Edward S. Amrook, Waltham, Mass.

469,408. Automatic Electric Gas Lighting Burner. Rufus C. Nourse and Thomas W. Lane, Boston, Mass.

469,424. Electrical High and Low Water Alarm. Alcinus C. McConnell, Allegheny, Pa.

469,428. Diaphragm for Electrical Cells. Charles N. Waite, Newton, Mass.

This invention consists of a diaphragm for an electric cell consisting of a dense and compact layer, sheet or film, composed of a metallic albuminate.

469,438. Railway Signaling Apparatus. Frank I. Myers, New York, N. Y.

The object of this invention is to clear a signal at once on the last wheel of the train leaving the block, whether the train be a long train or a short train, or a single locomotive.

469,441. Electro-Magnetic Reciprocating Engine. Merle J. Wightman, Scranton, Pa.

Claim twenty-six reads:
"26. The combination of the reciprocating core having a coil traversed by alternating currents, and the fixed coils traversed by continuous currents and also by the alternating currents flowing in the first-named coil."

469,454. Process of and Apparatus for Controlling the Discharge of Molten Contents of Crucibles or Other Vessels. Augustus J. Rogers, Milwaukee, Wis.

469,460. Trolley for Overhead Railways. Nelson E. Austin, Danbury, Conn.

469,462. Automatic Draft Regulator. Ira F. Beers and Frederic C. Beers, Elmira, N. Y.

469,469. Tube for Electric Conductors. Edwin T. Greenfield, New York, N. Y.

469,470. Conduit for Electric Conductors. Edwin T. Greenfield, New York, N. Y.

469,471. Electro Magnetic Stop Motion for Steam Engines. William W. Hailstone, Long Island City, N. Y.

469,474. Telephone Support. Hammond V. Hayes, Cambridge.

469,475. Electric Cable. Hammond V. Hayes, Cambridge and John S. Stone, Boston.

469,481. Electrical Atomizer. Colin Lightbody, Brooklyn, N. Y.

469,482. Incandescent Lamp. Frederic H. Manchester Providence, R. I.

469,483. Incandescent Lamp. Frederic H. Manchester Providence, R. I.

469,486. Apparatus for Pointing Carbon Pencils. Philo Moses, Fremont, Ohio.

469,515. Electric Machine. Michael von Dolivo-Dobrowolsky, Berlin, Germany.

469,522. Electric Cable. Hammond V. Hayes, Cambridge, Mass.

469,538. Process of and Apparatus for Electroplating the Hulls of Vessels. Alexander D. Buchanan, Long Island City, N. Y.

469,648. Fire and Burglar Alarm. Thomas J. Gordon, Eureka Springs, Ark.

469,649. Signal Device for Telephone Pay Stations. William Gray, Hartford, Conn.

469,650. Signal Device for Telephone Pay Stations. William Gray, Hartford, Conn.

469,652. Automatic Advertising Apparatus. William C. Jennings, Camden, N. J.

469,656. Electric Lighting System. James F. McElroy, Albany, N. Y.

Claim one is:
"The combination, with a dynamo electric generator operated by the motion of the train, of a potential switch in the circuit of said dynamo, said switch being operated by the magnetic pull of the revolving armature on the field magnets mechanically transmitted to said switch."

469,669. Apparatus for Stopping Engines. Jacob P. Tirrell, Boston.

469,670. Blow Pipe. Truman H. Aldrich, Cincinnati, O.

469,672. Electro Magnet. Andrus D. Ayres, Kalamazoo, Mich.

469,706. Telephony. William C. Lockwood, New York, N. Y.

The invention comprises a local circuit embracing a transmitter and an electro magnet, in combination with a secondary circuit embracing an electro magnet and a conductor connecting said local and secondary circuits with the line conductor and ground, whereby a secondary or induced current is impelled or forced over the line by the primary current.

469,712. Device for Controlling Electric Motors. Albert L. Parcelle, Boston, Mass.

This invention especially relates to that class of electric motor circuit controlling devices in which the circuit is closed through a gradually decreasing resistance, which affords the time necessary to develop the proper conditions to prevent burning out or injuring the motor.
Claim four reads:
"The combination, substantially as hereinbefore set forth, of the switch lever of an electric motor, a double acting controlling pneumatic cylinder having an air inlet valve in each end, and air passages at the middle, a piston therein, and a connection between the switch lever and piston."

469,723. Underground Electric Conduit. Edward P. Robbins, Cincinnati, O.

469,725. Dynamo-Electric Machine. Elmer A. Sperry, Chicago, Ill.

The claim reads:
"In a dynamo the combination of a rotating shaft with an annular armature, rods passing through the same, a supporting spider for such rods, said rods flattened at the point or points where the armature coils pass them and a field magnet."

469,745. Non-Interfering Fire Alarm Telegraph Box. Frank F. Loomis, Akron, O.

469,750. Automatic Trolley Catch. Stephen A. Shepard and Frederick P. Lang, Allegheny, Pa.

469,765. Distributing Box for Cable Systems. Charles H. Wilson, Chicago, Ill.

The second claim is:
"A distribution box provided with a partition to separate the box into two compartments, said partition being provided with metal pins insulated from each other for affording electrical connections through said partition, the box being provided with removable covers on opposite sides so that access may be had to either chamber without opening the other."
The manhole or vault is preferably constructed so as to be in horizontal cross section in the form of a cross, the ducts being connected with niches thus formed either opposite to one another or at right angles to one another

469,782. Telephone Transmitter. Joseph C. Goulding, Cardiff.

469,792. Electrically Heated Smoothing Iron. Willis Mitchell, Malden, Mass.

469,796. Galvanic Electric Plaster. John W. Shults, Wichita, Kan.

469,797. Galvanic Electric Plaster. John W. Shults, Wichita, Kan.

469,799. Electric Locomotive. Thomas L. Willson, Brooklyn, N. Y.

469,800. Electric Meter. James J. Wood, Fort Wayne, Ind.

469,802. Electric Alarm Clock. Joseph Yungbauer, St. Paul, Minn.

469,806. Commutator Brush and Holder. Charles D. Jenney, Indianapolis, Ind.

469,809. System of Electrical Distribution. William Stanley, Jr., Great Barrington, Mass.

Claim one reads:
"In a system of electrical distribution and in combination, an alternating current dynamo and converters electrically connected with the main line conductors in multiple arc and organized to transform the current in the main conductors into currents of less potential and greater quantity in the secondaries, each converter made with a primary coil containing such length of wire exposed to magneto electric induction that when operated by the dynamo with which it is to be used with its secondary circuit open the electrical pressure and counter pressure in its primary circuit shall be equal to incandescent lamps or other translating devices in the secondary circuits."

469,828. Conduit System for Electric Railways. John E. Waller and Edward Manville, London, England.

469,856. Telegraph Apparatus for Branch Offices. John B. Hurd, Red Bank, N. J.

469,861. Contact Device for Electric Railways. John C. Love, Philadelphia, Pa.

469,862. Electro Magnetic Machine. Robert Lundell, New York, N. Y.

469,865. Telephone System. Thomas W. O'Brien, Wilkesbarre, Pa.

469,873. Apparatus for Illuminating Cars of Cable Roads. Charles E. Scribner and Ernest P. Warner, Chicago, Ill.

469,895. Extension Electrolier. Charles Deavs, New York, N. Y.

469,899. Trolley for Electric Railways. William H. Morgan, Alliance, O.

469,905. Electrical Releasing Device for Target Traps. Paul North, Cleveland, O.

469,917. Armature Winding for Dynamo Electric Machines. Rudolf Eickemeyer, Yonkers, N. Y.

Of the three claims the second reads:
"A low tension armature winding composed of sections each in one or more separate lengths of bendable metal united mechanically at its ends and having a short side and a long side, and end portions which are centrally offset in opposite directions, and are correspondingly curved."

469,940. Insulator. Charles N. Hammond, Boston, Mass.

469,944. Power Transmitting Device for Electric Railways. Edward H. Johnson, New York, N. Y.

469,949. Electric Soldering Tool. Johann J. Ritter, Basle, Switzerland.

469,995. Electro Magnetic Annunciator. Francis W. Dunbar, Newark, N. J.

470,008. Electric Light Attachment for Lamps. Ralph C. Putnam, Philadelphia, Pa.

470,013. Lightning Arrester. Charles F. Scott and Alexander Wurts, Pittsburg Pa.

470,014. Fuse for Electric Circuits. Charles F. Scott and Alexander Wurts, Pittsburg, Pa.

470,038. Electric Link Welding Machine. Charles L. Coffin, Detroit, Mich.

470,057. Dynamo or Motor. Ralston C. Kintzing, Brooklyn, N. Y.

The invention consists of a dynamo or motor composed of a hollow spherical shell in two parts, the lower part or hemisphere having base and bracket bearings for the shaft integral therewith, the opposing field magnets being attached to the two hemispheres, respectively.

470,073. Electric Battery. Erminio Ortelli, Cadenabbia, Italy.

470,080. Adjustable Suspension Apparatus for Electrical Translating Devices. Harry D. Sisson, Pittsfield, Mass.

470,123. Voltaic Battery. Henry I. Harris, London Eng.

470,129. Electric Railway Signal. William Holloway, Jr., Wayne, Pa.

470,143. Automatic Valve Controller. Washington H. Kilbourn, Greenfield, Mass.

470,155. Electrical Device for Stopping Horses. Albert B. Holson, Chicago, Ill.

470,158. Electric Elevator. Carson J. Sturgeon, Erie, Pa.

470,161. Circuit Interrupting Device. Alexander Wurts, Pittsburg, Pa.

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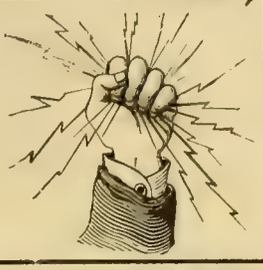

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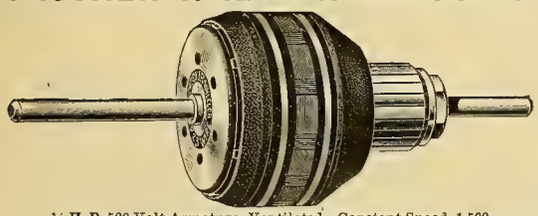

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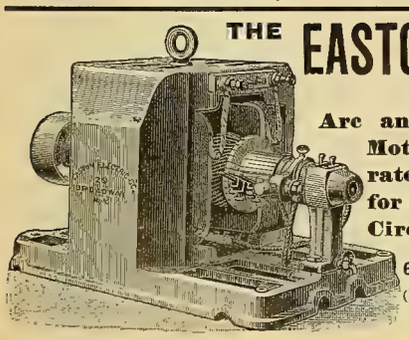

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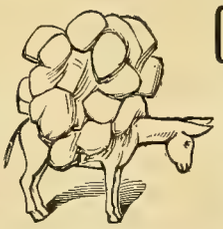

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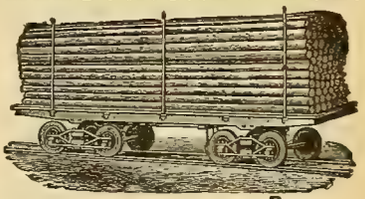

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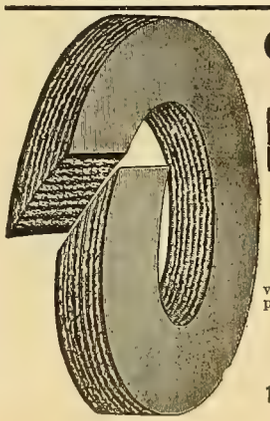

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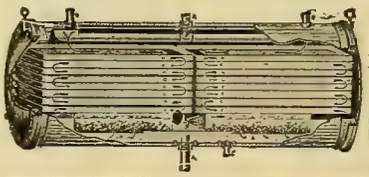

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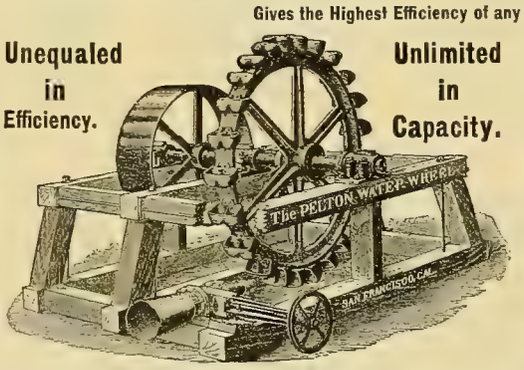

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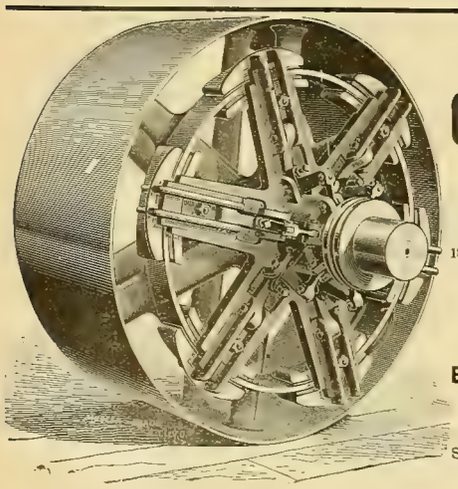

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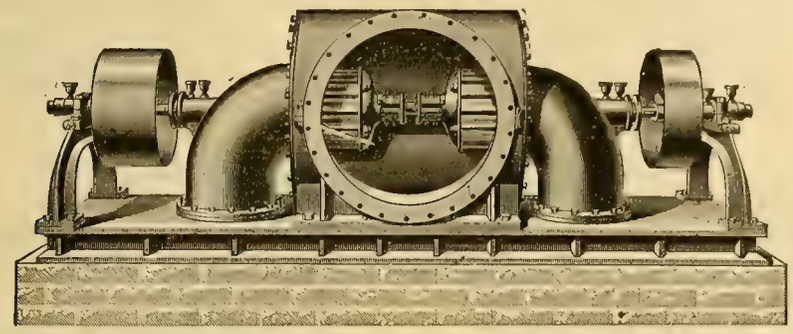

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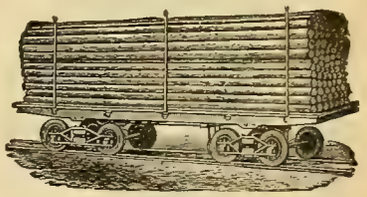

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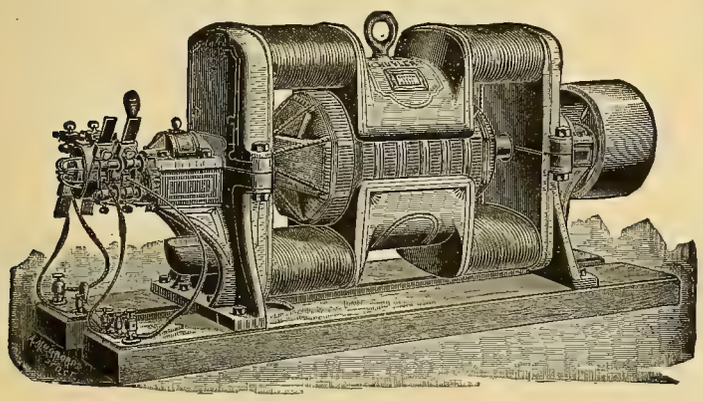

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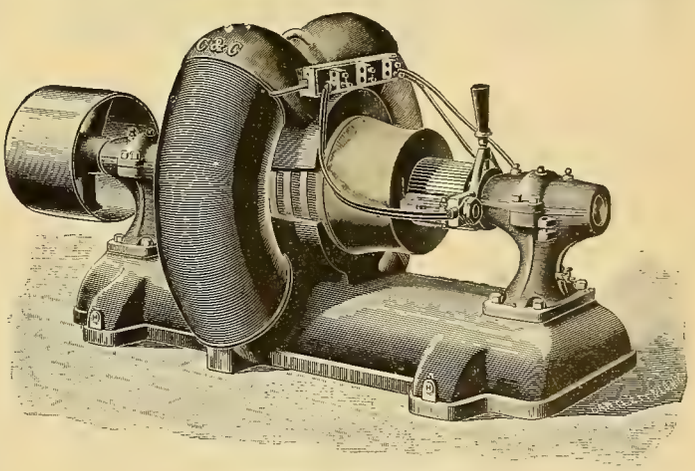

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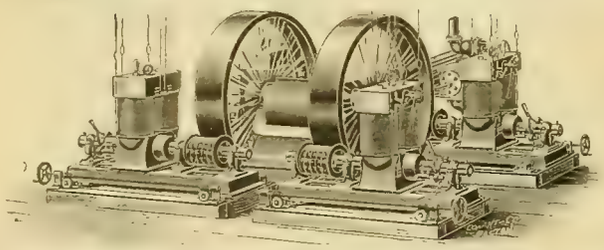

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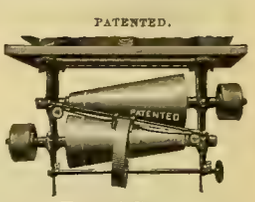

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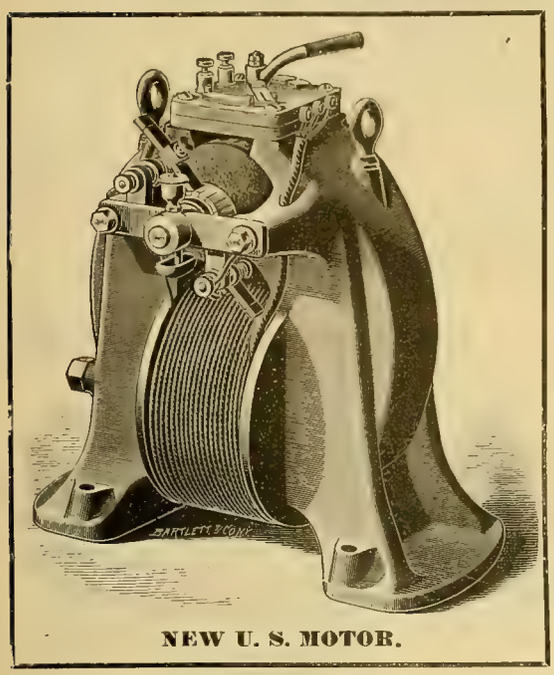

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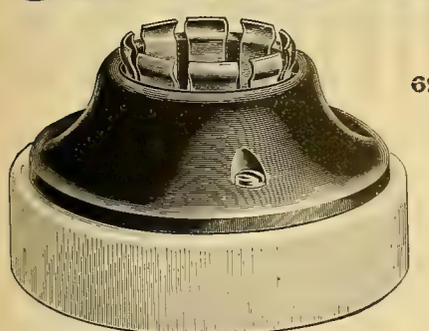

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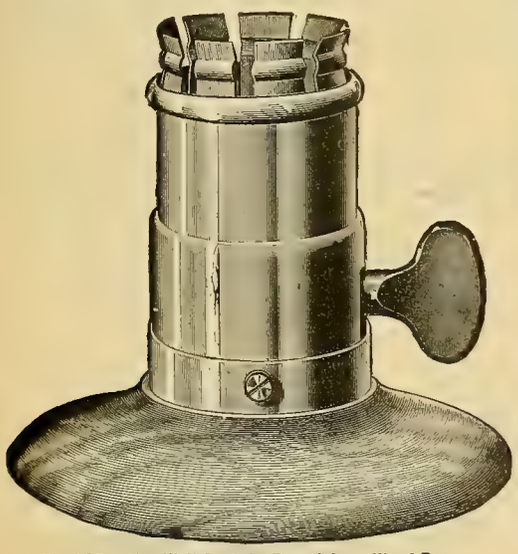

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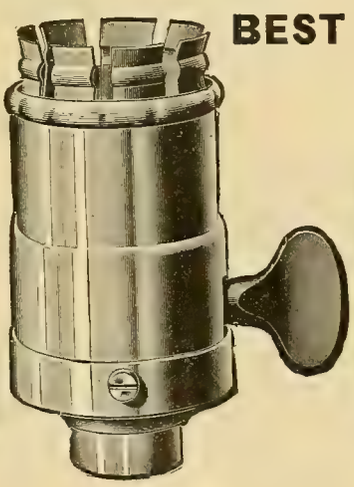

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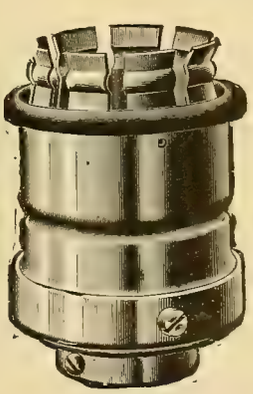

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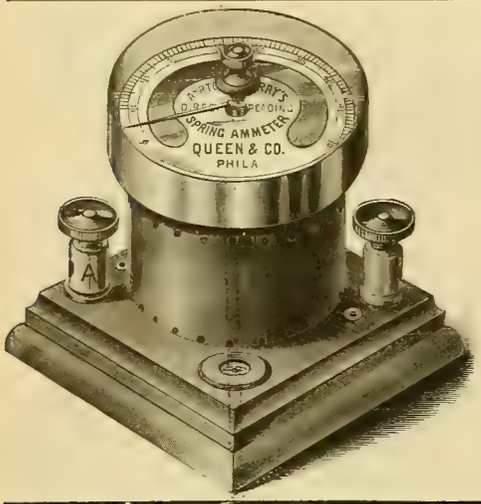

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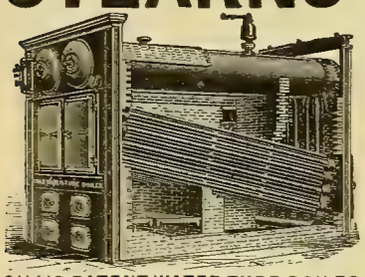
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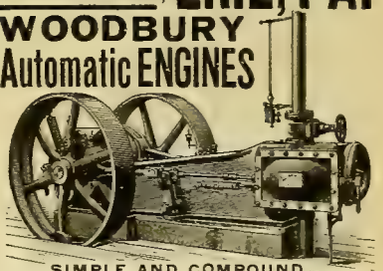
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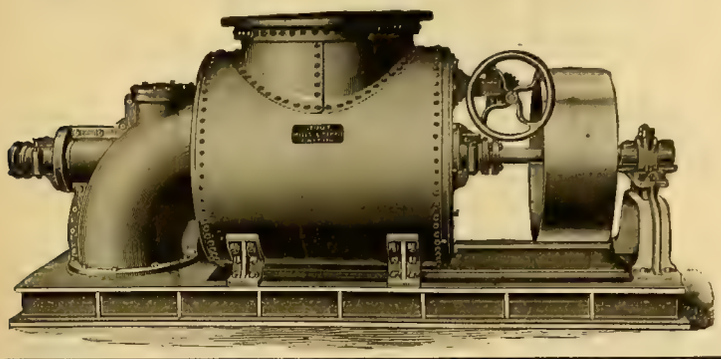

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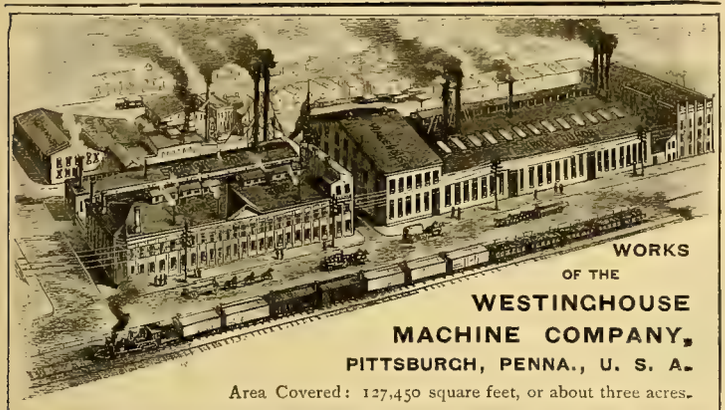

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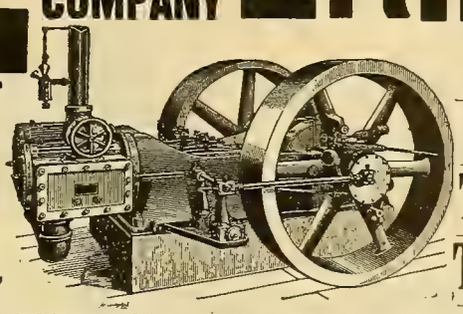

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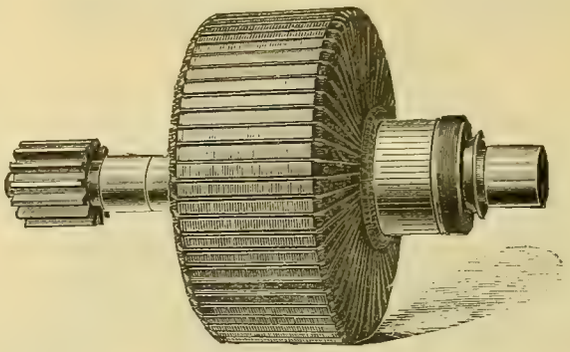

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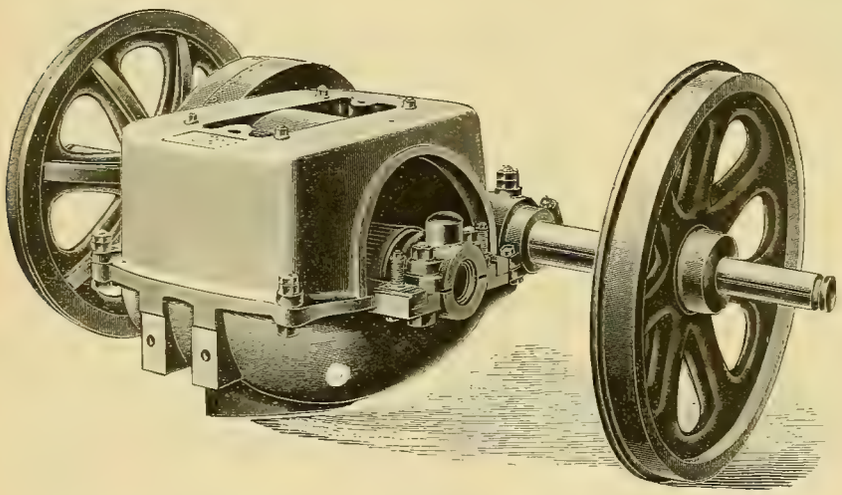

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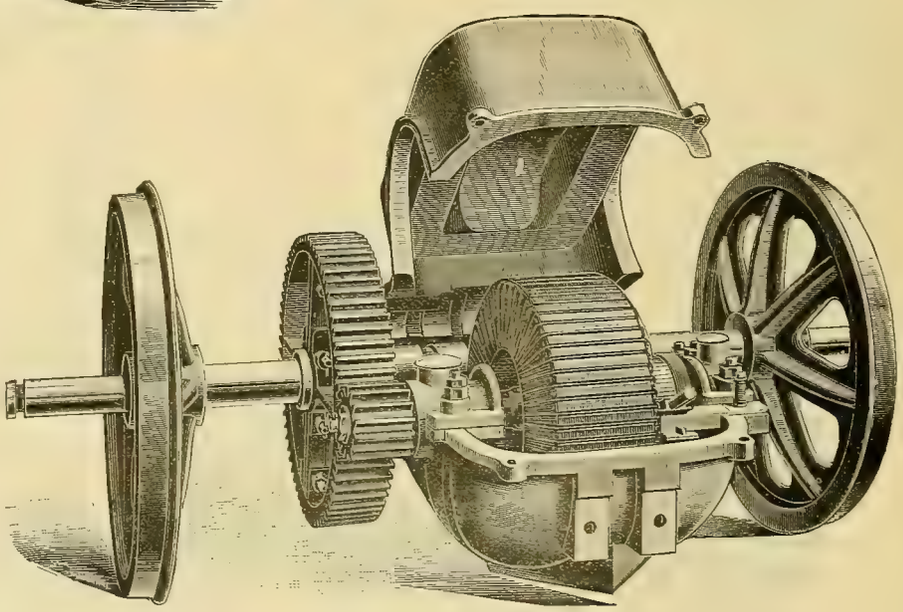

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THE ELECTRICAL SUPPLY CO.,

GENTLEMEN:—We have been running your brushes on our Edison Dynamo for two months and find they are a decided improvement.

HENRY MUNSTERMAN,
Chief Engineer.

CHICAGO, Aug. 22, 1891.

THE ELECTRICAL SUPPLY CO.,
Michigan Avenue and Randolph Street, Chicago.

GENTLEMEN:—We have used a set of your Wirt Brushes on our dynamo, and have had no sparking and scarcely any attention required during that time. The brushes furnished by the makers of the same dynamo were always more or less troublesome, and required frequent resetting and dressing of the commutator. I would now consider it a hardship to be obliged to use the old brushes.

Yours truly, (Signed) R. C. PAGE,
Engineer Libby Prison Museum.

MARYSVILLE, O., Jan. 2, 1892.

THE ELECTRICAL SUPPLY CO., Chicago, Ill.

DEAR SIRS:—The brushes came in good order, and after giving them a trial I find them to be the best brushes we ever used, as they run smooth and do not cut the commutator, or spark. We will order more. Very truly, R. TURNER,
Chief Engineer Marysville Light & Water Co.

WEST KENTUCKY INSANE ASYLUM,

HOPKINSVILLE, KY., Dec. 20, 1891

THE ELECTRICAL SUPPLY CO., Chicago.

GENTLEMEN:—Having used your Wirt Brushes for over a month I am satisfied they are all that you claim for them. Please send me your general catalogue. Yours respectfully,

JNO. G. LUTZ.

CHICAGO, Nov. 19, 1891.

THE ELECTRICAL SUPPLY CO., Chicago, Ill.

GENTLEMEN:—After trying one set of your Patent Dynamo Brushes, I have put them on all three of our incandescent dynamos, and like them so well that I would not be willing to use the old style of brush again. Yours truly,

D. B. RAMSEY,
Chief Engineer Union League Club.

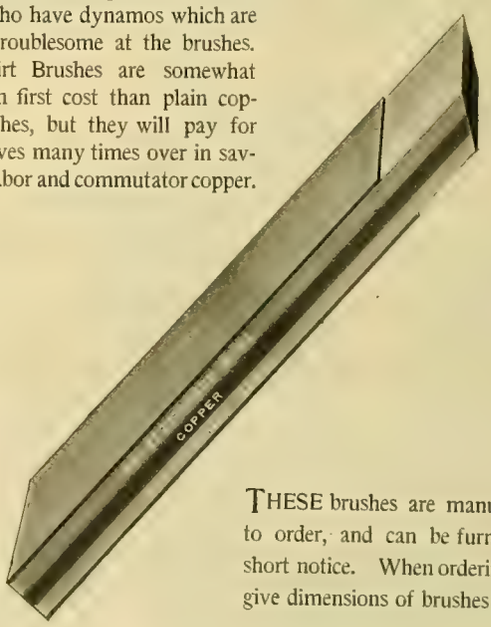
DENVER, COLO., Nov. 27, 1891.

THE ELECTRICAL SUPPLY CO., Chicago, Ill.

GENTLEMEN:—I am much pleased with the Brushes. I gave them the most severe test I know of, placing them on a commutator where *even carbon* brushes were not successful in reducing the sparking, and where there was a very heavy current at high potential, with a constant "chewing" up of the copper. Your Brush has eliminated all trouble, and I have asked our Company to order a number of them, when I shall use them on our other dynamos.

Yours truly, R. H. STERLING,
Electrician, Denver Consolidated Electric Co.

WE invite correspondence from those who have dynamos which are at all troublesome at the brushes. The Wirt Brushes are somewhat higher in first cost than plain copper brushes, but they will pay for themselves many times over in saving of labor and commutator copper.



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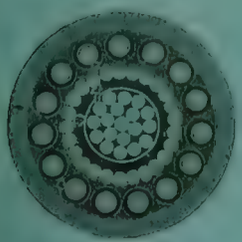
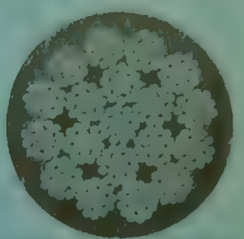
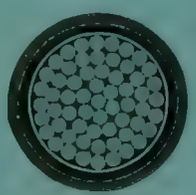

Underground Core.


Feeder Cable, Brooklyn Edison Electric Light Co.

Underground Core, N. J. Central R. R.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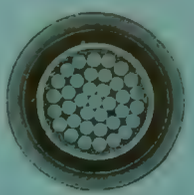
Submarine Work, Edison Electric Light Co., Easton, Pa.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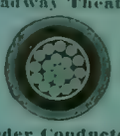
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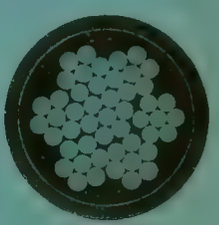
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SPRINGFIELD, ILL., Feb. 2, 1892.

DETROIT ELECTRICAL WORKS, Detroit, Mich.

Gentlemen:—In reply to yours of Jan. 28th, would say that last fall, during the State Encampment, we had, most of the four weeks, three trail cars to each of your motors, and pulled up a 3 per cent. grade with perfect ease from 250 to 300 persons, but with your last improved or inverted motors, we had four trailers, and brought in, by actual count, 422 persons, without any trouble whatever. We did the same during our Fair in September last, and if I did not think your motors do the most work with the least power, I should not have given you lately an order for five more motors.

On January 18, 1892, we had a very heavy snow storm here; our cars never stopped, made their regular trips, while the City Railway Company, with their T.-H. equipment, had to quit running in the afternoon at 5 P. M. We had no trouble in pulling through the heavy snow drifts.

We have two Edison Motors, but they being out of repair at that time, we could not give them a fair trial to see how they would go through the snow.

Yours very respectfully,

(Signed) PEOPLE'S ELECTRIC RAILWAY CO.,
Per J. H. Schuck, President.

Detroit Electrical Works,

DETROIT, MICH., U. S. A.

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F. I. STONE, Chattanooga, Tenn.

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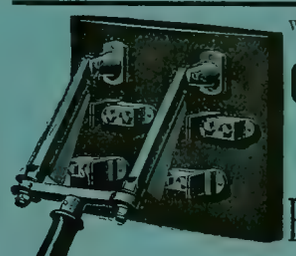

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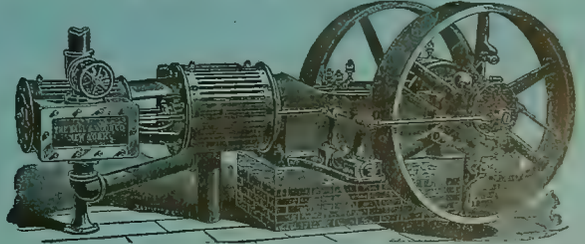

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Colburn Electric Mfg. Co.
Detroit Electrical Works.
Diamond Electric Mfg. Co.
Duplex Electric Co., Ltd.
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Fort Wayne Electric Co.
Heisler Electric Co.
La Roche Electric Works.
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Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

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Electric Merchandise Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Rae, Frank B.
Short Electric Railway Co.
Thomson-Houston Electric Co.
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Pierce, Josiah.
Rae, Frank B.

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Greeley & Co., The E. S.
La Roche Electric Works.
Queen & Co.
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Western Electric Co.
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The Jamestown Street Railway Company report as follows: JANUARY 6, 1892.

* * * * * * * * * * * * * * * * * * *

On Sunday morning last it commenced snowing very hard, and so continued all day Sunday, Sunday night and Monday. We were obliged to put forth every effort to prevent blockading of the road, which we succeeded in doing.

* * * * * * * * * * * * * * * * * * *

On Sunday morning we started your Generator No. 2 at 6:30 a. m., and continued to use the same until Tuesday morning at 3:30 a. m., when we shut it down. This Generator was in continuous service during the entire time, and was not even sanded, nor the brushes touched. It did not use to exceed one-half quart of oil. We consider this remarkable because of the hard work the Generator was doing. * * * * * * * *

Yours very respectfully, GEORGE E. MALLBY, Superintendent.

THE SHORT ELECTRIC RAILWAY CO.,

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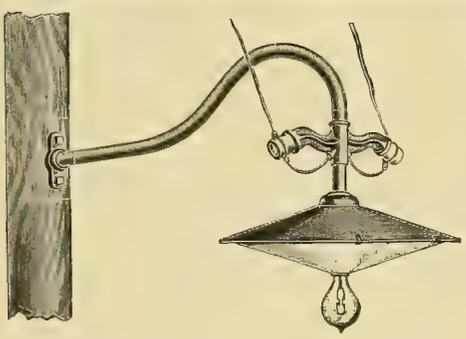

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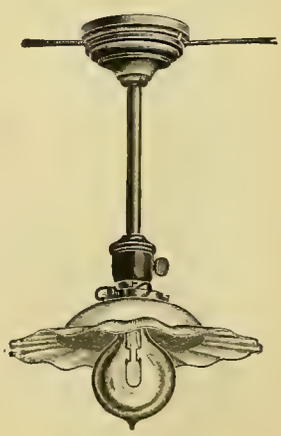

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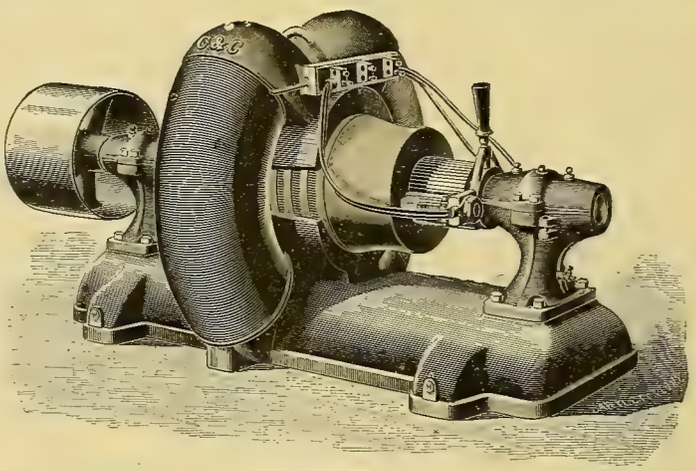

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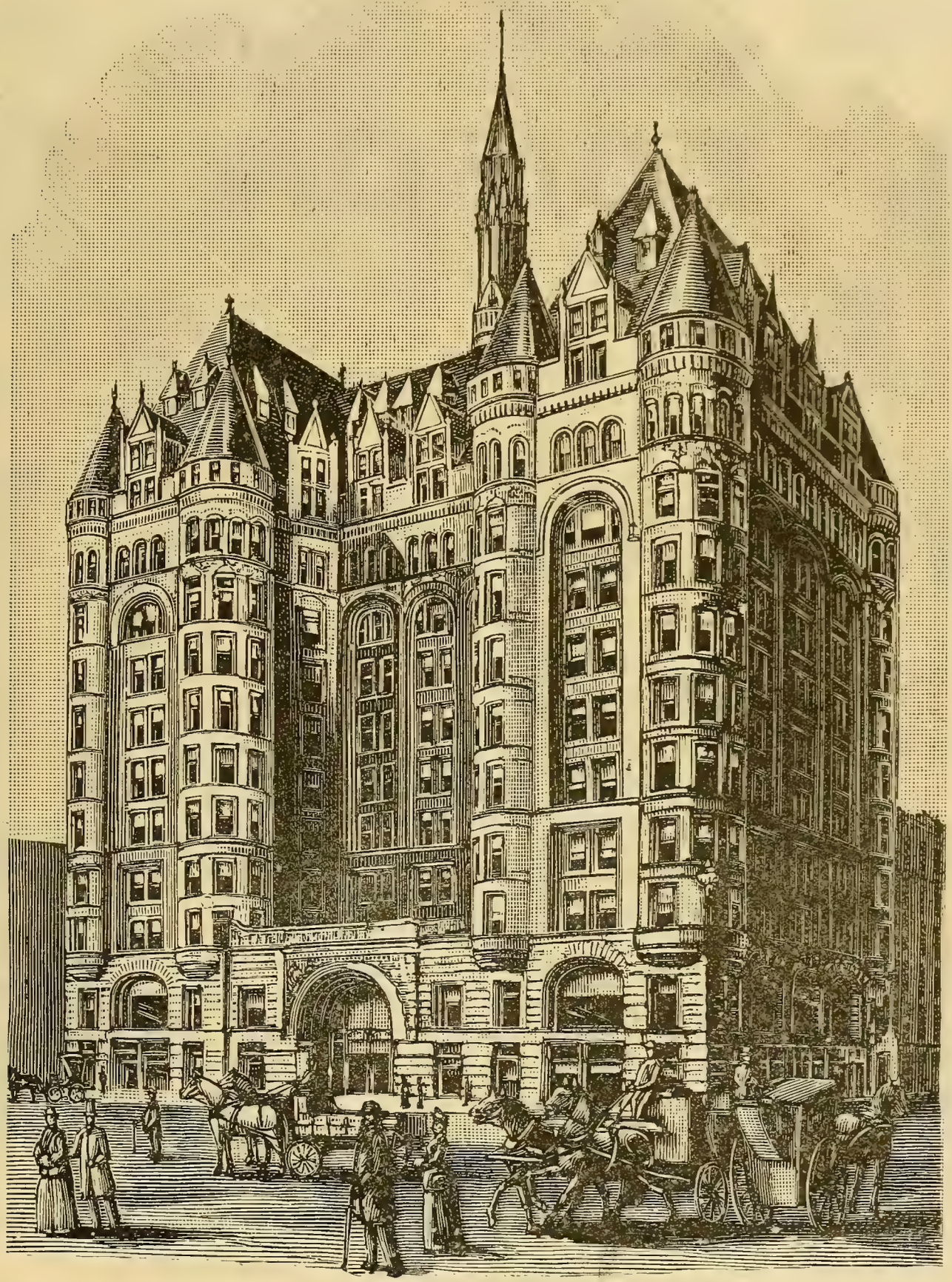

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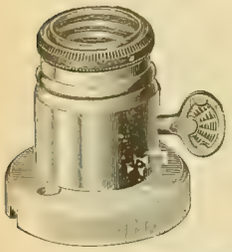

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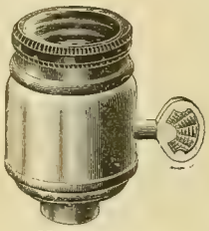

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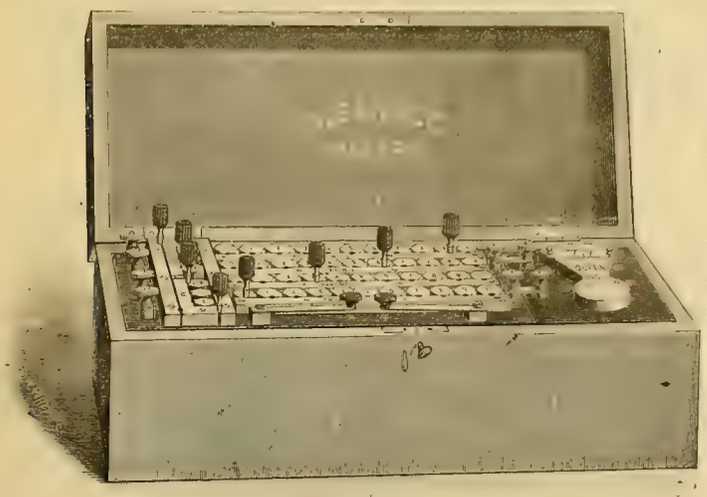

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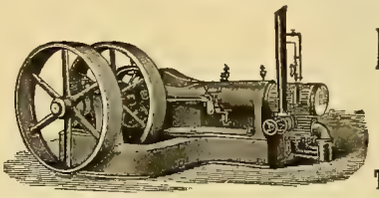

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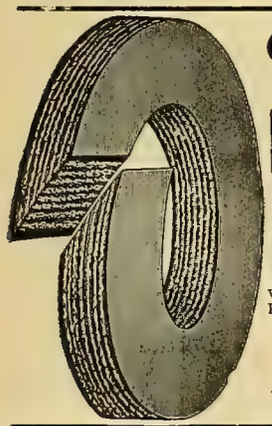

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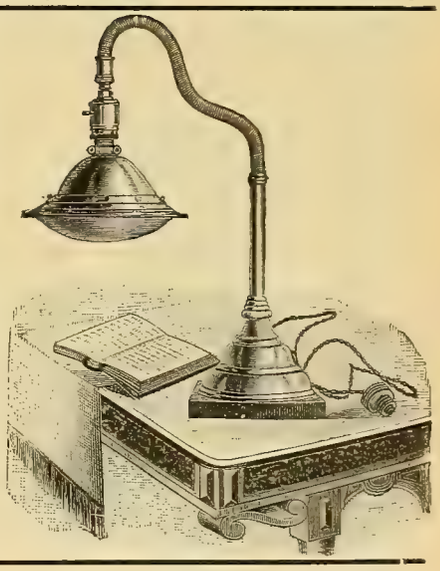

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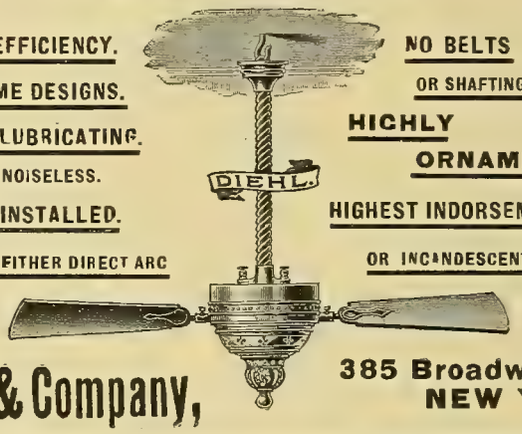

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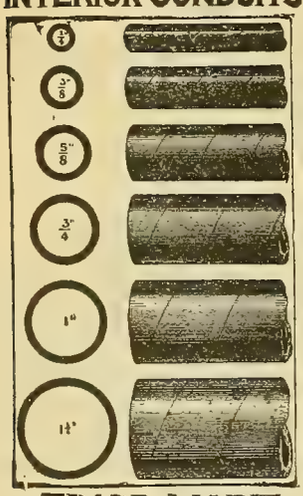

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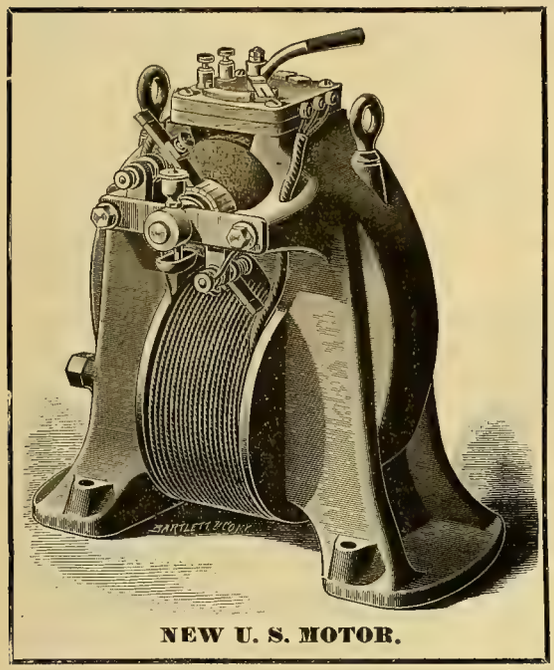

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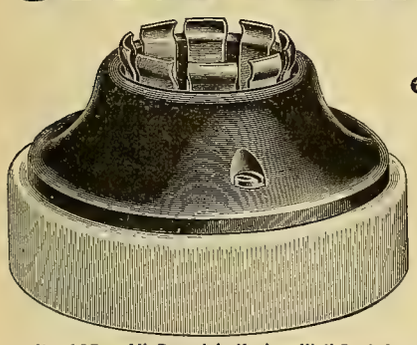

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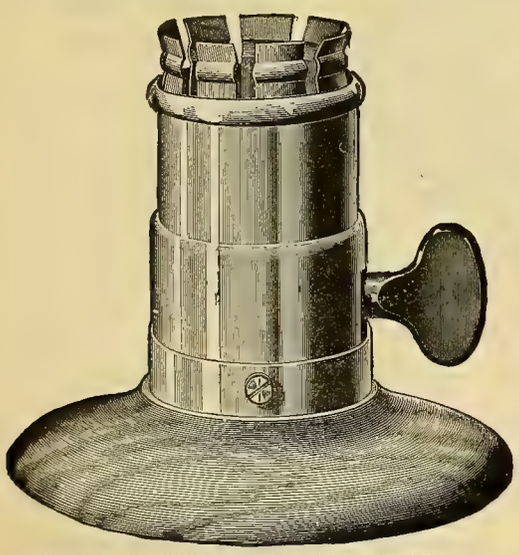

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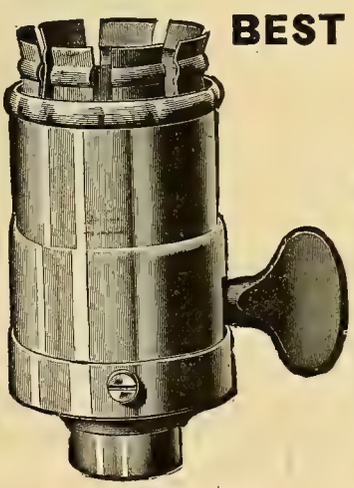

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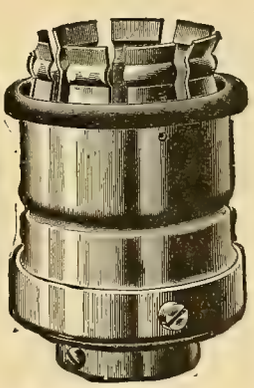

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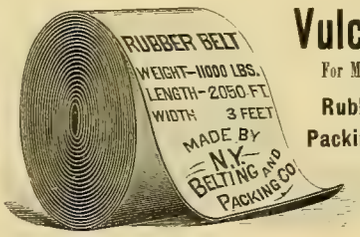

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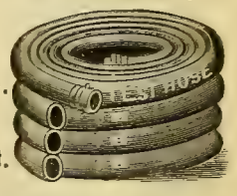

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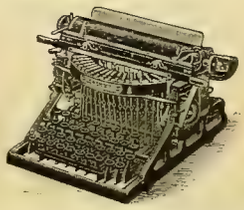

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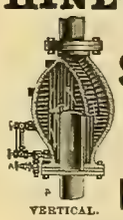

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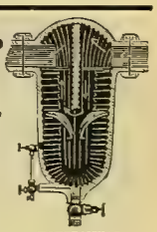

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Western Electrician.

EVERY SATURDAY.

Vol. X. CHICAGO, MARCH 19, 1892. No. 12

Electric Cranes at the Grant Locomotive Works.

One of the most interesting of the recent electrical installations in and about Chicago is that represented in the accompanying illustrations. It comprises the great electrical cranes and lighting plant at the Grant Locomotive Works, which are now being fitted up. The removal of this large concern from Paterson, N. J., to Chicago is a significant indication of the growth of the latter city as a manufacturing center. The works are located on the line of the Wisconsin Central railway, about six miles west of the center of the city, and comprise six or eight large brick buildings erected in the most substantial manner and provided with the latest machinery and labor-saving devices.

FIG. 1. ELECTRIC CRANES AT THE GRANT LOCOMOTIVE WORKS.

When in full operation the works will employ from twelve to fifteen hundred men. It is expected that they will constitute the nucleus of a new manufacturing suburb, similar to Pullman and Harvey, to be known as Grant.

After considering the question carefully the former president of the company, E. T. Jeffrey, decided to use electricity for the transmission of power to the immense traveling cranes which are required in locomotive construction, and also arc and incandescent electric lighting for the illumination of the various buildings. The electrical generating plant is located in the southeast corner of the erecting shop, and is shown in Fig. 4. It occupies a space about 40 feet square. An Ideal engine of 150 horse power capacity drives to the center of a line shaft, upon which are four friction clutch pulleys, from which are driven two power generators and two arc lighting dynamos. The power generators are of the latest type of the Edison compound wound dynamo, one of 60 kilowatts and one of 30 kilowatts capacity, connected in multiple, and set upon solid brick foundations four feet in depth. The power switch-board is made of matched and beaded pine. All electrical conductors are exposed upon the surface of the board, and are of polished copper bars and rods secured in position by polished brass cleats of special design. These cleats, as well as the switches and cut-out , are mounted upon slate bases, so that the bare copper is thoroughly insulated and raised from the wood, precluding danger from fire due to heated contacts. There are four separate feeders for power, one running to each of the four shops—erecting, boiler, foundry and machine shops. Each feeder is provided on the switch-board with a knife switch, so that when any crane is not in action the current may be cut off from it. The current for the motors on the traveling cranes is taken from overhead trolley wires, Fig. 3, which are suspended from the iron truss rods of the roof by means of insulating bells. The trolley wires in the machine shop, boiler shop and foundry are fed at the center of the travel, while in the erecting shop the trolley wires are fed at two points, so as to maintain an equal pressure throughout the travel of the cranes.

The crane in the erecting shop, a view which is given in Fig. 1, is of 40 tons' capacity, and is equipped with five motors. The hoisting equipment on this crane is double, and consists of two motors each of 12 horse power capacity. For traveling, a single 8 horse power motor is used, and for traversing two motors of 4 horse power each. The crane girder is 6 feet in depth, and has a very large span, the distance between rails being 78 feet, while the travel of the crane is 400 feet. The current for the motors on this crane is taken from No. 000 B. W. G. trolley wire by means of a double trolley, one wheel being in advance of the other, the maximum load being about 250 amperes at 110 volts. This crane is to be used for moving very heavy pieces from one portion of the shop to another, and is capable of lifting a locomotive off its wheels, and transfering it to a new position in the shop.

The crane in the boiler shop is of 20 tons' capacity, and is provided with three motors—one 12 horse power for hoisting, one 8 horse power for traveling, and one 4 horse power for traversing. The travel of this crane is 247 feet, and the span 57½ feet. The crane in the foundry is of 20 tons' capacity, and is provided with three motors—one of 8 horse power for hoisting, one of 6 horse power for traveling and one of 2 horse power for traversing. The span of this crane is 50 feet, and the travel 263 feet.

But one of the four cranes has thus far done any actual work. This is the one installed in the machine shop, which has proved very useful in lifting heavy machinery from flat cars on the track running through the building and placing it in position. The crane is of 10 tons' capacity, and is provided with three motors, one of 8 horse power for hoisting, one of 6 horse power for traveling and one of 2 horse power for traversing. The span of this crane is 64 feet and the travel 260 feet. Interesting details of construction are shown in Figs. 2 and 3. The former picture gives a good view of the traversing carriage mounted on the crane. This carries the 8 horse power hoisting motor and the 2 horse power machine by which it is itself moved. All the motors are of the United States type. The drum supporting the hoisting chain and the intermediate gearing and the trolley connection are clearly shown. Fig. 3 gives an end view of the crane, taken from above. The main trolleys and the 6 horse power motor furnishing power for moving the whole crane are plainly seen.

Under each crane on the trolley side hangs the operator's cage, from which the movement of the crane is

controlled. Each motor is provided with a main line knife switch and a starting resistance box controlled by a multiple contact switch and lever. An Edison ampere meter shows the operator the total load taken by the crane under all conditions. Each motor is provided also with reversing gear, so that a movement in either direction may be made.

The illuminating of the buildings is done mainly by arc lights, 38 being installed at present. These lamps

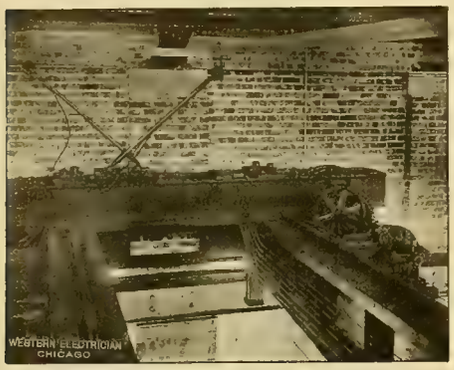


FIG. 3. ELECTRIC CRANES AT THE GRANT LOCOMOTIVE WORKS.

are of the triple carbon type, and are suspended from the roof of the buildings above the cranes, provided with pulleys and cords so that they may be lowered to any desired height for facilitating trimming or localizing the lighting. The dynamos for furnishing current to the arc lamps, Fig. 4 are the new type of Edison arc generator, and are each provided with automatic regulator and self-oiling bearings. The arc dynamos, like the power generators, are set upon solid brick foundations and raised high above the floor by double insulating base frames A two circuit plug arc switch-board is provided with standard Edison ampere meters for each dynamo. The dynamos have an aggregate capacity for 56 ten ampere lamps, the capacities of the machines being 32 and 24 lights respectively. For localized lighting above lathes, drills, etc., and under and about locomotives in process of construction, three hundred incandescent lights are employed, distributed throughout the shops. The steam for driving the electrical plant is taken from a main, which runs underground from the main boiler house, about 300 feet away. This plant is the only one of its kind in Chicago, and is one of the largest electric traveling crane plants in the United States.

The design for the generating plant and electrical construction was made by Louis A. Ferguson, electrical engineer of the Chicago Edison company, which had the contract, and installed under the personal direction of J. H. Goehst, superintendent of construction. The traveling cranes were furnished by the Industrial Works of Bay City, Mich., and installed by Mr. Perry, the company's electrician.

Crystal Palace Exhibition.

In writing of the electrical exhibition now attracting visitors at the Crystal Palace, London the correspondent of the *Philadelphia Telegraph* says: "It is set out in the grand transepts and nave of the Palace at Sydenham, and is certainly the biggest thing of the kind we have yet had the pleasure of seeing in this country. The visitor finds himself at a loss to select any special exhibit for atten-

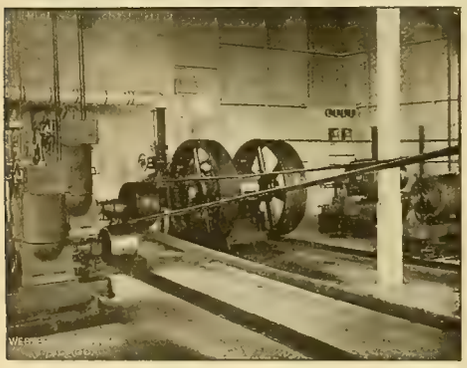


FIG. 4. ELECTRIC CRANES AT THE GRANT LOCOMOTIVE WORKS.

tion, the whole thing being so interesting in character and so varied. There are nearly 250 exhibitors, and one can see at a glance what an important branch of industry this business is becoming, and how much time and attention are necessarily devoted to the development of its various uses."

Photography as Applied to the Investigation of Electrical Phenomena.

By Chas. Proteus Steinmetz.

With considerable interest I read in the Western Electrician of February 24th Mr. Kammeyer's remarkable photographic researches on the action of over-normal currents upon fuses, the more as the conclusion reached by Mr. Kammeyer entirely agrees with my experience. I have found, also, that while alternating currents when broken cause little or no flash, continuous currents of much smaller power sometimes cause very vicious breaks. For instance, I found the spark between copper and mercury, caused by the break of an alternating current of 60 to 80 amperes and some 200 volts, very insignificant, while continuous currents of a few amperes only when broken sometimes cause nasty, noisome sparks. On other occasions again, for instance in short circuiting a large storage battery, the continuous current spark did not differ perceptibly from an alternating flash of the same capacity—that is, the same potential and current strength.

Therefore I cannot consider the viciousness of the continuous current spark observed by Mr. Kammeyer as incident to the continuity of the current, but only as an accidental phenomenon caused by conditions which indeed may be almost always present in continuous current circuits while absent in alternate current circuits.

I do not think that surface distribution of the alternating current has anything to do with this phenomenon. For at the frequencies usually employed of 100 to 140 complete

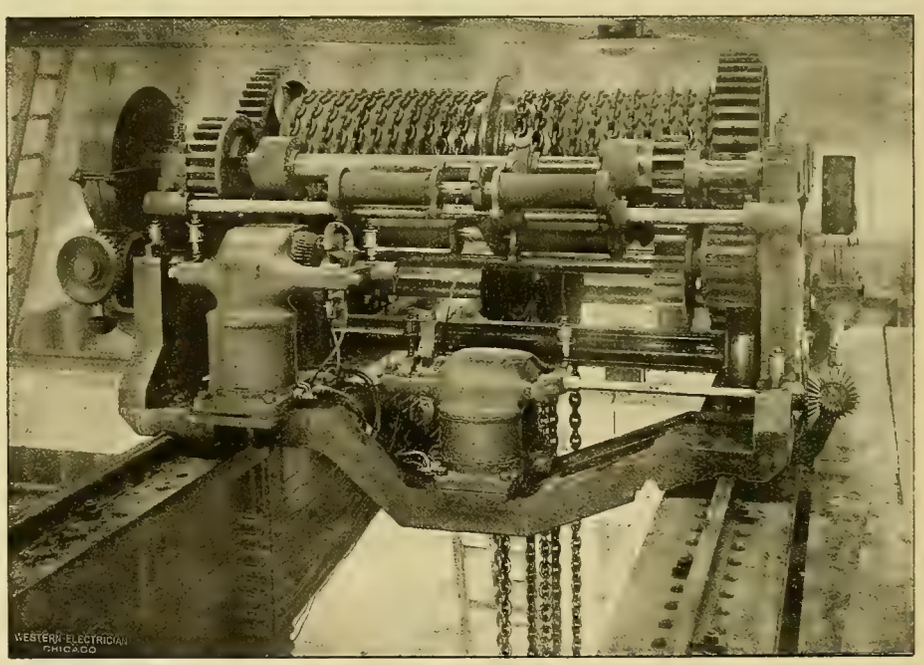


FIG. 2. ELECTRIC CRANES AT THE GRANT LOCOMOTIVE WORKS.

periods per second the alternate current is distributed over the whole cross-section of the wire, as the fact proves that even with still higher frequencies the resistance of the wire is still proportional to the cross section, and not to the diameter, as it would, more or less, if surface distribution took place. Hence surface distribution is to be expected only with very much higher frequencies as they are found, for instance, in condenser discharge. Besides, the "continuous current of unlimited strength" which caused those vicious sparks would be liable to the same surface distribution. For this phenomenon depends only upon the rapidity of change of current strength, and the continuous current which blows the fuses was not at all steady, but increasing in strength with enormous rapidity.

On the other hand again, the commercial frequencies of alternating currents are so high already that they can hardly compare with the slow alternations of currents working a percussion drill. If the current passes from 200 to 300 times per second through zero, these zero-periods are so very short that an influence of them upon the spark can hardly be expected.

I think we can best find out the reason of this difference between continuous and alternating current sparks if we consider what is going on in the moment of blowing the fuse at the point of interruption and in the whole circuit altogether.

In the moment the fuse blows the current still continues to flow for a very short while, carried over the break by the metallic vapors or dissipated particles of metal. But, the resistance of this bridge over the gap being very high, the amount of energy expended at the place of interruption is very large, and it is this energy which is converted into heat and light and appears as flash. Now the smaller the current the less energy is expended and the smaller the spark. Again, if the electromotive force is high the break will occur so suddenly that, although an enormous current passes, only a small amount of energy is expended because of the short duration of the current. This explains the insignificance of the 1,000 volt spark.

But this "electric energy" is not the only energy expended at the point of interruption. The electric current not only consists of a phenomenon taking place inside of the electric "conductor," but also comprises as an essential part the disturbance set up outside of the wire, the magnetic field of the current. And this magnetic field represents potential energy—that is, work, which has been stored up during the rise of the current, and must be expended or consumed when breaking the current. This potential magnetic energy appears in the moment of breaking the current at the point of interruption as heat and light also, while, so far as its influence on the current is concerned, it is represented by what is called "self-induction."

Now, in an alternating current circuit self-induction is practically *nil*, because even a small amount of self induction almost entirely interrupts the current by a kind of spurious resistance or impedance. Hence, in an alternating current circuit the spark caused by the blowing of the fuse almost entirely consists of "electric energy," and the quicker the fuse blows the smaller the electric energy expended at the point of interruption and the smaller the spark. In a continuous current circuit self-induction can be practically *nil* as in a storage battery closed by entirely non-inductive resistance, and then the continuous current spark is just as harmless as the alternating spark. But in a continuous current circuit self-induction can be enormous, as, for instance, in the shunt-field of large dynamos, and the potential energy of magnetism can count by many hundreds or even thousands of foot-pounds. When breaking the circuit this whole amount of energy discharges and appears at the point of interruption as heat and light. And the quicker the break occurs the quicker the discharge of this large amount of energy must take place, the more vicious and noisome the spark becomes, so that when breaking a current of a few amperes and hundred volts at the point of interruption much more energy may be discharged than in a circuit of say 250 volts and 70 amperes but of practically no self-induction; for instance, an alternating circuit. Now between these limits, of the non-inductive harmless accumulator or alternating spark and the high-inductive vicious shunt field spark, there is a wide range, but in general we must say that in the alternating spark only what we called "electric energy" is discharged, while in the continuous current spark, besides this "electric energy," an amount of magnetic energy—be it only the self-induction of the dynamo armature—must be discharged, which in general makes the continuous current blow-out more vicious and noisome than the alternating current blow-out. I believe this phenomenon of self-induction or of magnetic discharge was the real cause of the greater viciousness of the continuous current spark, observed by Mr. Kammeyer.

National Multipolar Generator.

The multipolar generator is coming more and more into use in America. One of the latest aspirants for favor is the machine just put upon the market by the National Electric Manufacturing company, of Eau Claire, Wis. The illustration shows the general design of the machine to be similar to several well-known types already on the market.

The field magnet frame is of octagonal shape, and cast in one piece, insuring an absolutely unbroken magnetic circuit around the four poles. The armature is of the Pacinotti type, containing 96 rectangular grooves, into which are laid the conductors, two turns in each groove. This reduces the air gap to a minimum. Carefully annealed sheet iron rings are used in building up the armature core. These rings, after being insulated by a patented process, are clamped between the two halves of a bronze spider, or carrier, and are held together by steel bolts in the interior of the core, with no bolts of any kind passing through the armature core proper. The entire core is, of course, effectually insulated from its frame. The commutator is of very massive design, is made of tempered copper, and is insulated with mica exclusively. Four sets of brushes are used, avoiding the necessity of cross-connections, with the attendant liability of poor contacts. The generator shown in the illustration has an output of 50,000 watts, and is over-compounded for a potential of from 110 to 115 volts. It is designed for a speed of 620 revolutions per minute.

Electric Power Transmission and Distribution.[1]

By Dr. Louis Bell.

I have no paper prepared for this evening, but shall talk for a short time on some of the problems with which we have to deal in the electrical transmission of power, a subject which I think I am safe in saying is at present of pre-eminent importance in electrical engineering. The particular topics with which I shall deal are those in which the subject is considered from a purely practical standpoint, not from the point of view of the theoretical student of electricity, who looks upon the transmission of energy merely as taking a certain amount of energy at one point, and dumping it down at another some miles distant; but rather from the point of view of a man who finds it necessary to have a certain amount of power to be used in various ways, and perhaps at various distances.

Now in the first place, taking the whole subject of the transmission of power, we may conveniently divide it into two portions, two separate problems, if you please. One of them is the distribution of electrical power rather than its long distance transmission—the case which often comes up in cities where power is generated at a central station, and then distributed to motors at various points where it is needed. Here, fortunately, the conditions are pretty well understood. They are practically those that belong to central stations practice, with such modifications in the wiring as may be necessary on account of the variations of the load which is put on the motors.

The second part of the subject is the transmission of energy from a point where it can be cheaply generated to a point where it is badly needed; this phase of the subject is assuming more and more importance every day, and, although under certain conditions it runs very closely into the former case, it yet has very peculiar characteristics of its own. For example, you may have at various points need for motors for the supply of power to a group of mines. This is a case which is not infrequent at the present time. If you were to erect a power station right in the center of the group you could supply the power very conveniently if coal were cheap and labor were not unreasonable.

That would simply be an exaggerated case of central station practice—that kind of central station practice which is intended exclusively for motor service. However, coal may be very high, as is frequently the case in the mining regions of Colorado, for example. But at some distance away we may have water power. In that case we could simply send the energy electrically and distribute it from a station operated by an electric motor instead of a steam engine. This is one of the very simple cases where the two problems run into each other; perhaps as simple a case as we could have. It amounts only to taking a single large unit of power at one point and carrying it to another.

Then again we may have another case of long distance work, this perhaps being the more common. For example, we have here a group of mines, or a series of small towns, or whatever it may be, where electricity is needed, scattered along at various points, and we have to supply them all from a single point.

There the circumstances become somewhat more embarrassing, frequently very much more embarrassing. But the palm for inconvenience must be awarded to the third case of long distance work, where we have no such arrangement as this which I have shown, where a large number of motors are to be supplied, but where two or three motors of considerable size must be supplied as before from a distant point. It is the meanest case one can possibly meet, I think, in the transmission of power, because the conditions which require nearly constant speed in the motors make the method of securing that condition, and at the same time economy, very difficult.

Now as to the method of solution in these three cases which I will enumerate again: First the supply of a condensed group of motors, which is equivalent to the supply of a central station; second, supplying a scattered number; third, and worst, supplying a few large motors.

Now as to methods: Of course the first and simplest method is to put in a generator of sufficiently high tension to carry the current over a reasonably small wire, and either use it to operate a motor generator, or under certain circumstances, compounding the generator for the center of distribution, and then distributing just exactly as you would if it were a central station. Probably in most practical cases you could use specially wound railway generators for the purpose, and work 500 volt motors at the other end. That problem really solves itself, because the methods and apparatus are tolerably familiar to every electrical engineer. Eventually, however, the distance from the point of supply to the center of distribution becomes so great that those conditions will not suffice to meet the requirements of the case. In that case we must either use very high tensions directly, or with transformers, so that the second general case is really a transformer system, because we have to use motor generators or alternating transformers anyhow when the distance becomes so great that the drop would be impracticably large if we attempted direct supply. This second general case involves, then, a transformation which may be either direct or alternating. In a direct transformation we could use either a very high tension direct current machine, driving a motor, and thence a generator, or synchronous or polyphase alternating, also driving generators. And then finally we come to that form of alternating system which seems now to have arisen to the magnitude of a popular cult. Just exactly what its future is to be is hard to say. At present it is viewed with something akin to awe. I refer to the three-phase system on which so much comment has been made. It is a little hard just at present to say what is coming out of it, as I will presently show. Just now it is revered, and perhaps for the reason that the sonorous name of Dolivo von Dobrowolsky is a potent one to conjure with.

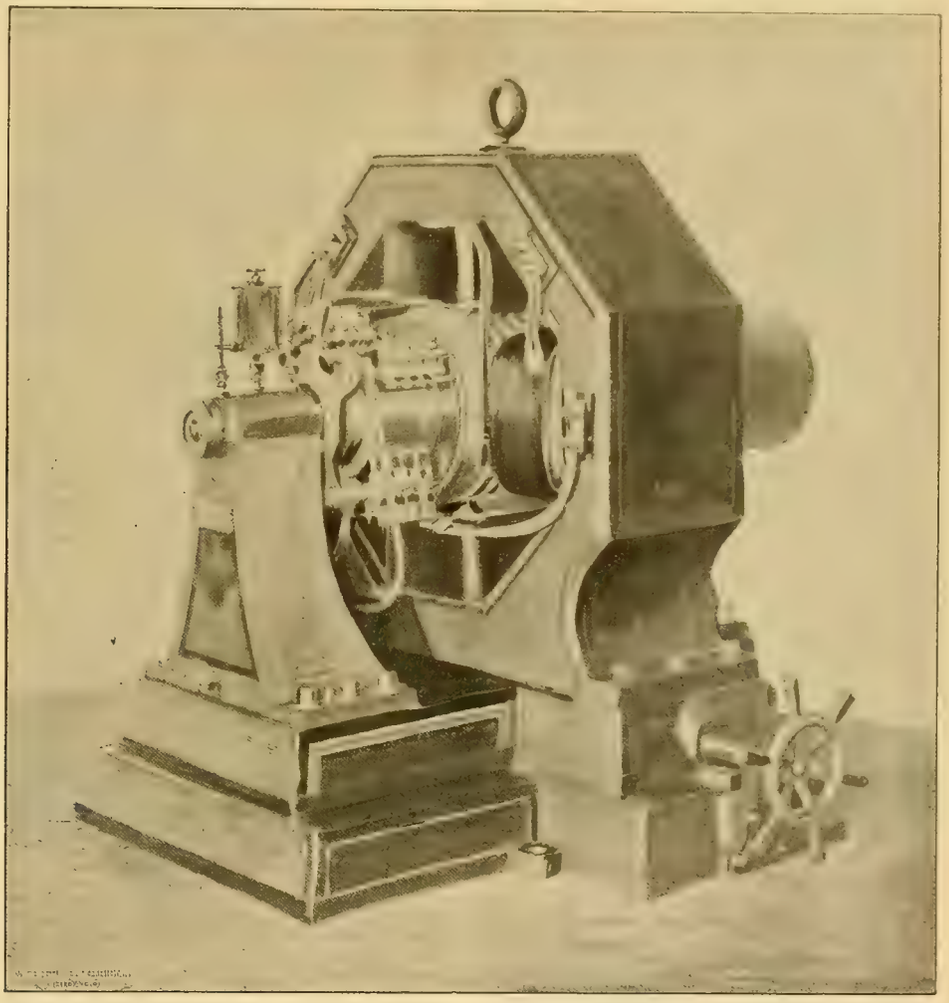
And so finally, we have an alternating system of distribution, where alternating motors are used.

Now, as you know, each of these three particular systems, with their modifications, have characteristic advantages. Where you can use direct supply, and the cases are more numerous perhaps than the average man would think, it is very effective, indeed, and thoroughly economical. It simply amounts to feeding a network at a distant point, a problem with which any central station man is able to cope; and where the distances are not great, and conditions upon the motors are not very severe, the method will prove successful, even if the distance is as high as five or six miles—perhaps ten miles. The condition for success is that the number of motors shall be considerable, so as to give a fairly even load, because, if you do not have a fairly even load if you attempt that supply by a long feeder, the variations in the drop of the feeder will be so great as to make embarrassing variations in the speed of the motor. In a great deal of work it is not desirable to have more than ten or fifteen per cent. variation in speed, and where the load is extremely variable, and you are feeding over a very long feeder, you are quite likely, indeed, almost certain, to get more variation than you want. That is just the feature that makes the supply of the few large motors so very difficult. Where you are dealing with one, almost anything will answer the purpose. Two direct current series wound machines can be combined so as to run almost as well, almost as uniformly and neatly, as if they were fastened together with ropes. They will run synchronously, and where a single unit is to be delivered over even quite a long distance, that particular procedure may prove thoroughly successful. When you have more than one unit it becomes embarrassing. I may add that where but a single unit is to be supplied, you can use a synchronous alternator as well as anything. In fact, it has some advantages on account of the absolute synchronism. It is very convenient if you are going to supply lights at the other end of the line.

Second, come the cases of distribution involving transformation. Now, that may mean a wide variety of things, because, in such a case, you are either operating a central station at a distance, or are using alternating current transformers, and working, perhaps, three phase motors at the other end, or two phase motors—anything that the state of art may render practicable.

And then, finally, comes the alternating system, with special alternating motors. I rather doubt whether, at the present time, if the average electrical engineer were asked on this system to put in an extensive plant on short notice, he would take the offer without hesitation. Even in Germany, where the three-phase system has reached a special development, it has not been experimented with sufficiently to prove to us exactly what it is going to do. It is, in all human probability, no better in its operation than a good shunt-wound motor, at all events. And, as I just mentioned, a shunt-wound motor will play queer tricks where the variations in the drop on the line are very great. I do not see any reason why the three-phase motor should be exempt from the general law, although it does have the advantage of convenience in certain cases. Its efficiency is not, probably, quite as high as a good continuous-current motor. Then, aside from that, there are the alternating-current motors, either synchronous or run by special devices. Then you have the Ganz machine, which is said to be quite effective. It has an efficiency of 85 per cent. or so, will stand a reasonable amount of overloading, is self-starting, and has given, experimentally, good results. In this country we are promised by Mr. Stanley a motor which will fulfill many of the necessary requirements.

So much for the general conditions of the problem. But the thing to which I am going to call your attention for a few moments, is the cost of all this. That is a vital question to be considered in every case with which we have to deal. Sooner or later it all comes down to a matter of dollars and cents, notwithstanding anything you may accomplish in the laboratory. As soon as you get out and



NATIONAL MULTIPOLAR GENERATOR.

1. Address before the Chicago Electric club, March 7, 1892.

try to sell the apparatus you must be able to tell what it will cost, and how it is going to get through.

Now in all this planning for alternating current transmission, one thing has arisen in nearly every proposition, and that is the step-up and step-down transformation. In other words, it would seem to be a very convenient and economical procedure, in case we have a long distance to overcome, to put in a transformer at the generator and one at the motors, so as to be able to have a very small amount of copper in the line. Of course the gain is simply the gain that always results from using very high voltage, the saving of copper.

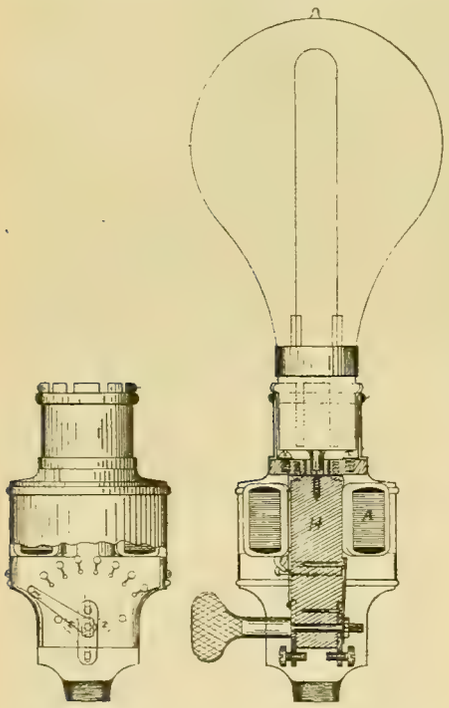
Now to come down to practical figures, let us see what these various things cost in the various methods that are employed. In the first case, that of direct supply, the generators are the only expensive things with which we have to deal, aside from the motors which come in every case. The principal expense outside of the generators is the line, and if the drop is permitted to be large the line expense need not be very heavy. But if we try to get along with a small drop the line expense will be very heavy.

Coming to the transformation methods, we have in the first place a direct current transformation; there we have to supply three sets of generators, whereas in the direct supply we had only one. In other words, we have to supply the generator at the other end of the motor, and then a second generator for feeding the working motors. By that process we may be able to use a higher voltage on the line than would be otherwise practicable, and hence to get along with less copper. With the alternating system, if supplied in the same way with the motor generator, we also have the three generators. If applied direct as in the third case, simply a pair of transformers need to be operated.

I suppose on a fair average the generators cost about $30 per horse power. The motors and secondary generators would cost about the same.

Now as to the cost of the line, the cost of the copper will vary, of course, according to the voltage we use. The cost of the pole line is a factor that has too often been forgotten in the discussion because, particularly when very high tensions are used, the cost of the pole line will be more than the cost of the copper, and it may reach a figure where the cost of the copper will play a very small part in the total cost. Suppose we name the prices of the different elements that enter into the problem.

Now in the first case, that of direct supply, we have the cost of $30 or thereabouts per horse power. But this is not all. We have the cost of the line, both the pole line and the copper. The cost of the pole line, allowing say forty-five poles to the mile, set, will probably not be far from five dollars per pole. That is counting from two



FIGS 1 AND 2. THE CONSTRUCTION OF THE RIES SOCKET.

to three dollars for the pole itself, and a little less than that amount for setting. Or at least that is the figure which is customary in railway work, and I think that applies rather generally. So that it actually comes in the cost of transmitting the power. Instead of having this uniform cost for any distance, you have a cost that increases with very unpleasant rapidity. For each mile you go you will have to put in something like $250 for a pole line, so that the total expenditure will run up very rapidly indeed, for long distances.

Suppose we try the other process, that of using a motor generator. Here we have the initial cost of three machines anyhow. In other words, we have to put in nearly a $100 per horse power for the machines. We will then start at about $90 per horse power as the initial cost of the machines alone. Then by using a higher potential, as can readily be done with synchronous alternators, or very high potential, direct current machines, you can save quite a little in copper. The pole line still proceeds to get in its work, and that may be a considerable figure; so that for each mile we will have to add quite a little for pole line. You may use rather lighter poles, and so on, but still we have the cost of the copper increasing with the distance. On the whole we have bettered ourselves from the fact that by raising the potential we do not need quite so much copper. It should be remembered that the cost of the pole line is nearly a fixed amount, whatever the horse power transmitted.

Now we will consider the case of the three phase system, or any similar alternating system. It may appear at first sight, that the use of the step-up transformer is going to help us a great deal. In case we do not step up we have an unknown cost for the line. That line, of course, is made up of two parts; in the first place the copper, and in the second place the pole line. Now in any case where the copper is not particularly expensive and does not form a particularly large proportion of the whole cost, it probably will not pay to step up. In other words, it may probably happen that the cost of copper per kilowatt transmitted is less than the $30, which would be the cost of the transformers, and the distance to which you would be able to go

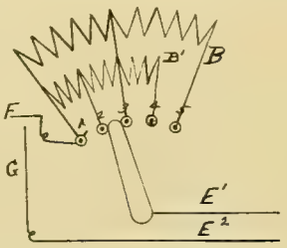


FIG. 4. THE CONSTRUCTION OF THE RIES SOCKET.

before it would pay to step up, is a considerable number of miles, more than one would suppose at first thought. For example, we have the cost of the copper wire,—you may take 00 copper wire, costing about $300 per mile, or thereabouts, and supposing you step up so that you can use a number 6 wire, then you will have to put in about $75 per mile. Now the difference between the two is not so formidable as might appear when you consider that instead simply of dealing with the copper, you have in one case to deal with about $500 per mile, and in the other case about $300, because you have to add the cost of the pole line also. So that it may very well happen that although you are able to use a small wire by stepping-up, you are increasing the total cost, for the reason that you put in transformers, say at $30 a kilowatt, and you need not set up anything like that amount in wire. You will have to go quite a few miles before your extra cost of copper would equal the cost of the transformers. There seems to be a tendency, just now, to use the step up transformer, if you are going only into the next block, irrespective of the fact that transformers cost money. A pair of them costs practically as much as an extra generator.

With regard to long-distance work, there are a great many questions being asked just now, and I think the wisest thing an engineer can do is to keep his eyes open and his mouth shut about committing himself to methods; because, to tell the truth, we don't know very much about it. After a distance of twenty-five or thirty miles is covered, the whole subject becomes inextricably snarled.

Of course, the alternators, working direct or with step-up transformers, supply the most fascinating method, on account of the ease with which you can transform the current. But I understand that in the Frankfort-Lauffen line there were times when it was almost impossible to get much current at the receiving station. When the load was light the false current on the line was sometimes so great as to leave little for the net result. Of course, this did not represent a true loss on the line. It represented simply a false current, and no considerable loss of energy, but it "queered" the machines most effectively. They did not get the power at the other end of the line, although the generators were running vigorously. To be sure, it didn't take much power to drive them.

We do not know how severe that false current matter is going to be. For a distance of over thirty or forty miles it is only fair to say that, commercially, we do not know anything about the proper methods. The experiments that have been tried at Lauffen were successful as gigantic laboratory experiments. The time will undoubtedly come when they will be practical from a commercial standpoint; but he would be rather a hardy man who would propose it as a real commercial scheme, although he might think it magnificent by way of a colossal experiment, or a demonstration of the basis of the proper system.

In fact, the transmission of power from Niagara to Chicago, which could be made well enough, would be a demonstration on a scale which would give an immense impulse to the long distance transmission of power, although I think that hardly any one believes that it would be commercially successful at present.

As regards short distance work, up to 25 or 30 miles, every one of the well-known methods which have been worked out are certainly fitted to answer the purpose. It is only when we desire to handle extremely long distances that we are in doubt; but these doubts are going to be put out of the way, I think, in a very few years, perhaps in a few months.

Discussion.

Fred. Degenhardt: Upon what do you base your conclusions that the work was a colossal experiment? The description of those who have seen it?

Prof. Bell: I investigated the question very carefully, and I found it was very difficult to get exact information; but I succeeded in getting the facts from several gentlemen who saw the tests made. At full load the efficiency was good, and the power received at Frankfort was satisfactory. At light loads, as the load began to be taken off, the false current began to be a serious matter.

It should be mentioned, of course, that its only serious effect would be to lower the output capacity of the generators. It does not amount to a decided loss of energy. During the worst times at Lauffen the turbines were using only a small amount of power and but very little was received at the other end. The false current seemed to use up the capacity of the machine.

One interesting feature may be mentioned there, and that is that the static capacity of the line may help the matter, provided the self-induction of the machine bears a certain ratio to it. But the self induction of the circuit and the static capacity work against each other. However, under proper self-induction you might get a case in which there would be almost no false current. But under great changes of load or other circumstances the self-induction changed, the false current would appear as it did in that case when the load was lightened, and it raised to a rather formidable figure. Those facts were kept very much in the dark, and it was only with considerable difficulty that I was able to find out what the real state of the case was. There were times when the motor was doing no work and no lamps to speak of, were consuming current, when the load was very light, when the ammeter registered almost full load, of course simply showing up the false current. Although it is not a very serious objection, inasmuch as it simply means the allowing of larger generators, it still adds to the cost of the experiment; and I think that under the circumstances under which they were working in that Lauffen-Frankfort line, the experiment would not be commercially succesful. This was the general opinion of those who looked into that particular case. It was a magnificent experiment, and it is invaluable as showing what can be done. It will give a stimulus to long-distance work which can hardly be over-estimated, but as a commercial affair I very much doubt whether any of us would care to put money into such an enterprise, although the experiment could be made successful at a much greater distance.

F. W. Horne: I would like to known how they regulate the power at the wheel in order to get a constant speed at the motors. In this country I have seen some six or seven plants operated for the transmission of power especially, and in every case the speed has varied at the generators from 100 to 500 revolutions, and the electromotive force varied from 300 to 725. At the present time in the West the best regulator they have for water wheels is a Chinaman watching the wheel; and I would like to know if they are ahead of us in Europe in respect to regulation at the initial point, and what method they employ.

Dr. Bell: I do not know the name of the regulator that

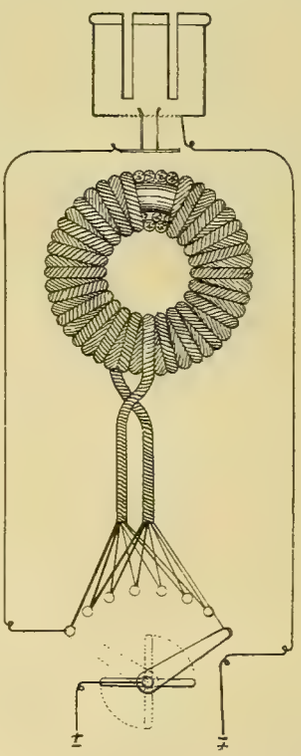


FIG. 3. THE CONSTRUCTION OF THE RIES SOCKET.

they used at Lauffen, but they really did not have very much need for regulation, because they could pre-determine their load. The load does not change in an irresponsible sort of a way. When they know the load or know all the circumstances they do not have occasion for exact regulation. But I do not think they are ahead of us there.

Chas. G. Armstrong: Dr. Bell has cited motors scattered along through quite a little territory, and motors together, large units and small units, but in each case his power has been at one place. Let us change the conditions, and suppose that our motors are either at one place or scattered, and our power also scattered; and suppose we have 20,000 horse power, scattered along in 20 or 30 miles, where the motors, either many or one, are situated.

Dr. Bell: That is rather an interesting case, and one which I fancy would not meet with very serious objection. It might be accomplished in a number of ways. I think in most cases it could be done very handily by running individual circuits—that is, using at all these sources of supply

a certain number of motors; or it might be used just exactly the same way, as in the case of the incandescent network—for example, the Berlin network, which I think is fed from four stations. There is no objection to running 20 miles if you want to, and feeding one or more networks. It simply complicates the problem a little in the way of multiplication, not by adding any new or severe conditions.

With respect to long-distance transmission of power by direct currents, I was interested in a plan which has been tried in the north by Satura, and there they had some advantage in the question of these false currents. But the magnitude of the difficulty we do not know at present. I think if I were going to try such a transmission I would rather either step up or use 20,000 volts synchronous alternators insulated in oil.

It is difficult to explain the nature of the false currents alluded to without going into the alternating current theory; but they practically amount to this: The larger line is a condenser, pumping the current into the line, and the line sends it back. It simply amounts to a large condenser, that is all. The only question is really the magnitude of the objection, and that is not determined yet.

The Construction of the Ries Socket.

Although the majority of readers of the WESTERN ELECTRICIAN are doubtless familiar with the external appearance of the Ries regulating socket for alternating current incandescent lamps, information as to the details of construction of this little fixture have heretofore been withheld by the manufacturers. The accompanying cuts showing the internal arrangement of the device will therefore be of interest.

This socket was devised chiefly as a means for gradually and economically varying the intensity of the light, as well as extinguishing it altogether, with the least possible loss of current; the purpose of the socket is also to obtain within a small space a wide range of regulation combined with a high degree of efficiency, and further to premit of safely and effectively operating from a given socket lamps differing in voltage and candle power. These objects are attained by providing the lamp or socket with an annular core wound with a number of lengths of insulated wire arranged in the form of a strand or cable, the ends of the several wires being cross-connected and brought to a series of terminals arranged within the socket in position to be traversed by an arm or contact-brush attached to the lamp key. The arrangement is such that the current may either pass unobstructed through the socket, or may be "choked" by being made to traverse in succession a number of the wires forming the winding around the core.

Figs. 1 and 2 give a very clear idea of the details of the socket. Fig. 3 is a diagram of connections, while Fig. 4 shows a special modification of the connections.

The ring-shaped choking coil is set in the casing as indicated. The core of the coil is composed of thin iron stampings, and the insulated cable is wound on the core to a depth of one or two layers. The free ends of the wires composing the cable strand are brought to contact terminals, as shown in Fig. 1, and the diagram, Fig. 3, so that all the wires composing the strand are in series. The contacts consist of pins set in a block and in the path of a little arm on the key spindle.

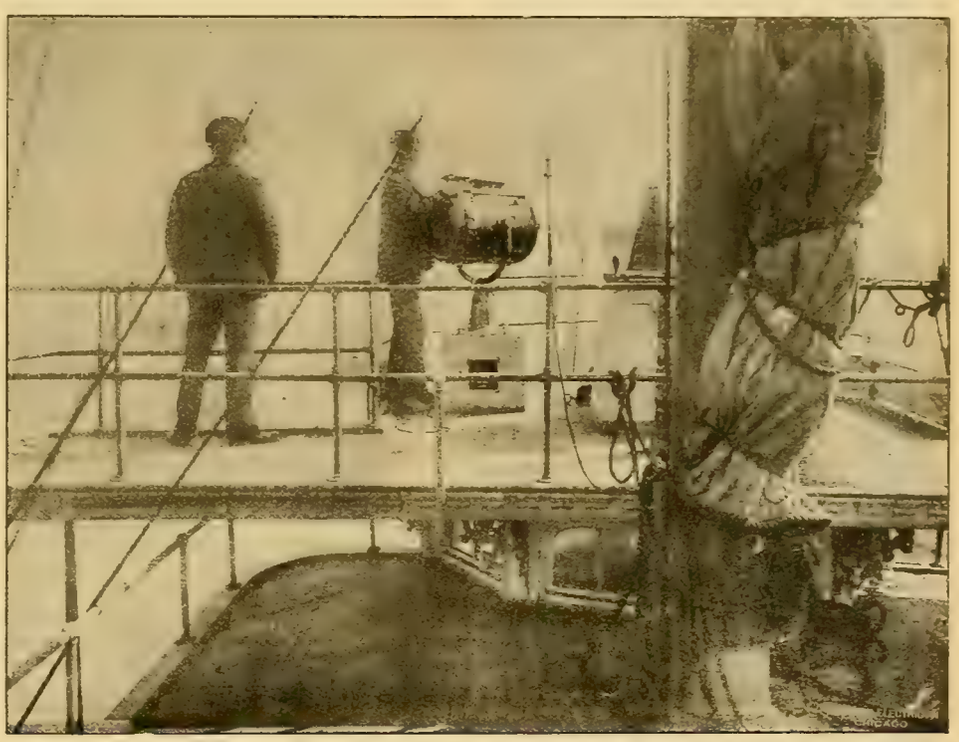
The operation of the socket will be now understood. As the key is moved to the left, passing over the contacts successively, the length of active opposing wire included in the lamp circuit is progressively increased, thus causing the core to generate a gradually increasing counter electromotive force that opposes the flow of the current and causes the lamp filament to glow at its lowest point of incandescence. When the arm of the key is moved to the stop at the extreme right, so as to rest upon the contact, as shown in full lines in Fig. 3, the circuit is opened and the flow of current is entirely interrupted. In like manner, when the key is moved toward the left or from the full to the dotted position shown in the cut, the lamp is gradually brought from total extinction to full brilliance, and it will be evident that any intermediate degree of incandescence can be maintained for any desired length of time by moving the arm to the desired point.

Fig. 4 represents the modified form of winding in which both the interruption of the light and the accidental short-circuiting of a section of the choking coil are prevented, and in which the transit of the switch-arm from one terminal to the next produces what may be termed a "half-step" in the variation of the amount of light given by the lamp. In this arrangement the wires of the cable *B* are divided into two sets, *B* and *B* (shown separately in the diagram for the sake of clearness), the terminals of one set alternating with those of the other. Ordinarily only one set or portion of a set is in circuit at one time; but in the act of passing from an even-numbered to an odd numbered terminal, or vice versa, the switch-arm *D* places both sets or portions of sets, as the case may be, in multiple with each other. By thus affording a double path for the current around the core, the resistance is varied without substantially changing the amount of counter force generated. This action causes a more even and gradual variation in the flow of current to the lamp.

The Electric Search Light on the Lakes

To the seafaring man the electric search light is no longer a novelty, but the navigators of the great lakes, it seems, have only recently had their eyes opened to the fact that the addition of a powerful projector to their equipments not only lessens the dangers incidental to voyages over these treacherous waters, but enables them also to effect a very material saving in time.

Not long ago the owners of the lake steamer City of Ludington of the Goodrich line, Chicago, decided to light their boat by electricity. Accordingly a 300 light Mather dynamo was purchased and connected by means of a very compactly arranged system of rope transmission with a small Elms engine of the upright type. This plant was employed to furnish current for 160 16 candle power lamps distributed throughout the vessel. The electric lighting plant was started about the middle of January last and has been in service eversince. About two months ago the advisability of employing an electric search light as an aid to navigation was considered, and the idea of introducing this appliance met with such favor that the steamship company immediately ordered one of the Mather company. The



ELECTRIC SEARCH LIGHT ON THE LAKES.

instrument, of the Wexler, New York, type, is now considered to be an almost indispensable portion of the vessel's outfit.

The City of Ludington plies between Chicago and Manistee, Mich., making in all thirty-two stops. The search light on this boat is particularly useful in that it enables the pilot to "pick up," or, as a landman would say, find at night, the stakes and buoys that mark the channel through the "Flats" at Green Bay, and also to get the bearings of the bridge piers on what the lake sailors call the Peninsula.

As an instance of the great saving in time that has already been effected by employing the electric light in this manner a recent winter night's experience was related by First Mate J. Body of the City of Ludington. The vessel was off Kewaunee, Wis., and heading for that port. The wind was blowing from the east, the ice was coming in fast and all on board had about made up their minds to make the best of a freeze that might keep the vessel out of harbor for several days. In this emergency the search light was brought into service. A careful manipulation of the powerful beam of light soon revealed to Captain Gallagher a break in the ice, which would permit the safe passage of the vessel. About half an hour afterward the crack closed, and the City of Ludington had a four days' wait, but it was at the Kewaunee dock.

Another vessel without the electric projector was caught in the ice, broke her screw and had to send to Milwaukee for assistance.

An illustration of the City of Ludington's search light as it is used in practice is presented herewith.

Electricity at the World's Fair.

There was but one bid for the arc electric lighting at the World's Fair in Chief Burnham's office at 1 [illegible] on March 15th, the time set for the opening of bids. This was from the Thomson-Houston Electric company, and was at the average rate of $38.50 per lamp for the duration of the fair. This makes a total of about $232,000 for the lamps called for in the specifications already issued. The bid will undoubtedly be accepted.

Frequent inquiries for the prospectus of the electrical department at the World's Fair are met by the response that it is still in the hands of the printer. The "copy" was put in the possession of this individual several weeks ago, but it appears that one concern does all the printing for the World's Fair by contract, and that a rush of work has caused the delay.

Artists express much admiration for the Franklin statue, which is to be placed at the southern entrance to the electricity building, and which was recently illustrated in this paper. Young E. Allison has an article describing it in the last number of the *Engineering Magazine*. In speaking of the statue, Mr. Allison says: "It requires no effort to see that the sculptor has rendered the idea in a most graphic and dramatic and yet in a perfectly simple and natural manner. There is the mark of the storm in the blown drapery and locks; there is the look of keen and eager suspense in the face, and the figure is poised at the moment of intense mental and physical activity in expression. With 'Franklin' written under Rohl-Smith's statue even a schoolboy might tell the story and see, without suggestion the flashing clouds into which the eyes are peering with the desire to drag their secret to earth. There will be no art work of a realistic character at Chicago which will surpass the statue of Franklin. It is the best representation by art that has yet been made of that homely old anecdote of how the philosopher 'drew the lightning from the skies,' and Rohl-Smith has rendered it with epical suggestion."

Double Carbon Lamp Litigation.

The Chicago firms that have been sued by the Brush Electric company for alleged infringement on its double carbon patents for arc lamps have filed their answers in the United States Circuit Court. They admit that they are using the double carbon lamp, but claim that Brush was not the original inventor of the improvement. Their lamps were purchased from the Western Electric company, a case against which is now pending. The patent of Brush is claimed to be void, and it is asserted that the invention was mentioned in many publications and patents prior to the time Brush secured his patent. Marshall Field & Co. and the Chicago Arc Light & Power company, who are defendants, say that the lamps they are using are but a small part of their electric plant, and to enjoin them from using the lamps would result in rendering the whole plant useless. Nearly if not all the suits will be defended by Barton & Brown, who are retained by the Western Electric company.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE new system of calls introduced by the Chicago Telephone company has thus far met with no opposition although it was feared some complaints would be made a so radical a change. The subscribers appear, however, to realize that the change is made with a view of improving the service, and they have therefore accepted the changes with good grace. The new system has already been described in the WESTERN ELECTRICIAN, and the advantages claimed for it seem to be realized.

OWNERS of steamboats on the lakes are discovering that the electric search light is a paying investment, especially when ice has to be fought. In the early spring months, before the ice is gone, vessels are oftentimes seriously delayed, and much time and money is lost. But, by the addition of this simple appliance to the boat's machinery, it becomes a comparatively easy matter to find a way at night through the ice fields. In another column is presente an interesting description of the manner in which the electric search light is employed on Lake Michigan to find cracks in the ice. An electric search light outfit is so simple and cheap, comparatively speaking, that it seems as though every steamboat owner on the lakes should immediately adopt what has proved itself to be such a valuable aid to navigation.

STAID old Massachusetts, it seems, is considering seriously the substitution of electric for steam power on several of its important railways. There is every prospect that the general railway law of the state will be so amended as to make the letter of the statute conform to the change that many well-informed railway men believe to be impending. Several leading railway officials have expressed themselves as desirous of experimenting with the new method of conveying power, and it would seem that an earnest effort was about to be made to utilize electrically transmitted power for long-distance transportation. The problem is a fascinating one and, while it presents many difficulties that yet remain to be solved—more, perhaps, than many of the enthusiastic writers for the daily press suspect—he would be a bold man who would venture to assert that the day would never come when the principal railways of the country would be operated by electricity. It is to the credit of the Old Bay State that it is in the van in the movement to attain this desirable result.

THAT iron manufacturing concerns of the largest class are not confined to the East is shown by the article on "Electric Cranes at the Grant Locomotive Works," on the first page. The establishment of a great plant for the production of locomotives certainly mark an epoch in the growth of Chicago as a manufacturing center, and the fact will give satisfaction to every friend of the city, even if a few of them do entertain the hope that the time is coming when the steam locomotive will be supplanted by one built for the conversion of power transmitted by electricity. But those who are interested in electrical progress will be attracted most by the large traveling cranes operated by electricity. One of these—that in the erecting shop—is strong and powerful enough to carry a dismantled locomotive about the factory as easily as a strong man would handle a baby. All told, there are four of these cranes, and the plant is one of the largest of its kind in the United States. Its proprietors deserve credit for their progressiveness.

IN an article presented elsewhere in this issue on "Photography as Applied to the Investigation of Electrical Phenomena," C. P. Steinmetz brings out some interesting points relating to what Carl Kammeyer, in a recent paper before the Chicago Electric club, termed the "viciousness" of the flash on the rupture of fuses in continuous current circuits. It will be remembered that Mr. Kammeyer's experiments indicated that fuses on alternating circuits blew with less violence than those on continuous current circuits. Mr. Steinmetz attributes the difference in the action of the two fuses to the difference in the self-induction of the currents on which they are employed. He cites the harmless character of the spark in the case where a storage battery circuit is closed by a non-inductive resistance, and then refers to a condition where self-induction may be enormous, as, for instance, where there is connection with the shunt field of a large dynamo. Mr. Steinmetz considers that, generally, in the alternating spark or flash, only "electrical" energy is discharged, while, in the continuous current, in addition to the "electrical" energy, there is exhibited a certain amount of "magnetic energy."

TRANSMISSION of power by electricity formed the subject of an interesting address by Dr. Louis Bell before the last meeting of the Chicago Electric club. Attention was directed to the fact that there was yet much to be done before the transmission of power in large quantities and for very long distances could be considered commercially successful. True, there had been considerable progress made and many valuable experiments had been conducted, but this experimental work, especially in Germany last year, while possessing considerable value, had not by any means solved the problem from a commercial view point. The public generally loses sight of the important fact that electric power transmission must be economical in order to secure financial support and encouragement, but electrical engineers as a rule, it may be said, realize the necessity of attaining that point where a return for the investment required may be reasonably expected. It would seem that the engineers in considering the long distance problem, however, had been carried away by the grandeur of the experiments and the theoretical possibilities of the project. That there is a great field for electric power transmission there can be no doubt, but it should be borne in mind that long distance transmission is as yet practically a new subject; that there are limitations to the commercial application at present, and that further experiments should be made with a view to extending the limits of commercial application rather than developing new theories.

THE mayor of Chicago has signed the much talked-of "smoke abating ordinance," and it now remains to be seen whether the company exploiting the compressed air system intends to distribute stock or power. It seems to be very generally believed that the former commodity will receive the company's closest attention. It is fair to presume in any event, though, that those who have had experience in selling electric power to Chicago consumers will not become subscribers to the stock of the new company. At the present time there are hundreds of horse power of electric motors in operation in Chicago, and the way in which the rival electrical manufacturers swoop down on the prospective purchaser of even a small motor would lead the more conservative to believe that the demand for power from the central station is pretty well taken care of in this particular locality. It is difficult to see just how the introduction of another central power station is going to bull the power market. This belief in an existing demand seems to be entertained, or at least is given out to the gullible, by the promoters of the new enterprise, and if talk means anything, one might be convinced that all the offending smoke producers in Chicago will immediately throw their steam plants into the scrap pile, and put in air engines. Such a thought is of course an absurdity. The city of Chicago has for several years been possessed of, and has now, two central stations from which power can be rented at rates with which, we venture without hesitation to state, the compressed air company, if it makes a legitimate profit, will not be able to compete. Of course, such statements as these bring up the question of the relative efficiency of the two systems. But it is not necessary to go so far. We will only refer the seeker after interesting facts to the gentlemen who have built up in Chicago the electric power circuits. And in conclusion, we venture to predict that the philanthropic smoke abaters will, when they commence to canvass for power, be somewhat surprised, and realize the truth of the saying about how easy it is to take the animal to the water, or bring the water to the animal, but how hard it is to make him drink.

THE ice is broken at last, and visitors to the World's Fair city, who may locate in the southwestern section of Chicago, may now feel assured that they can reach the fair grounds without having to go down town or take a sleeper on the south side cross town lines. The city council has this time done its duty, not only to the company but to the people as well, and for this reason is to be congratulated. In another column there may be found detailed information as to the electrical privileges that have been granted to the South Side Railway company. Few of those wise ones who believe in the existence of what might be termed sympathetic reciprocity between a certain street railway company and the council have had any doubt but that permission would be granted for the erection of the overhead system on the South Side. In this connection it is most amusing to an outsider to note the complacent manner in which the council not only allows the installation of electric motive power, but at the same time leaves it optional entirely with the railway company as to any future changes in its method of propulsion. "And in the event that some more favorable and practicable method of furnishing electricity or other motive power for the operation of said road be discovered," reads the provision in the ordinance, "said Chicago City Railway company, its successors or assigns, shall have the right to adopt the same in the place of or in connection with the use of said electrical overhead contact wires."

However this may be, the citizens need have no fear. Chicago was the pioneer city in the matter of placing electric wires underground, but on the adoption of improved methods of street car propulsion the World's Fair city has been far behind other municipalities. The future will show at least that the city council acted wisely in not haggling at this time of urgent need over the question of introducing a system well tried and universally acknowledged to be most efficient.

In this connection it should be remarked that the company and the council would earn the gratitude of the people of the South Side depending on the Indiana avenue line if the ordinance, as passed, had provided for the equipment of the Indiana line north of Thirty-ninth street with the electric system. It is not yet too late to add this line to the list. Indiana avenue deserves improved service. It is an important thoroughfare, and a large number of people are depending upon its street car line for service north and south.

French Electric Lighthouses.

The application of electricity to lighthouses in France dates from 1864. The system was extended very slowly, and in 1878 only three were in operation in the country. The fact was commented upon in that year at the exposition, when the slow development was referred to in these terms: "It is not because the machines designed to generate current have proved unreliable, or that accidents have happened. They have, on the contrary, worked with great regularity. But all the lighthouses on the coasts of France have appurtenances adapted for oil." The element of cost also was a determining factor, as it was necessary in making the substitution to sacrifice all the capital invested in the oil apparatus, and to devote a very considerable sum to the installation of a plant for the new mode of lighting. Since 1878 however, it has been generally admitted that the electric light was infinitely superior for use in these signal towers, and it has been the general plan to equip the more important lighthouses with electrical apparatus.

The cost of an equipment such as is used in France is not small. At La Heve, where the first two lighthouses which were furnished with electricity are located, it was necessary to construct a power house for the four generators and two engines. It was also necessary to build coal storage vaults, a reservoir for water, quarters for workmen, and to modify the internal apparatus for use in connection with electric lamps. The cost of this work was $19,000. The machinery cost about $22,000 in addition.

Since this plant was installed electrical apparatus has

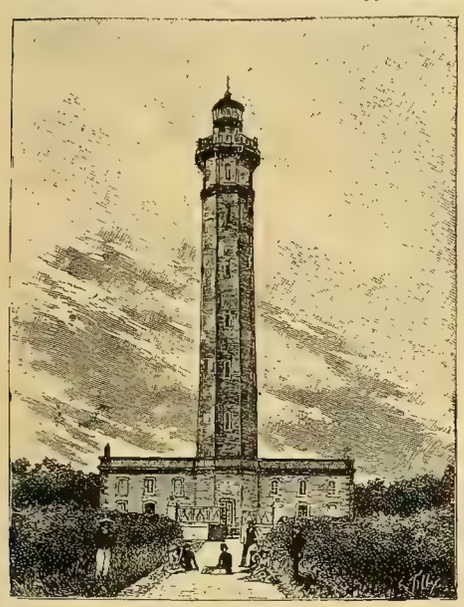


FIG. 1. FRENCH ELECTRIC LIGHTHOUSES.

been greatly improved and the cost is now much less, and the expense of equipping forty-six towers with electric light for which the change was decided upon will not be over $25,000 each. Nine of this number are already in service. One of them, that of Les Baleines, is illustrated in Fig. 1, Fig. 2 is a view of the old tower at this point, which was built in the time of Henry IV. (1589–1593).

Fig. 3 shows the plan of the power plant at the lighthouse of Belle Isle en Mer. *AAA* are the Benier hot air engines, *B* is an air compressor, *DD* are the compressed air reservoirs, *I* is a Megy engine, *K* is a Gramme dynamo, *L* the main shaft, *R* pipes and valves, *SS* Meritens dynamos.

Fig. 4 shows diagrammatically the relative illuminating power of the old and new methods of illumination. The dotted circles inclose the area in which the old lights were effective; the outer circles designate the distance at which the electric light is visible.

The cuts are reproduced from *La Nature*.

Where is Mr. Gessman?

H. G. Gessman, an electrician employed by the Edison General Electric company, mysteriously disappeared on January 20th in St. Joseph, Mo., where he had been sent by the company to take charge of the Edison machines during the test on the People's railway of the different varieties of electric motors. Gessman went to St. Joseph from Omaha where he had been for some time in the interest of the company. As soon as he arrived there he went to the office of the railway, and a little later he started to look for a boarding place. Since then he has not been seen or heard from. He is thirty years old and unmarried. It is feared that he met with foul play.

Chicago Board of Trade Quotations.

It is reported in the Chicago papers that the Western Union Telegraph Company has offered the directors of the Board of Trade of Chicago $10,000 per annum for the privilege of sending out the official quotations on the floor

FIG. 4. FRENCH ELECTRIC LIGHTHOUSES.

of the board of trade, the figures to be collected by the board. The offer is creating some discussion, and it is asserted that when the directors grant the Western Union the privilege of sending out quotations the houses with private wires and the Postal Telegraph company will demand a similar right, and it is the opinion of many of the brokers that it cannot be denied them. Free quotations also mean the establishment of bucket shops in all their glory. In speaking on this subject R. G. Chandler, a member of the quotation committee, is reported to have said: "We are probably not giving away such a snap as some of the members seem to think. If the Western Union comes in we cannot hinder the private-wire houses from sending out the figures, because that would be a violation of an anti-monopoly law. We now have a number of injunctions hanging over us, and the minute we sanctioned a monopoly the courts would cause us trouble. The old-time wide-open markets will again be in vogue, provided, of course, the telegraph company succeeds in getting in."

Fire Alarm Patent Litigation.

An important suit relative to fire alarm telegraph patents was tried in Chicago last week before Judge Blodgett in the United States circuit court. It was entitled the Gamewell Fire Alarm company of New York against the city of Aurora, Ill. The plaintiff brought suit to restrain the defendant from using the Ruddick succession fire alarm box, of which a number are installed in the city of Aurora, claiming that this box is an infringement on the Stover patent, which is owned by the Gamewell company. The "succession" part of the box consists in a device providing for non-interference in case two boxes are pulled

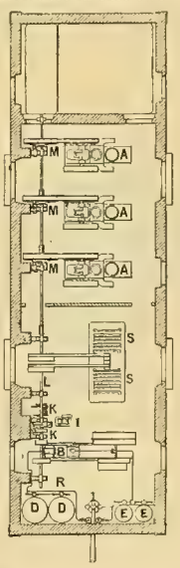


FIG. 3. FRENCH ELECTRIC LIGHTHOUSES.

simultaneously, allowing the signals to be sounded successively. It is this feature that the Gamewell company claimed to have covered by the Stover patent. On the trial, however, the defendant established the fact that there was a prior English patent. The judge also held that it was not shown that the Ruddick box was an infringement on the Stover patent, and the suit was dismissed with costs to the complainant. The defense was assumed by the Inter State Fire Alarm company of Omaha, which manufactures the Ruddick apparatus and which was represented at the trial by Hall & Brown of Chicago. The case is an important one to manufacturers and users of fire alarm telegraph systems. In Cleveland similar suits are pending and will now undoubtedly be dropped. It is said, however, that the Gamewell company will bring suit against Moses G. Crane of Boston for alleged infringement. Mr. Crane is an expert in the manufacture of fire alarm telegraphs, and is now manufacturing a system of his own.

The Street Railway Fight in Dubuque.

Judging from the daily papers published in Dubuque, Iowa, there has been a lively contest over the contract for the new equipment of the Dubuque Street Railway company. This is the company that essayed to operate its line by storage batteries. The cars were run for several months under this system, with varying success, and then President Rhomberg declared that storage batteries were a failure as applied to street railways in Dubuque. The line is now to be equipped with overhead conductors, and several companies made bids for the work. There was brisk competition, but finally the Edison company was awarded the contract for the generating plant and the line construction, while the Detroit Electrical Works secured that for the motors. This resulted in a newspaper warfare between Mr. Rhomberg, the president of the com-

FIG. 2. FRENCH ELECTRIC LIGHTHOUSES.

pany; F. W. Horne, of the Chicago office of the Thomson-Houston company; and L. E. Meyers, who represented the Detroit company. Mr. Horne asserted that he was advised that the Rae motor was an infringement of patents owned by the Thomson-Houston company, and that it was an "obsolete machine" anyway. He also intimated that suits would be brought against Mr. Rhomberg's company, adding that the Allen & Swiney line—a rival road in which the Thomson-Houston company owns stock—would be put in first-class shape. Mr. Meyers retorted that Mr. Horne had misrepresented the facts and that he, Horne, was sore because he had not secured the contract. The local company would be amply protected, he said. Mr. Rhomberg contributed his share to the controversy by asserting that Mr. Horne had tried to "bluff" him to award the Thomson-Houston company the contract by threatening infringement suits and active competition on the part of the Allen & Swiney line. There was apparently considerable feeling aroused, and the newspapers bristled with bellicose interviews. Mr. Rhomberg asserts that he will have his road running with Rae motors by May 15th.

Postal Telegraph Service.

Among the bills introduced in the United States Senate last week was one by Mr. Sawyer to authorize the establishment of a postal telegraph service. It provides that the postmaster-general, upon the advice and approval of the secretary of the treasury and attorney-general, may contract with any person, company, or corporation owning or operating telegraph lines for the transmission of correspondence, press dispatches, and postal money orders at such rates as may be agreed upon by the contracting parties, not to exceed the rates now charged for similar messages.

Milwaukee's Electric Railway System.

An electric railway system of 130 miles, all practically under the control of one company, is possessed by Milwaukee, a city with a population of 230,000 and with a territory of less than twenty-five square miles. Henry Villard is at the head of the Milwaukee Street Railway company, which controls the whole system of the city, and the purchase price of the lines and the equipment of them with electricity, which is to be the only motive power used on Milwaukee street railways, represent an outlay of more than $6,000,000.

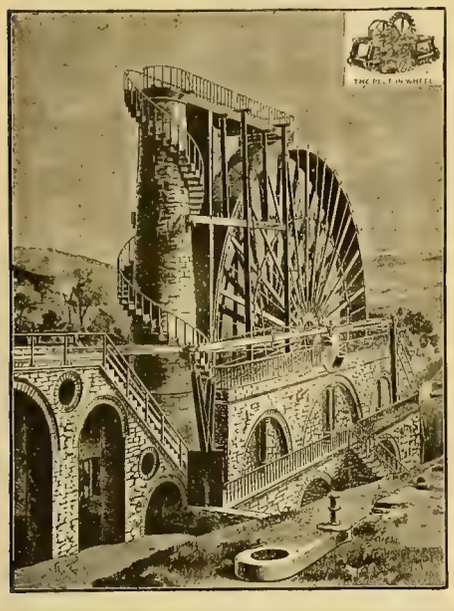
No words could give such a clear idea of the great extent and completeness of Milwaukee's street railway system as is afforded by the accompanying map. Every line on the map, except the heavy lines on the border, represents a street railway, either equipped or being equipped with electricity. The street cars of the city run upon sixty-three streets, and the lines form a perfect network.

The old lines which make up the new system dovetail nicely. The franchises which the common council will soon grant will perfect the combination of the different lines by connecting many and forming new ones where they are needed. Lines are either built or projected to all of the suburbs—Wauwatosa, Whitefish Bay, Lindwurm, North Greenfield, Layton Park and St. Francis. The cars which run every day number fully 250, and the number of men employed in operating the lines exceeds 900. The weekly pay roll is more than $13,000. There are three power houses, with an aggregate of 10,000 horse power. Eventually all of the lines will be operated from the big Edison power house on River street. Three powerful engines and dynamos are being put in as fast as possible. The plant will possess 8,000 horse power when the work is completed, and Henry Villard is authority for the statement that it will be the most complete electric power house in the country. The building is a massive

MILWAUKEE ELECTRIC RAILWAY SYSTEM.—MAP SHOWING EXTENSION OF LINES.

structure, so strongly built that much of the heavy machinery is operated on the second floor.

The overhead system is used throughout, center poles being used on the new lines except a few blocks in the business district where side poles are used. The road beds differ on the different lines. On the Hinsey lines



MARKED ADVANCEMENT IN UTILIZING WATER POWER.

stringers are laid on ties and flat rails fastened to the stringers. On the West Side Railway lines the rails which are T-shaped, and are fastened to steel chairs, which in turn are fastened to wooden ties. The Villard people have secured control of the Hinsey and West Side lines, but have not taken formal possession of them. The Hinsey roadbed will be renewed as soonas possible. The lines built under the Villard regime possess perfect road beds, it is considered. On the trunk lines the road bed consists of 80-pound steel rails, T-shaped, fastened directly to wooden ties imbedded in the street. These rails are seven inches high. On the other lines the construction of the road bed is the same, except that 60-pound rails, five inches high, are used. These new lines, in a few wards, are built for all the world like a steam railroad, and it is stated that a locomotive and a train of cars could run over them without injury.

The rolling stock provided for is excellent. Some of the old cars and many new ones that are roomy and well made are in use at present, but there will be 150 new cars provided.

The E. S. Smith High Speed Engine in Train Lighting Service.

"Not a rotary engine, and yet the motion of its parts is such that there are no dead centers." Such is one of the many strong claims made for the engine illustrated in the cuts by the designer, E. S. Smith. Without going into

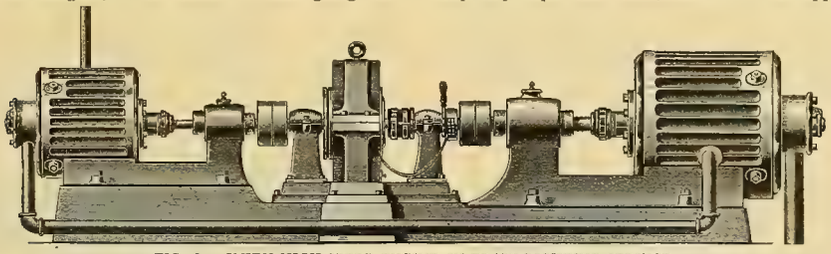


FIG. 2. SMITH HIGH SPEED ENGINE IN TRAIN LIGHTING SERVICE.

details of construction it may be said that this engine, which is being manufactured by the American Engine company of Bound Brook, N. J., is built to run at 1,000 or more revolutions, is provided, with an automatic cut-off, and is therefore especially applicable to every service in which high speed is desired and space must be economized.

Fig. 1 shows the E S. Smith engine coupled directly to a C. & C. dynamo and arranged for train lighting service. In Fig. 2 is shown the method of coupling the compound type of this engine directly to dynamos.

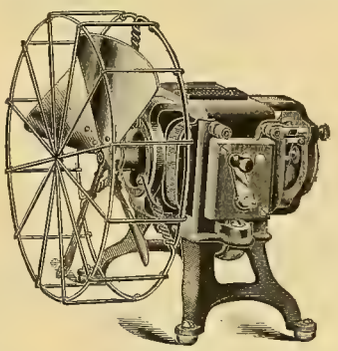
The whole plant for generating currents sufficient to light the longest train of cars need occupy only a very insignificant amount of space in one corner of the baggage car. The dynamo, in order to economize space, is placed directly over the engine, the latter standing on end, with its shaft perpendicular. For convenience in handling and to protect the machines from the baggage, they are inclosed in a strong box, to which the bed-plate of the engine and dynamo frame are bolted. In this box there is a tight partition between the engine and dynamo, filled with asbestos, mineral wool, or other non-conductor of heat. Two sides of this box are hinged, in two sections so as to make access easy to all parts of the dynamo and engine.

This arrangement makes it convenient to handle the entire generating plant in case it becomes necessary. The whole outfit may be easily and quickly taken from the car, by simply removing the bolts which secure the box to the car, and another box containing duplicate machinery may be put in its place in a few minutes. The box is provided with rollers to facilitate moving it about. Placed in this manner, it is figured that the entire generating plant, including engine of sufficient capacity to thoroughly light the longest train of passenger coaches, will occupy a space of less than two and one-half feet square by about six feet in height.

Marked Advancement in Utilizing Water Power.

No more striking evidence of the advancement that has been made in hydraulic engineering could be furnished than a comparison of the water wheels of forty years ago with those of the present day. In the accompanying cut is shown a wheel known as the overshot or gravity wheel. It is unquestionably the largest and most expensive water wheel ever constructed, and is located at Laxey, on the Isle of Man. This wheel is 72 feet in diameter, and is supposed to develop about 150 horse power to operate a system of pumps in a lead mine, raising 250 gallons of water per minute an elevation of 1,200 feet. This great wheel is said to have been running continuously since its construction forty years ago, even making its monotonous rounds on Sunday, much to the annoyance of some of the old Scotch Dissenters, who look upon it as a want of respect for the sacredness of the day.

The illustration affords a very good idea of the old method as compared with the Pelton system of power. The little cut in the upper corner represents a Pelton wheel of corresponding capacity (under similar conditions



NEW FAN MOTOR.

of head and water supply), being drawn to the same scale.

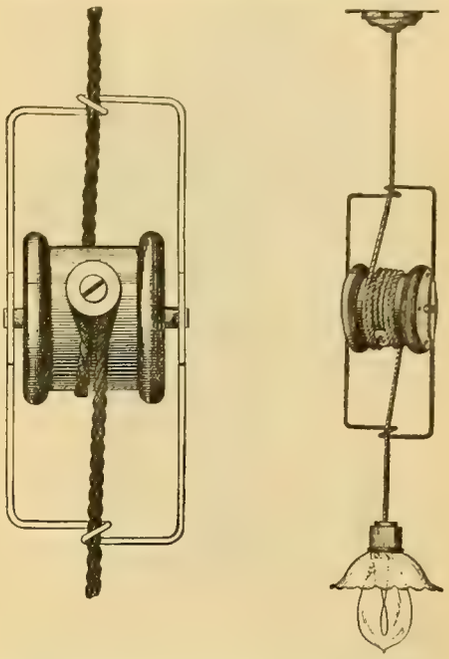
The efficiency of the Laxey wheel—taking resistance into account—it is estimated cannot be more than 65 per cent. of the theoretical power, while the Pelton will develop fully 20 per cent. more, and in size and appearance is a mere toy as compared to the ponderous piece of machinery shown, with its massive column, arches and stone foundations.

New Fan Motor.

R. J. Randolph, until recently with the Excelsior Electric company, has brought out and is manufacturing on a large scale a new fan motor, which will be known as the "Randolph Daisy." The fan has a regulating switch that controls the speed at will, varying from 900 to 1200 and 1800 revolutions. The bearings are made of lignum vitae, and are of unusual length. The current required is about equal to that required to run an incandescent 16 candle power lamp at 110 volts. The accompanying illustration will give an idea of the general appearance of the fan and motor. Mr. Randolph will have his business office at present with the Excelsior company.

Newton's Incandescent Lamp Extension.

The Detroit Electrical Works, Detroit, Mich., are introducing the simple electric light fixture shown in the cut. The illustration is self-explanatory. This lamp hanger consists of a pulley and frame containing a spring and



NEWTON'S INCANDESCENT LAMP EXTENSION.

pawls, the whole weighing about eight ounces. The device will allow an ordinary lamp to be placed at a distance of six feet, and it will carry a lamp from the lightest to the heaviest, with perfect safety. As will be seen, the fixture can be applied or removed from the cord by any one in a very few moments, and without interfering with the electric circuit.

Chicago Electric Club.

The Chicago Electric club has arranged for a series of papers on subjects connected with the electric railway. The titles of the papers are as follows:

March 21.—One Motor for Car Equipment.
Two Motors for Car Equipment.
March 29.—The Gearless Motor.
The Single Reduction Motor.
April 4.—Debate, "*Resolved*, We should have the trolley system in Chicago."

In view of the recent discussion in the city council of Chicago on this topic, it is very appropriate that the club should consider the subject in all its bearings. It might be

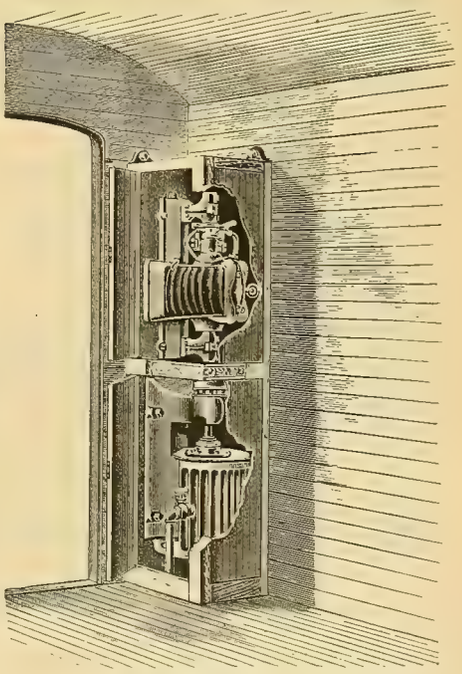
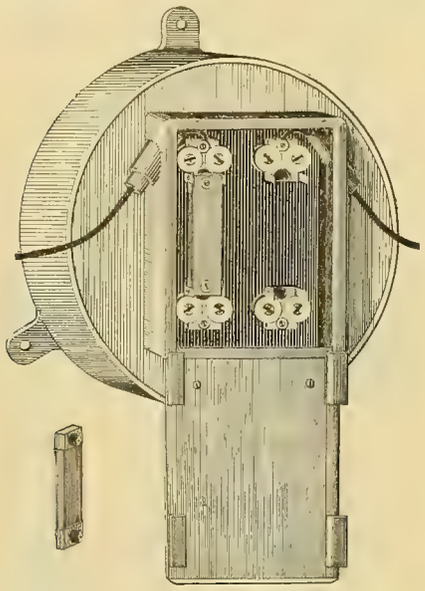


FIG. 1. SMITH HIGH SPEED ENGINE IN TRAIN LIGHTING SERVICE.

well to get the city council and some of the South Side company's officers at the meeting. They are, evidently, sadly in need of information on the electric system.

A New Transformer.

The Diamond Electric company, recently organized in Peoria, Ill., has placed in the market a new transformer, for which many novel features are claimed. The fuse box and blocks are so arranged that by sliding a catch under-



NEW TRANSFORMER.

neath the fuse box, as shown in the accompanying cut, they may be removed from a live circuit without danger, and a new fuse inserted in a moment without the use of tools. The mountings are porcelain and slate. Sizes running from 5 to 300 lights have already been made, a number of the latter being now under way in the factory.

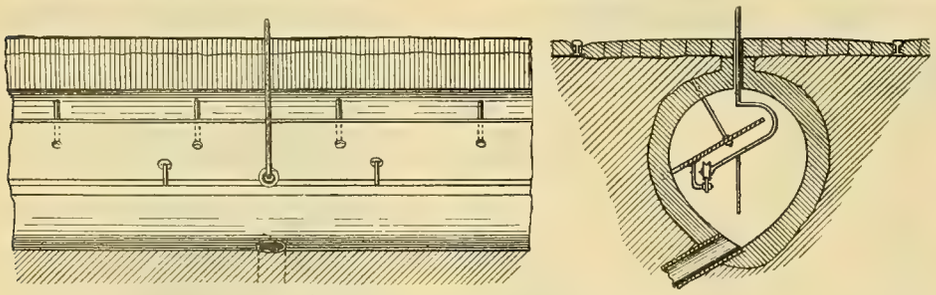
Edison Ceiling Cut-outs.

The ceiling cut-outs illustrated in the accompanying cuts have been introduced by the Edison General Electric company. In Fig. 1 is shown a new double pole cut out especially devised for cleat work, possessing many advantages and intended to take the place of the old form of single pole pendant cut-out. The devices shown in Figs. 2 and 3 are intended for molded and concealed work. The interior work in these cut-outs is alike. The contact pieces in the porcelain base are flat, and are provided at their terminals with small indentations which serve to catch and retain the bent contact pieces in the cover and make a perfect contact. Two safety fuses protect the appliance. The cut-outs are made of the best hard, white, non-absorbative porcelain.

The use of ceiling pendant cut-outs has hitherto been confined to lights hung from the cut-out by a flexible twin conductor. The flattened shape of the cut-out, shown in Fig. 1, is adapted to a swinging light. The light can be swung to a considerable distance from its normal point of rest, returning thereto much more quickly than is the case with the flexible cord pendant. The many advantages for store lighting and similar work presented by this arrangement are obvious.

Nesmith's Underground Electric Railway Conduit.

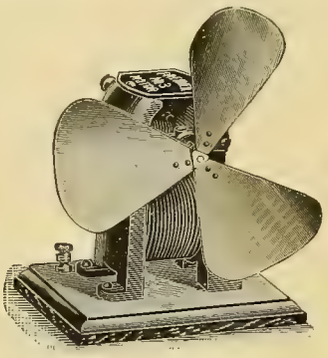
In this conduit there is a conductor provided with a protection plate in such a manner that a trolley wheel may ride on the conductor beneath the protection plate.



NESMITH'S UNDERGROUND ELECTRIC RAILWAY CONDUIT.

The details of construction will be understood from the sectional view shown herewith.

There is a metal plate extending longitudinally in the conduit and it is fixed diagonally as shown in the cross-sectional view. The lower side of the plate is secured to the side of the conduit about midway up the side by bolts, leaving about an inch space between the side of the conduit and the edge of the plate for drainage. A space of about four inches is left between the upper edge of the plate and the opposite side of the conduit. The plate is also supported in the diagonal position by means of anchor rods. To the under side of the plate are attached hanging brackets, which support the conductor. There is a trolley-arm reaching down through the roadway slot into the conduit, which is bent so as to pass around the upper edge of the inclined plate, extending diagonally beneath it. At intervals along the bottom of the conduit, sluiceways are provided, leading into a sewer for drainage. To the trolley-



PREMIER ELECTRIC FAN.

arm there is also attached a branch arm for a brush to sweep the bo tom of the conduit.

Premier Electric Motor.

In the accompanying cut is presented a new electric motor, which has been recently placed upon the market by

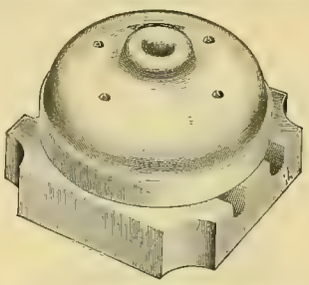
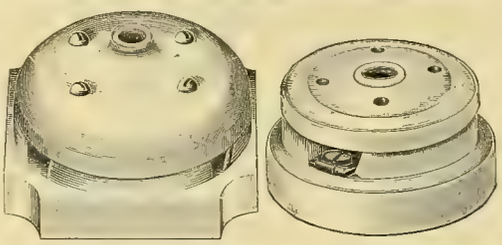


FIG. 1. EDISON CEILING CUT-OUTS.

the Premier Electric company, of Brooklyn. The little machine is compact, fills all the requirements necessary for running fans, toy launches, music boxes, etc. The magnet cores are made of the best soft iron; the machine is enam

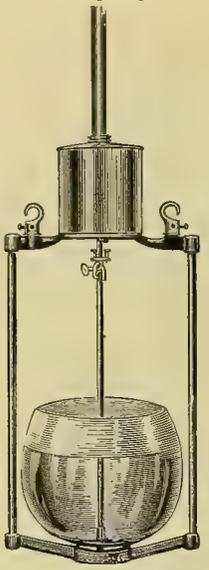


FIGS. 2 AND 3. EDISON CEILING CUT-OUTS

eled, carefully insulated, and wound with the best double covered wire. This motor is especially designed to run fans for ventilating dining tables, offices, desks, and the like. Notwithstanding the fact that this company has only been in the field but a short time, the sale of these motors have been very gratifying. The Premier company expects to move very shortly into a new factory which is now in course of erection near the site of the present works.

Duplex Arc Lamp.

The arc lamp shown in the illustration is manufactured by the Duplex Electric company, Limited, of Corry, Pa., and is designed to burn on either arc or incandescent circuits. The frame of this lamp is wide, and was especially designed to overcome the objectionable feature so often noticed in arc lamps, of casting large shadows. The carbons are fed by a train of gears that are controlled by differential magnets, which cause a uniform feed and consequently a steady, noiseless, white light. These gears are connected so as to allow a rapid upward movement of the



DUPLEX ARC LAMP.

feed-rack to facilitate trimming. They do not stick when constantly exposed to the weather. This is an important point, as the great objection to geared lamps is their tendency to "hang up."

This arc lamp is made in two styles, single and "twin" carbon. Both styles are made to give a light of either 1200 or 2000 normal candle power. The twin carbon lamp, it should be mentioned, is practically the same as the single carbon, with the exception of the carbon holder.

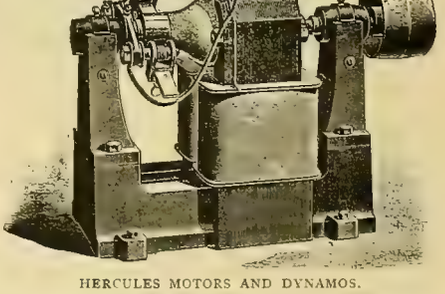
Hercules Motors and Dynamos.

As can be seen from the illustration, the Hercules machine is of the inverted horseshoe type. In the motors and dynamos of this type the whole of the magnetic circuit is made up of sheets stamped out of one sheet of Swedish iron. The plates are thoroughly insulated to prevent the generation of Foucault currents and consequent heating. The field coils are separately wound on brass spools, thus allowing the coils to be easily slipped over the core. The armature which is of the modified Siemens type, has teeth forming longitudinal channels in its periphery in which the coils are wound. These teeth, besides reducing the magnetic resistance of the air space to a minimum, prevent the coils from flying out. The magnet frame is bolted to an iron base having iron standards and self-oiling bearings, even in the smallest size of machines. By this method of construction the company claims that it obtains more magnetism in a given space with less loss of energy than by any other means.

The Zucker & Levett Chemical company, New York, is introducing these machines.

Electricity for Steam Railroads in Massachusetts.

It appears that several of the railroad companies in Massachusetts view with favor the proposition to substitute



HERCULES MOTORS AND DYNAMOS.

electricity for steam power on their lines. A bill authorizing railroad corporations subject to the general railroad law of the state to operate their roads by electricity has already been favorably reported to the legislature. The Boston correspondent of the *Evening Post* of New York in writing on this subject, says:

The movement in its present form was originated by the

late general manager of the Boston and Maine railroad system, James T. Furber. He believed that the time had come for the practical application of electricity to railroad transportation, and at his suggestion the order was offered. It might have been that his sudden death would have put a stop to the matter for this session, but at a hearing before the railroad committee, at which President Choate of the Old Colony road was present, the committee questioned him upon the feasibility of Mr. Furber's idea. He was decidedly in favor of it, and said that the Old Colony was ready to proceed at once to a practical trial of the application of electricity to the movement of ordinary railroad cars. It is said by the committee that the Boston and Albany road is also ready, and the prediction is made by the member of the committee who is in charge of the bill that within one year railroads in Massachusetts will be operated exclusively with electricity as a motive power. It is also predicted that electricity will be found cheaper and far pleasanter than coal, and that its speedy and general adoption as a locomotive force is at hand. The matter has been kept quiet until the railroads were ready to act.

Chicago to Have Overhead Trolley Wires.

On Monday last the Chicago city council passed the ordinances granting permission to the Chicago City Railway company to use the overhead trolley wire on several lines. The ordinances were amended so as to provide that the overhead wires are to be strung only when and where permitted by the mayor and commissioner of public works. There was a stipulation also that the feeder wires from the power houses should be carried in underground conduits in accordance with a provision of the ordinance in relation to this matter adopted last week in the West Division omnibus ordinance.

The amended section of the ordinance provides that if the company shall propel and operate its cars by electric power on Thirty-fifth street the overhead wires shall be suspended from poles set within the curb line limit of the street. The wires shall be suspended not less than eighteen and one-half feet above the rails, and the poles and supports shall be placed on an average of not less than 115 feet apart, except at the intersection of streets and avenues, when this distance would place the poles or supports on intersecting streets and avenues.

There is a further ordinance permitting the company to operate with electric motors the following lines:

Halsted street, from Archer avenue to the southern terminus of the tracks of the Chicago City railway company on said street.

Archer avenue, from State street to the intersection of Thirty-eighth street, thence west on Thirty-eighth street to the terminus of the tracks of the Chicago City railway company on said street.

Thirty-fifth street, from the east to the west termini of the tracks of the Chicago City railway company on said street.

Forty-seventh street, from the east to the west termini of the tracks of the Chicago City railway company on said street.

From State street east on Sixty-first street to the terminus of the tracks on that street, and on Cottage Grove avenue, from Sixty-first street to Sixty-third street, and on Sixty-third street, from Cottage Grove avenue east to Stony Island avenue, and on Sixty-fourth street, from Stony Island avenue to Madison avenue, and on Madison avenue, from Sixty-third street to Sixty-fourth street, and on Grace avenue, from Sixty-third street to Sixty-fourth street. Indiana avenue, from Thirty-ninth street to Fifty-first street, and on Fifty-first street, from State street to west line of Grand boulevard.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 12.—A week ago all appeared to be well with the work of the Telephone Subscribers' association in its fight for lower telephone rates. But to-day things have lost the roseate hue, and, apparently, the representatives of the association have given up hope of getting any bill passed by the present Legislature to appoint commissions in cities to fix the cost for telephone service. The history of the fight has been chronicled in my weekly letters. Richard Croker, the Tammany chieftain, gave out that he approved of the proposed legislation and promised that the representatives in the Senate and Assembly from his own district should introduce the bill; and the outlook was a most pleasing one for all parties concerned except the telephone company. Oow, however, comes the news that Senator Hagan declines to introduce the bill, because he "questions such radical legislation unless all other remedies are exhausted." Assemblyman D. F. Martin writes that he could not introduce the bill because it "would be considered a strike."

Secretary Gardner of the Subscribers' association, when he received on Thursday the news of Mr. Croker's ingenious manipulation of the matter said: "No one can convince me now that the Democratic leaders in this city and state are not under pecuniary obligations to the telephone monopoly. We have it from the lips of one of them that the telephone company subscribed $50 000 annually toward the Democratic state campaign fund. What reason can the bosses have for refusing to give it a hearing other than the arithmetical one that $50,000 a year is $35,000 more than $15,000?"

At a meeting of the executive committee of the Western Union company on Tuesday it was recommended that the regular quarterly dividend of 1¼ per cent. be declared by the directors. The failure to increase the dividend to 1½ per cent. quarterly was a disappointment to some of the bull traders who advanced the stock recently, and the decline was caused by liquidation of some of their accounts. Members of the executive committee say that the quarter, being the poorest of the year, was not considered the best period in which to increase the rate, but they state positively that the dividends will certainly be increased to the rate of 6 per cent. per annum before the end of this year.

The Anglo-American Telegraph company has been having trouble with its lines. A dispatch received Tuesday from Maranham, Brazil, stated that the land lines to Para were interrupted, and that nothing had been received from Para since the afternoon of the 6th inst.

It will be remembered that the common council of Plainfield, N. J., began not long ago an investigation into the Plainfield Gas & Electric Light company's methods. Experts employed by the council had presented testimony to show that the city had been getting from the Electric Light company only two-thirds of the service for which it had been paying, and suit was to have been begun against the company to recover damages, or payment of street lighting bills was to have been withheld to the amount of the alleged deficiency. On Tuesday, however, the committee on fire and lamps succeeded in securing from the company a concession of the justice of the city's claim, and the common council has authorized an adjustment of the matter by which the company forfeits, on its bills for street lighting, the full amount of damages claimed.

Erastus Wiman this week surprised the Staten Island politicians by demanding better figures for electric lighting service. Mr. Wiman informed the committee that under the present contract his company had been out of pocket, and that under the next contract the village would be obliged to pay $100 for arc lights per year, instead of $80, and $17.50 for incandescent lights, instead of $15. The committee on lights was surprised and indignant, but as Mr. Wiman threatened that unless the village came to his terms he would refuse to renew the contract and that the village would be left in total darkness, and as Mr. Wiman has the monopoly of lighting the villages on Staten Island, it is thought that the vote will be in favor of granting the electric light company the increase demanded.

Col. J. F. Dillont has severed his connection with the *Electrical World* and accepted a position with the *Architectural and Builders' Monthly*. The colonel has a wide and extended acquaintance in the electrical trade, and his many friends are wishing him success in his new position.

W. F. O.

Des Moines, Ia.

DES MOINES, Ia., March 12.—Citizens of Des Moines take a pardonable pride in the complete and thorough electric street car system that gives every portion of the city the advantages of rapid transit. The Des Moines Street Railway company, as at present constituted, is the culmination of long series of efforts to furnish the city this essential to its growth.

The transition from the horse cars to the present system involved litigation and the expenditure of a vast sum of money, and was even then largely experimental, having been commenced at the very beginning of the use of electricity for power in rapid transit.

The overhead wire was tabooed by many as being crude, but experience has proven that it is a most satisfactory system for a city of the size of Des Moines. There are now stretched along the streets of this city more than twenty-five miles of heavy copper wire and beneath this wire there is as fine a road-bed as can be found in any city in the Union. A heavier steel rail than heretofore used has been adopted, and the curves are all made of heavy railroad iron. The cars, forty in number, are roomy and elegantly finished. They have recently received a thorough overhauling, so far as the motors are concerned, and the latest improved noiseless single reduction motors have been introduced. This change alone involved an expenditure of $70,000.

The power house first built by the company on West Second street became far too small to accommodate the new machinery made necessary by the large increase in the system during the last two years, and a large and commodious power house was built upon the east bank of the river, and is now in use.

In the boiler room there is a row of ten large boilers. In the same room are the water heaters. The water is brought nearly to the boiling point before entering the boilers. This is done by utilizing the exhaust steam. The water comes directly from the river and is handled by four large pumps. The principal attraction in the engine room is a 500 horse power engine. Two auxiliary engines are in position, one 300 horse power, and one 250 horse power. These engines are all connected with the line shaft and are so arranged that a change from one engine to the other can be made with very little inconvenience. These engines operate ten Thomson-Houston generators, 80 horse power each, running at the rate of 900 revolutions per minute.

The company has its system divided in four sections and each has a feeder running from the power house to the center of the section. By this arrangement the breaking of the current upon one section does not interfere with traffic on any of the others.

The company has fitted up a large and roomy shop for the repair and construction of cars, and it is the intention in the future to build the cars to be added to the rolling stock equipment of the system. A large force of men is now constantly employed in rebuilding and repairing the old cars and fitting them up with the latest improved machinery.

Des Moines is one of few cities where a waiting room is provided for patrons of the street cars, where they are able, from one central point, to obtain a car going in any direction desired. They can do this because all cars pass around the loop about the postoffice building, adjoining which is located the waiting room and general offices of the company. The trainmaster and paymaster have offices just back of the public waiting room, and here each of the more than 100 employes of the company receives his wages every day, the company having adopted that system instead of the usual weekly or monthly payment system. On the second floor of the waiting room building are the offices of the president, general manager, auditor and clerks.

J. S. Polk, the president of the company, took personal charge of the reconstruction of the street railway system. In this work he was assisted by George B. Hippee, the general manager, who has made a special study of electric railways.

During the last year the company has expended $250,000 in improvements, and has plans matured for a similar expenditure during the coming year.

F. M. C.

Louisville, Ky.

LOUISVILLE, March 12.—At the annual meeting of the Louisville Electric Street Railway company it was decided to extend the electric lines, enlarge the present plant and equip several lines now operated by animal power with electrical apparatus. Officers and directors were chosen as follows: J. B. Speed, president; St. John Boyle, vice-president and general counsel; T. J. Minary, general manager; R. A. Watts, secretary and treasurer; J. M. Peters, assistant secretary and treasurer; Alexander Henry Davis, J. B. Speed, A. V. Dupont, A. P. Humphrey, T. J. Minary, E. E. Deniston, Isaac N. Seligman, H. H. Littell and St John Boyle, directors.

The Owensboro Electric company of Owensboro, Ky., has been incorporated with a capital stock of $50,000. The company will operate an electric light plant at Owensboro.

There is a movement on foot to build an electric road between Carrollton and Sparta, Ky., but as yet the plans have not been completed.

The Grand Rivers Iron company of Grand Rivers, Ky., has placed an order with the Edison company, for a 35 horse power Ball engine, one 24 light arc dynamo, one 55 light incandescent dynamo, 20 arc lamps, and the handsomest lot of office fixtures ever put up in Kentucky.

Carter, Jenne & Wille, a recently organized firm, has taken the Kentucky agency for the C. & C. motor.

The Gaynor Electric company, which was recently placed in the hands of a receiver, is selling out its stock and machinery preparatory to going out of business. The company's affairs were in worse condition than was first supposed and at a recent meeting of the board of directors it was decided to close the establishment.

L. H. Cooper & Co. have fitted out a large plant for lighting the big Ainesley Cockran & Sons iron foundry.

The Edison company has sold to Manager Quilp of the Auditorium a three horse power motor to be used in operating the curtain.

J. B. Yates has brought suit against the Western Union Telegraph company to recover $5,000 for failure to deliver a message. The telegram was sent to Alexanders, where Yates was living, but it was addressed to J. B. Gates instead of Yates, and was not delivered to Mr Yates till it was too late to catch a train which he would have taken had the message been delivered promptly.

C. C. Y.

Concord, N. H.

CONCORD, March 12.—The Concord Land & Water Power company, which is to develop the power at Sewall's Falls at this place for electrical transmissions has secured the right to string necessary wires. Over 3,000 incandescent lamps have already been engaged and 100 arcs. Work will be commenced early in the spring This plant is so situated as to supply the city and three of its suburbs, the farthest being about three miles distant.

Capital is being subscribed here to purchase the developed water power at Garvin's Falls, two miles below the city. This will be used to run a large electric power plant; about 5,000 horse power is available. It is understood that the street railway company and the Gas & Electric company are interested in this property.

The town of Franklin, a few miles north of this city, has just put in an electric lighting plant under the control of the town. Water power is used from Aiken's needle shop.

The Concord & Montreal railway has received new engines and dynamos for the lighting plant for its passenger station and shops here. The installation will consist of one 500 light and one 300 light Standard incandescent machine, one 50 lamp Thomson-Houston arc, and one Shawhan 150 light incandescent. For power the company has one 115 horse power Armington & Sims engine, and a 15 horse power Westinghouse "Junior." This plant will be in operation in a few weeks. A. B. C.

Indianapolis, Ind.

INDIANAPOLIS, March 12.—The Broad Ripple Rapid Transit company shows signs of life again since the new fair grounds have been located near its proposed right of way. It has asked for an extension of its franchise for the roads north of the city to November 1st. The board of public works has given the company until April 1st to prove its intention and ability to construct the road, and a similar concession from the county commissioners will prove satisfactory, it is said

Only two bids were received in response to the city's request for proposals for public lighting. The Fort Wayne company proposed to put up eighty-three towers, 125 feet high, with five lights on each, for $150 per light per year. The other bid was from the Indianapolis Brush company, which proposed to furnish 750 lights all night on the moonlight schedule for $95 per light per year. The board of public works will visit Detroit to inspect the tower system before deciding the question.

The people of Brightwood, a suburb east of the city, have raised $15,000 as an inducement to the Citizens' Street Railway company to run a branch from the College avenue electric line to Brightwood. M.

Denver, Colo.

DENVER, March 12.—The construction and operation of an independent electric light plant was considered at a meeting of the Arapahoe county commissioners a few nights ago. One plan is to place the engine and dynamos in the basement of the county jail, and from this point supply currents to the other buildings.

The Longmont Electric Light company's plant has been sold to Denver capitalists, who have reorganized the company, electing Frank P. Arbuckle president. The new title of the company is the Longmont Electric Light & Motive Power company. A new dynamo has been ordered, and the company will adopt the three-wire system.

E. C. D.

PERSONAL.

Emil Grah, of Toledo, O., was in Chicago last week.

C. A. Daigh, of the National Electric Manufacturing company, returned to Eau Claire on Tuesday last.

J. B. McDonald of the Anglo-American Storage Battery company, returned to Chicago on Sunday last from a flying trip to the City of Mexico.

Frederick Whitney Horne, of the Chicago office of the Thomson-Houston company, had a column article in last Sunday's *Chicago Herald* "In Defense of the Trolley."

W. W. Nugent, formerly with Hoffman & Billings of Milwaukee, as manager of their engine department, has opened an office in the Home Insurance building, Chicago, and will represent eastern manufacturers.

H. D. Moore, late of the Thomson-Houston factory at Lynn, has been appointed electrician to the British Guiana Electric company of South America. Mr. Moore speaks in high terms of the country, and says that electricity is being introduced very extensively in British Guiana.

J. W. Lattig, formerly superintendent of telegraphs of the Lehigh Valley railroad and more recently general superintendent of the National Switch & Signal company of Easton, Pa., has accepted the position of general superintendent of the Electric Secret Service company of New York, taking charge of the telegraph and signal department.

NEW INCORPORATIONS.

Helena Water Power company, Helena, Mont.; capital stock, $2,000,000; generating electric current for manufacturing and other purposes.

Buffalo & Lancaster Electric Railway company, Checktowaga, N.Y.; capital stock, $200,000; to operate a street surface railroad in Erie county.

Little Falls Electric Light & Power company, Little Falls, N. Y.; capital stock, $30,000; manufacturing electricity for light, heat and power.

Cayadutta Electric Railroad company, Gloversville, N. Y.; capital stock, $120,000; to operate a street surface railroad from Gloversville to Fonda.

Pennock Electric company, Los Angeles, Cal.; capital stock, $1,000,000; to manufacture electricity, light and power; T. H. Ward, Los Angeles, Cal.

Citizens' Power & Light company, Ashtabula, O.; capital stock $5,000; supplying electricity for light and power purposes; A. F. Dickinson, Harbor, O.

Consolidated Electric company, Burlington, Vt.; capital stock, $150,000; manufacturing, generating and selling electricity for heat, light and other purposes.

Fond du Lac Electric company, Fond du Lac, Wis; capital stock, $100,000; operating electric street railways; Coleman, Sutherland & Hines, Fond du Lac, Wis

Puget Sound & Alaska Commercial company, Seattle, Wash; capital stock, $25,000; to operate electric light and power plants, etc.; Lauron Ingels, Seattle, Wash.

Electric Bleaching company, Jersey City, N. J; capital stock, $2,000,000; to manufacture machinery for bleaching and cleaning fabrics; Collins & Corbin, Jersey City, N. J.

Holton & Adams Hardware company, Port Townsend, Wash.; capital stock $20,000; to deal in electric fixtures; Holton & Adams Hardware company, Port Townsend, Wash.

Central Construction company, Baltimore, Md.; capital stock, $200; to carry on a mechanical and industrial business, construct and equip electric, cable and other railways.

Creede Electric Light & Power company, South Creede, Colo; capital stock $50,000; to furnish electric light and power to the citizens of South Creede, Jimtown and vicinity.

Rich Electric Heating company, Elizabeth, N. J.; capital stock, $250,000. to manufacture, sell and rent electric plants, etc.; Geo. S. Bixby, 36 Wall street, New York City, N. Y.

Connecticut Pipe Manufacturing company, Orange, Conn., ; capital stock, $30,000; purchase, construct and operate electric light plants; Francis G. Beach, New Haven, Conn.

Peninsular General Electric company, Grand Rapids, Mich.; capital stock, $30,000; to manufacture and sell electrical appliances, apparatus, etc ; J. W. Champlin, Grand Rapids, Mich.

Buffalo, Bellevue & Lancaster Railway company, Lancaster, N. Y.; capital stock, $90,000; to operate a street surface railroad by electricity or otherwise from Buffalo to the village of Lancaster.

Edgerton Electric Light company, Edgerton, Wis.; capital stock, $6 400; to erect, maintain and operate an electric light plant, furnish power, etc.; Edgerton Electric Light company, Edgerton, Wis.

Idaho Electric Light & Power company, Wallace, Idaho; capital stock, $500,000; to build and operate a plant for the purpose of generating light and power; Chas. W. O'Neil, Wallace, Idaho.

Columbian Launch company, Chicago, Ill.; capital stock, $200,000; to purchase and operate launches run by steam, electricity, hot air or oil; Marston, Augur & Tuttle, 131 LaSalle Street, Chicago, Ill.

Water & Light company of Nebraska City, Nebraska City, Neb ; capital stock, $300,000; construction, maintenance and operation of a system of waterworks and lighting, and to furnish electric power in Nebraska City.

Pennsylvania Electric Engineering company, Camden, N. J.; capital stock. $25,000; to act as agent for the sale and manufacture of electric light and power supplies, etc.; C. V. D. Joline, 202 Market street, Camden, N. J.

Anna, Jonesboro and Asylum Electric Street railroad, Anna, Ill; capital stock, $75,000; to build and operate an electric street railroad between Anna, Jonesboro and the asylum in Union county; A. J. Nisbet, Anna, Ill.

Leavenworth Electric Railway company, Leavenworth, Kas.; capital stock, $300,000; to maintain and operate a street railway in Leavenworth and from Leavenworth city to Fort Leavenworth; William Dill, Leavenworth, Kan.

Champaign Rapid Transit company, Chicago, Ill.; capital stock, $50,000; to build and operate a line of street cars in Champaign City and county, to operate electric lights and furnish power; W. B. McKinley, Champaign, Ill.

Creede Building & Improvement company. Amethyst Colo.; capital stock, $1,000; to establish and maintain street railways, waterworks, electric light plant and other improvements in the town of Amethyst, Hinsdale county, Colo.

Lawrence Manufacturing company, Columbus, Ohio; capital stock, $30,000; manufacturing, selling, furnishing, fitting and repairing printing presses, electrical and other machinery, fixtures, etc.; Clarence M. Jones, Columbus, Ohio.

Seattle & Everett Railroad company, Seattle, Wash.; capital stock, $500 000; to build and operate railroads, steamboats and other transportation lines, electric light plants, telegraph and telephone lines; R. Hilton, Seattle, Wash.

Pneumatic Torpedo & Construction company, New York city, N. Y.; capital stock, $250 000; carrying on any kind of construction, electrical or mechanical; building torpedoes for war or commercial business, guns, projectiles, etc.

Fort Dodge Gas, Electric Light, Heat & Power company, Fort Dodge, Ia.; capital stock, $50,000; erection, construction and operation of light, heat and power plants in the city of Fort Dodge, Ia.; John F. Duncomb, Fort Dodge, Ia.

Pennock Battery Electric Light & Power company, Portland, Me.; capital stock, $1,000,000; to manufacture and deal in all kinds of incandescent and other electric lights, electric bells and machines of all kinds; Clarence Hale, Portland, Me.

Leonard Avenue Street Railway company, Columbus, O.; capital stock, $10,000; constructing and operating a street railway in Columbus, to be operated by electric, gas, steam, horse or other motive power, etc.; Theodore Leonard, Columbus, O.

United States Volta Electric Battery company, Charleston, W. Va.; capital stock, $1,015,000; buying, making, selling and leasing galvanic batteries and all other electrical inventions and patents for same, etc.; Timothy Hurley, 38 Wall street, New York, N. Y.

Robinson & Moore, Everett, Wash.; capital stock, $5 000, to construct and operate electric light and gas works, railroads; loan and borrow money; act as contractors and agents; to buy and sell real estate and improve same; B. S. Grossoup, Tacoma, Wash.

Buffalo & Niagara Falls Electric Light & Power company, Buffalo, N. Y.; capital stock, $100,000; to produce electricity for heat, light and power in Buffalo, Tonawanda, North Tonawanda, town of Wheatfield, town of Niagara, Niagara Falls and Suspension Bridge.

Siemens & Halske Electric company of America, Chicago, Ill.; capital stock, $500,000; to manufacture, purchase, sell or use electrical devices and appliances and apparatus, acquire patents, or other property, etc., relating to said business, etc.; Bayley & Waldo, 18 Borden Block, Chicago, Ill.

Shawneetown Electrical company, Shawneetown, Ill.; capital stock, $20,000; to construct, maintain, use and operate an electric light and power plant, with all necessary appurtenances, etc , in Shawneetown, Ill., and furnish electric light and power for the city, etc.; C. C. Travis, Shawneetown, Ill.

Wright Universal Electric company (incorporated in W. Va), New York, N. Y; capital stock, $5 000,000; manufacturing, owning, purchasing and selling patented and other devices, machinery, etc., for producing and utilizing electric light, heat and power; John Vincent, 32 Nassau street, New York.

Connecticut Pipe Manufacturing company, Orange, Conn., P. O. West Haven; capital stock, $30,000; to purchase, construct and operate waterworks and electric light plants, and engineering and contracting for same, and the construction of sewers and materials for same, etc.; Francis G. Beach, New Haven, Conn.

San Francisco & West Shore Railroad company, San Francisco, Cal.; capital stock, $1,000 000; to build and operate street and other railways by steam, animals, wire cables, stationary engines, locomotives, electricity or otherwise, from San Francisco, Cal., to Half Moon Bay, a distance of 30 miles; Louis F. Dunand, San Francisco, Cal.

W. W. McMillan company, Duluth, Minn.; capital stock, $50,000; heating and plumbing, to keep and handle all goods and material necessary for said business for wholesaling and retailing plumbers and gas fitters' supplies, boilers, pumps, engines, electric goods, and manufacture electricity for light, heat and power; Wm. B. Phelps, Duluth, Minn.

Winona Light, Heat & Power company, Winona, Minn.; capital stock, $150,000; to construct and operate a plant for generating electricity, furnish electricity for light, heat and power, and to manufacture and repair appliances used in connection with said business; H. C. Levis, Northwest Thomson-Houston Electric company 401 Sibley street, St. Paul, Minn.

Northern Light Electric company, St. Paul, Minn.; capital stock, $40,000; to construct, operate and maintain a plant for manufacturing and generating electricity, furnish electricity for light, heat and power, manufacture and repair all electrical appliances, to lease, hold, purchase, sell, convey and deal in real and personal property; H. C. Levis, 401 Sibley street, St. Paul, Minn.

ELECTRIC LIGHTING.

Manatee, Fla., capitalists are talking of erecting an electric light plant.

The Bridgeport, Ala., Electric Light & Ice company has contracted for the erection of its electric light plant.

Congress has appropriated the sum of $9,500 for an isolated electric lighting plant at the West Point Military Academy.

The Denton, Tex., Water, Light & Power company will

erect an electric light plant and construct a system of waterworks.

The Eagle Grove, Ia., council has declared in favor of electric light, and a plant costing about $20,000 will be put in by eastern capitalists.

A stock company organized to build an electric railway will erect an electric light and power plant midway between Huntington, W. Va., and Ashland, Ky.

The station of the People's Electric Light company at Moline, Ill., was recently burned, involving a loss of $30,000. The insurance amounted to $12,500.

The East River Electric Light company of New York has applied to the Supreme Court for permission to change its name to the Thomson-Houston Electric company of New York.

The Canton Waterworks & Electric Light company has been incorporated at New Orleans, La., to build and operate an electric light plant and waterworks in Canton, Miss. The capital stock is $50,000.

The Southern Electric company of Baltimore has purchased the franchises and plant of the International District Telegraph & Construction company, and will refit it for arc and incandescent lighting, and to supply power for manufacturers.

The electric light tower on the corner of Center avenue and Jefferson street, at Bay City, Mich., said to be the tallest of its kind in the United States, was condemned at a recent meeting of the board of electric light commissioners. The pole is 220 feet high.

A meeting of the stockholders of the St. Louis, Mc., Electric Power company will be held on May 2d to vote on the proposition to increase the capital stock $75,000 and to change the name of the corporation to the St. Louis Electric Light Power company.

The plant of the Rock Island, Ill., Brush Electric Light company was recently sold at auction by the receiver. It was bid in by General Manager Hammond, of the Brush Electric company of Cleveland, for the sum of $10,500. The company was organized in 1882.

ELECTRIC RAILWAYS.

It is stated that W. C. Jones of Columbia, Tenn., will build an electric railroad.

The dummy line of Bonham, Tex., will probably be converted into an electric railroad.

The Hull street line of the Richmond & Manchester Street Railway company of Richmond, Va., is to be operated by electricity.

It is stated that the contract has been signed for building an electric railroad at Fredericksburg, Va., and work will be begun at once.

Both branches of the city council of Baltimore have passed the ordinance granting the Central Passenger Railway company authority to use the electric trolley system.

The Board of Trade of Manchester, N. H., has been discussing the question of introducing electricity as a motive power for the street railway system of that city, and a special committee has been appointed to consider the matter.

The Harrisonburg & Bridgewater Electric Railway company, of Harrisonburg, Va., will build an electric railroad from Harrisonburg to Bridgewater, a distance of eight miles, and work is to be commence as soon as the weather will permit.

TELEGRAPH.

A judgment of $1,534 was rendered by consent of the defendant in favor of William Faulkner against the Western Union Telegraph company at Grand Rapids, Mich., and the case was dismissed. Faulkner was a lineman for the company, and was injured, he claimed, in an accident caused by the negligence of the company's foreman. He sued for $15,000 damages. The company settled instead of standing suit.

The *Railroad Telegrapher* gives the following advice to operators, which will bear consideration: "If any telegrapher has an idea of visiting the World's Fair, and is endeavoring to secure a position in Chicago to enable him to do so, we advise him to dismiss the thought from his mind at once. Do not forget that a rush to Chicago will decrease salaries, and that the expense of living will be greater than in any other city. The operator who accepts a low salary, expecting to see the World's Fair, will find himself doomed to work night and day in order to keep even with his expense account. Keep your present position. Save your money and go to Chicago, and take the time to see the fair as a visitor."

A press dispatch from New York having asserted that C. F. Dunbar of Buffalo had brought an action in the Supreme Court to enjoin the Western Union Telegraph company from paying any money on account of its guarantee of 8 per cent. to the Montreal Telegraph company on lines leased by the Great Northwestern company, Mr. Dunbar makes the following statement of the matter: "I have not brought any action against that company at all An action is, however, being brought againt the company through my influence. W. O. Ross, of New York, who owns stock in the Western Union company, is the gentleman who is instituting the proceedings. Through the influence of some friends I got this Mr. Ross to bring an action against the company. We will see if the company has a right to put its money, or the money of its shareholders, into a foreign country. The only outcome of the matter possible will be that the Western Union will not advance the money required to pay off the Montreal lease at 6 per cent., and the stock will go down to par. I, having sold short, will buy at par, and thus make a little money. It is all the result of a little speculation of mine. I wanted to hurry up the matter, and the consequence was this action of Mr. Ross against the Western Union."

TELEPHONE.

Dublin and Belfast, in Ireland, are now connected by telephone.

The telephone line between Santa Barbara, Riverside, Pasedena, Los Angeles, and intermediate points in California has been opened for business.

From April 1 to November 1, 1891, there were 12,507 conversations over the Paris London telephone line. The price is $2 for three minutes' conversation.

The Canadians demand payment for public franchises granted big corporations. On March 3d the Bell Telephone company paid to the city of Toronto $1 636, being five per cent. on its quarterly earnings, which goes to the city in payment of its franchise privilege. Last month the company made a contract with the city of Hamilton by which it binds itself to pay to the city $1,500 a year in quarterly payments, for the privilege of doing business there. The contract also specifies the rates to be charged for telephones, and is for the period of ten years, the tax to be readjusted at the end of that time.

ELECTRIC MINING.

The Turkey Creek Mining company of Telluride, Colo., has ordered an electric motor for its mill. The machine will be put into operation as soon as it arrives.

An electric lighting and power plant has just been installed at the Cargo Mucacho mines on the Colorado river, a short distance above Yuma, Arizona. The mills, offices, boarding houses and other buildings are lighted up with 16 and 32 candle power lamps. The same dynamo that furnishes this light also supplies power for electrical hoisting machines. One of the machines is placed in a drift 550 feet below the surface.

A party consisting of several prominent coal operators and superintendents from various parts of Pennsylvania assembled recently at Scranton, Pa , to look over two or three of the electrical underground haulage plants installed in that vicinity. The plants visited included those of the Erie Brecker colliery, where a forty horse power locomotive is hauling anthracite coal; the Forest City mine, where an eighty horse power locomotive has recently been put in, and the Landus mine of the Blossburg Coal company, where another eighty horse power locomotive handles the output of the mine to the gravity plane, and a small stationary motor is employed in shifting the empty cars at the port of the plane.

A powerful electric hoist has been installed in the Alta mine, located about two miles from Corbin, Mont. The hoist is of 65 horse power, with a double drum 5x5, and will raise two and a half tons of ore 400 feet in one minute. It is placed at the mouth of the shaft, which is 1,500 feet from the mouth of the tunnel, which is cut into the side of the mountain. The shaft has a depth of 240 feet. The generator which supplies the current is situated at the concentrator some 10,500 feet from the mine. The generators are of 40 kilowatts capacity, carrying a current of 500 volts. Fifteen tons of copper wire, strung on poles, carry the current from the concentrator to the mine. The loss between the generator and hoist amounts to ten per cent. It is estimated that a saving of from 30 to 50 per cent. will be effected by the substitution of electricity.

MISCELLANEOUS.

Sciences et Commerce is the name of a new French technical journal. The first number presents a creditable appearance.

Electric motors have been applied to silk weavers' looms in Germany. Two looms were put in motion, the result being more satisfactory than power furnished by means of caloric engines or gas motors. The German papers think the result shows that house industry could easily be made to flourish by the transmission of electric power.

Several citizens of Baker City, Oregon, and San Francisco, have formed a company to utilize the waters of Pine and Rock creeks for electric power, which will be conveyed to Baker City, and utilized for running machinery at that place, as well as electric railways and lights, doing away with the expensive steam power now in use. The distance of transmission is about fourteen miles.

It is announced that Richard H. and William H. Edmonds, who have so ably conducted the *Manufacturers' Record* of Baltimore, have severed their connection with that journal, which has been purchased by Walter H. Page, Edward H. Sanborn and Thomas P. Grasty. The *Manufacturers' Record* has been an active, intelligent and influential advocate of Southern development and is a credit to class journalism. The Messrs. Edmonds have built up an important periodical, and their retirement will be generally regretted.

At the recent meeting of the executive committee of the Canadian Electrical association it was suggested that members should prepare papers to be read at the first annual convention in June as follows: S. J. Parker, "Does Electric Lighting Pay?" J. J. Wright, "Power"; A. B. Smith, "Safe Wiring"; R. K. Dunstan, "Construction Work"; D. Thomson, "Central Stations"; H. O. Fisk, "Carbons." A sub-committee was appointed to arrange for place of meeting in connection with the annual convention in June, also for the accommodation of exhibits, and for motive power.

The Chicago office of the Thomson Houston company believes in fresh air as well as fresh orders and the mining department, it seems, has undertaken the double task of supplying both the air and the orders For some time the managers of the mining and lighting departments, who occupy one office, have suffered from insufficient ventilation. But Prof. Badt with that boldness characteristic of the mining engineer, determined that if the pure air wouldn't come in of its own accord, he would bring it in. The two managers are now noted for the cool manner in which they close contracts;and their altered demeanor is said all to be due to a galvanized iron pipe that leads from the roof of the building to the ceiling of their apartment. The scheme is a simple one. A twenty-inch pipe opening on the roof connects on the fourth floor with a Sturtevant blower, and thence it extends downward with openings on the second and first floor. On the fourth floor, in series, so to speak, with the blower, there is a steam coil through which the air can be drawn should it be desired to warm it, and there is also a three horse power Thomson-Houston motor for driving the fan. Wires lead down to the mining department office and there connect with the necessary switches and an ammeter. All inquiries as to how "to raise the wind" are now referred to the mining department.

TRADE NEWS.

The catalogue just issued by Milliken Bros., Chicago and New York, contains photographic illustrations of poles so tastily designed as to go a long way toward meeting objections to overhead construction.

Bartlett's catalogue, illustrating the new Johnson switches, manufactured by the Interior Conduit & Insulation company, New York, is a work of art. There is in the little pamphlet, too, "a deadly parallel" that cannot fail to interest buyers.

That the "bureau of information" of the Thomson-Houston company, better known to many, perhaps, as "G. F. Curtiss," understands the art of making up a tasteful catalogue is evidenced by a little pamphlet just received, entitled "Electric Motors."

That twenty of the Buffalo feed water purifiers should now be in use on steamers on the lakes and twenty-five on stationary boilers on land speaks well not only for the heater but for the energy of Robert Learmonth, 200 Bouck avenue, Buffalo, who is exploiting the device.

Curtis & Curtis of Bridgeport, Conn., manufacturers of the Forbes patent die stocks, pipe cutting and threading machinery, have recently had a most exhaustive scientific test made of their machines, the results showing great efficiency under severe strains without mishap or breakage.

Thomas G. Grier has returned from Philadelphia. While there he renewed his business arrangement as the western representative for H. T. Paiste. Mr. Grier has removed his office to room 427 "Rookery" where he will carry a full line of Paiste "China" switches and other appliances manufactured by this house.

Queen & Co.'s portable testing resistance sets still continue to meet with great favor wherever they are introduced. The new style, known as the "1891" type, which was brought out last fall, is especially appreciated, as its peculiar construction has overcome many previous difficulties in both outside and inside testing.

A new company to be known as the Diamond Electric Manufacturing company has just been organized in Peoria by Gustave A. Scheeffer and William E. Francis. A very complete factory has been equipped with the latest machinery for doing all kinds of electrical work, and with Mr. Scheeffer's experience the undertaking should meet with success.

The Great Western Electric Supply company, Chicago is pushing the sale of the Bernstein series incandescent lamp, for which it is the general Western agent. It is claimed for the lamp that the "combination socket" has been so perfected that it acts perfectly automatic so that should an accident happen to the lamp, the circuit will remain intact.

"Many persons have a vague impression that a storage battery will furnish an independent and unlimited supply of electricity. It should be remembered that it is a reservoir only, which must be recharged from time to time." To this word of advice quoted from the catalogue of the River & Rail Electric Light company, New York, it might be added that storage cells are similar to men; treat them well and they will do their work well.

A. R. Jackson of Jerseyville, Ill., has secured a franchise for electric lighting at Albia, Ia., and is now proceeding with the installation of his plant. He will use Edison incandescent and Thomson-Houston arc apparatus The Pond Engineering company, St. Louis, has Mr. Jackson's contract for a complete power plant, including a 14x13 inch Armington & Sims engine, two 60 horse power steel boilers, furnaces and the necessary fixtures.

The new "K. C." wire being introduced by the Knudson-Cuttriss Wire company, New York, is attracting attention. The fiber insulation on this wire, it will be remembered, is water-proof, but it contains no rubber or gutta percha. This company will either manufacture this wire or sell manufacturers' licenses to factories under its U. S. patents, the Canadian patents having already been disposed of. It may be remarked that Messrs. Knudson and Cuttriss are well known as inventors. Mr. Knudson was one of the originators of the well known "K. K." wire, which has been remarkably successful, and Mr. Cuttriss is the electrician of the Commercial Cable company.

The Athens, Ga., Railway company, whose lines are equipped with the Detroit Electrical Works system, announces that the service has been excellent and has given

satisfaction from an economical point. General Manager Voss of the Athens company says: "We have had very little trouble or expense with the bevel gear; in fact, there is no trouble with it when the friction collars are kept well adjusted, which is very simply and easily done. Our cars make less noise and run smoother than those of any other system that I have ever inspected. I have been in the street railway business for some twelve years, and last year, before we began to make any change in our line here, I made a tour of inspection of the different systems."

The Page Belting company Concord, N. H., will erect this summer a new brick factory 250x60 feet, three stories high, with basement and attic. Each room will have an electric motor of sufficient power to run the machinary. The Sturtevant system of heating will be used. All elevators, pumps, ventilating fans and in fact everything requiring power will be operated by motors. Current will be supplied from the Sewall's Falls plant. Over 100 horse power will be used in the new shop alone. Geo. F. Page, president of the company, is largely interested in the Sewall's Falls company and it is largely due to his energetic efforts that Concord is to have its immense water power transformed and brought within the city limits.

It is not often that electrical companies announce "bargain days" or "annual spring sales," but a circular just received would indicate that Queen & Co., Philadelphia, have decided that old stock is worse than none. This, of course, does not apply to any of the regular stock. It only refers to the Ayrton & Perry spring ammeters and voltmeters, which do not find so ready a sale now as formerly. When these ammeters and voltmeters were first placed on the market some five years ago, they were without doubt first-class instruments. Recently, however, Queen & Co. have found that they could produce instruments of greater accuracy, and for station use of equal accuracy, at a less cost than the Ayrton & Perry type. It was decided, in consequence, to insure a prompt disposal of the instruments of this make still on the shelves, and they have reduced their prices.

For many years the demand for a water wheel giving an absolutely steady power has caused many current water wheels to be placed on the market, but, according to the John E. Beggs Machinery & Supply company, New York, until it introduced its current water wheel, the results in most cases were failures. A short time ago a prize was offered at Buffalo to the inventor of the best current water wheel, and from the many presented the Beggs company's wheel received the first prize. Since that time this company has been preparing to place its invention in general use, and now the company does not hesitate in guaranteeing the wheel under almost any reasonable conditions, for driving electrical machinery. It is said that this wheel can be used where no other wheel can. The Beggs company solicits correspondence at 74 Cortlandt street, New York.

A. L. Ide & Son, Springfield, Ill., report sales of engines for electric lighting and street railway work since Jan. 1, 1892. The hores power is given in each sale: Decatur Electric Light & Ice company, Decatur, Tex., 55; C. Peper, St. Louis, Mo., 25; C. H. Baush & Son, Holyoke, Mass., 35; M. T. Morrill, Golden, Colo., 90; W. J. Lemp, St. Louis, Mo., 260; Power & Collins, Seattle, Wash., 80; Staver & Walker, Portland, Ore., 35; E. W. & F. Utt, Springfield, Ill., 100; E. W. Blatchford & Co., Chicago, Ill., 55; Ashland Block, Chicago, Ill., 900; L. T. Fuller, Calvert, Tex., 45: Groveland Apartment Building company, Chicago, Ill.,; 180; Fort Clark Horse Railway company, Peoria, Ill., 500 Winslow Bros., Chicago, Ill., 35; Westminster & Van-couver Tramway company, Vancouver, B. C, 1,000; Duluth & Iron Range R. R. company, Duluth, Minn., 400; Plymouth Roller Mills company, Le Mars, Ia., 60; Hyde Park Electric Light & Power company, 200; O'Donnell & Duer, Chicago, Ill., 35; E. T. Sykes, St. Louis, Mo., 80; National Electric Manufacturing company, Eau Claire, Wis., 400; The Mecca company, Chicago, Ill., 400; Springfield Electric Light & Power company, Springfield, Ill., 150; Arlington Street Railway company, Fort Worth, Tex., 500; Chicago Arc Light & Power company, Chicago, Ill., 100; W. W. Cole Building, Chicago, Ill., 320. Sixteen Ide engines will be started in Chicago during the next sixty days, and this addition will make 110 engines, amounting altogether to about 10,000 horse power, in the World's Fair City.

BUSINESS.

Frank King, an officer and director of the new electric railway known as the Denver, Lakewood & Golden, recently built between Denver, and Golden, Colo., was in Chicago for several days last week. While here he made a contract with the Patten Motor company for the equipment of his line.

The Pelton Water Wheel company, New York and San Francisco, reports a large number of recent sales of water wheels and motors, several of which are to be utilized for operating electric power plants. This company has just shipped two motors to the Candelaria Mining company of Mexico to operate electric generators under 1,100 feet head.

Perry & Noyes, stock brokers, Edison building, New York, consider the outlook for electrical stocks as most excellent. Phonograph stock, of which the North American is the parent company, they think will occupy considerable importance, as Mr. Edison has become interested again, being represented in the directories of the different companies.

The Union Electric Works, Springer building, Chicago, have recently gotten out a new and very attractive design for a combination letter box and speaking tube frame for apartment houses, and have already made several fine contracts to introduce the device. This company is also having an active business in its "in" and "out" annunciators for apartment houses.

Elias E. Ries, president of the Ries Electric Specialty company of Baltimore, was a visitor last week at the New York office of the WESTERN ELECTRICIAN. Mr. Ries was on his way home from a flying trip to Boston and other New England cities, and he brought with him a large number of orders for the regulating socket, which will keep the factory more than busy for some time to come.

Hussey & Co., 211 Randolph street, Chicago, have enlarged the size of their standard letter box combination to accomodate the new postals cards and have otherwise improved the design in general appearance. These letter boxes have been placed in several new flat buildings in Chicago and contracts have been signed for two or three more, indicating an active business for this enterprising young firm.

The electric light plant of the Camden, Ark., Electric Light and Power company, recently destroyed by fire, will be newly equipped. Formerly steam was secured from the water works boilers, but the company will now put in its own plant, having ordered two new boilers, and a No. 7 Hoppes exhaust heater from the Pond Engineering company, through its Dallas, Tex., office. The engines, while considerably damaged, can be repaired.

John A. Barham, president of the Janesville Street Railway company, Janesville, Wis., has ordered, through the Chicago office of the Pond Engineering company, a complete steam plant necessary to operate his road by electricity. The plant includes an Armington & Sims engine, with foundation box; a boiler, with stack and the usual fittings: a Blake boiler feed pump, and a Hoppes exhaust heater. The Pond company's contract also includes delivery and erection of this machinery in Janesville, with foundations, brickwork, pipe connections, etc., all ready for service

The partnership heretofore existing between Arthur L. Bosley and Lewis R. Schultz, under the firm name of the Pennsylvania Electric Engineering company, Philadelphia, has been dissolved and another company under the same name has been incorporated with a capital stock of $25 000. Officers for the ensuing year are as follows: Arthur L. Bosley, president and manager; Benj. W. Tingley, vice-president; Lewis R. Schultz, secretary and treasurer, and Frederick S. Koons, assistant secretary. The business will be continued as formerly, at the Pennsylvania Mutual building, Philadelphia.

ELECTRICAL STOCK MARKET.

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, March 12th, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	96	97
Edison Illuminating company of New York	81½	82½
" " " Brooklyn	75	80
" " " Boston	100	105
" " " Chicago	130	140
Edison Ore Milling company	15	20
United States Electric company of New York	10	20
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomson-Houston Electric company	58½	59
" " " Preferred	28	29
Westinghouse Electric company	15	16
North American Phonograph company	5	6
New York " "	2½	5
Automatic Exhibition company	2	3

Market in all electrical securities dull.

ELECTRICAL PATENTS.

Issued March 8, 1892.

470,194. Electric Motor or Dynamo Electric Machine. Henry H. Hosford, Cleveland, O.

470,199. Electric Motor or Generator. Rankin Kennedy, Glasgow, Scotland.

470,204. Electric Cut Out and Safety Device. Charles R. Meston and Alexander W. Meston, St. Louis, Mo.

470,217. Connection for Armature Conductors. George Stephens, Lynn, Mass.

This invention consists in the combination of the bared portions of the armature conductor and connecting conductor, the sleeve around the same and a clamp supported by the armature and clamping said sleeve.

470,221. Electric Railway. Elihu Thomson, Lynn, Mass.

This invention consists primarily in the combination, with an elongated contact bar or plate elongated in the direction of movement of the vehicle, of a series of projecting line contacts pivoted to swing either forward or backward in the direction of movement of the vehicle, and each normally out of connection with the line and separated from one another by spaces approximately equal to the length of the contact bar or plate, but a little less than such length, and electric switches actuated by a part moving with the vehicle so as to place the projecting contacts in connection with the line in succession as they are engaged by the elongated contact bar or plate.

470,231. Fire Alarm and Telephone Apparatus. Edward H. Amet, Chicago, Ill.

This invention consists in the combination, with a telephone and telephone circuit of the usual construction, of an automatic fire alarm signaling device, a thermostat and thermostat circuit including a magnet, an induction coil circuit having a secondary circuit adapted to be included in the telephone circuit, the magnet in the thermostat circuit operating to cut on the telephone and throw the secondary circuit into connection with the telephone line, so that the signaling device may in case of fire serve to automatically send a signal to the central office.

470,237. Conduit for Electric Wires. Charles A. Freeman, Steubenville, O.

470,256. Electric Gas Lighting Burner. Horace A. Pinkham, Wollaston, Mass.

470,260. Electric Battery. Vincenzo Riatti, Milan, Italy, assignor to Julian Goldsmid, London, England.

470,279. Trolling Hook. Henry Zuckweiler, Pekin, Ill.

470,294. Electrical Attachment for Pianos. Fritz A. Feldkamp, Newark, N. J.

470,318. Electrical Wire Stripper. Arthur Cuthbert, Maidenhead, England.

470,329. Underground Conduit for Electric Cables. Carl A. W. Hultman, Stockholm, Sweden.

Claim two reads:
"In combination with the conduit block for electric cables or wires, metallic bars or tubes lodged in exterior longitudinal grooves in said block, and the adjacent ends of the sections of such blocks wrapped with cloth prepared with melted asphaltum, as described, and said cloth and block ends covered with cement or some flexible compound."

470 340. Movable Coil for Electrical Measuring Instruments. Edward Weston, Newark, N. J.

This invention consists of an insulated coil conductor having numerous turns cemented together to form a compact annular body, and provided on opposite sides with pivots to which the terminals of the coil are respectively connected.

470,341. Electrical Measuring Instrument. Edward Weston, Newark, N. J.

470,356. Insulator for Overhead Electric Railways. Henry D. Winton, Wellesley, Mass.

470,372. Push Button. Charles H. Delano, Woburn, Mass.

470,382. Safety Cut Out. Max Kerstein, Boston, Mass.

470,402. Regulating Socket or Holder for Incandescent Electric Lamps. Elias E. Ries and William S. Hory, Baltimore, Md.

470 417. Insulator for Trolley Wires. William S. Andrews, New York, and Henry P. Ball, Brooklyn.

470,418. Electrically Heated Oven. John V. Capek, New York, N. Y.

The seventh claim reads:
"An electrical heater having a heating conductor mounted on but insulated from a heating plate, and a plate over but insulated from the heating conductor, the edges of one of said plates being bent to form a holding device, and a cover held thereby."

470,419. Electric Oven. John V. Capek, New York, N. Y.

The main object of this invention is to provide a heater of convenient and economical arrangement in which the several parts may be varied in position or arrangement in accordance with the requirements of the user.

470,428. Electric Store Service Apparatus. Midbury W. Hassan, Rochester, N. Y.

470,441. Electric Current Meter. Johan W. T. Olan, New York, N. Y.

470,455. Magnetic Ore Separator. Charles T. Thompson and Richard H. Sanders, Philadelphia, Pa.

470,456. Magnetic Ore Separator. Charles T. Thompson and Richard H. Sanders, Philadelphia, Pa.

470,471. Incandescent Electric Lamp. Augustus C. Carey, Lake Pleasant, Mass.

The object of this invention is to save the bulb and its appurtenances, and supply a new filament at considerably less cost than an entirely new lamp.

470,478. Automatic Heat Signaling Device. Willard G. Day, Baltimore, Md.

470,505. Electric Car Brake. John Redmond, Seattle, Wash.

470,514. Lightning Conductor. Harvey Simpson, Kenosha, Wis.

470,516. Electric Locomotive. Elmer A. Sperry, Chicago, Ill.

470,521. Electric Generator. Charles J. Van Depoele, Chicago, Ill.

470,552. Galvanic Battery. John H. Davis, Detroit, Mich.

Of the five claims the third reads:
"In a battery, the combination of the battery vessel or jar, the bibulous carbon forming the negative electrode located therein, the excitant supported above the bottom of said jar, the positive electrode and circulating fluid."

470,557. Telegraph Relay. Charles M. Dyer, Cloverdale, Ind.

470,566. Machine for Heading Spokes. Thomas Hill, Quincy, Ill.

470,596. Electric Circuit Closer. George W. Price, Baltimore, Md.

470,608. Electric Dust Collector. Richard E. Wardhaugh, Jacksonville, Ill.

470,627. Electric Locomotive. Sidney P. Hollingsworth, Washington, D. C.

470,634. Telephone. William A. West, Bellefontaine, O.

The ninth claim reads:
"The method of reinforcing telephone currents, which consists in varying the current in one or more local circuits by the initial line circuit and causing said local currents to induce conspiring reinforcing currents in the line."

470,638. Electric Search Light. Robert S. Dobbie, Brooklyn, N. Y.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

RAILWAY FEEDER AND TROLLEY WIRE,
ELECTRIC LIGHT LINE WIRE,
Incandescent and Flexible Cords,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES,
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SITUATION WANTED.

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Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

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The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half pound boxes, in strips about one foot long and five eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

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THE GUM-ELASTIC ROOFING

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Solicit orders for light Drop Forgings for Electrical work. *16 years' experience.* Estimates promptly furnished on receipt of samples or drawings.

CROCKER-WHEELER ELECTRIC COMPANY,

SLOW SPEED MOTORS.

¼ H. P. 500 Volt Armature, Ventilated. Constant Speed, 1,500.

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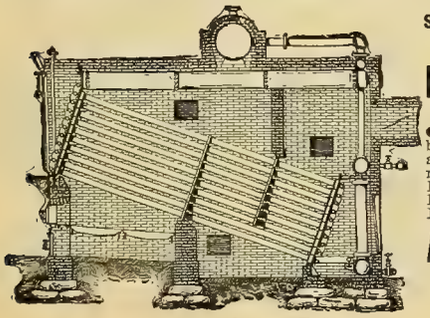

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SAFE. ECONOMICAL. DURABLE.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the **Electric Light Companies** of Detroit, St. Paul, Columbus, Cincinnati, Louisville, Jersey City and a great many others; also by the Armington & Sims Engine Co., Providence, R. I.; the Lynn Belt Line Street Ry. Co., Lynn, Mass. and the Thomson-Houston Electric Co., Lynn, Mass.

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For Sale Cheap, Second-hand Machinery, Arc and Incandescent. Also Motors. All Apparatus Guaranteed.

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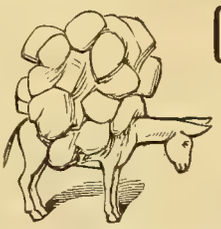

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For Electrical Purposes.

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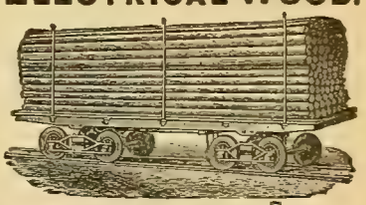

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STANDARD SCREW GLASS INSULATORS,

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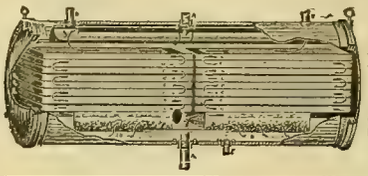

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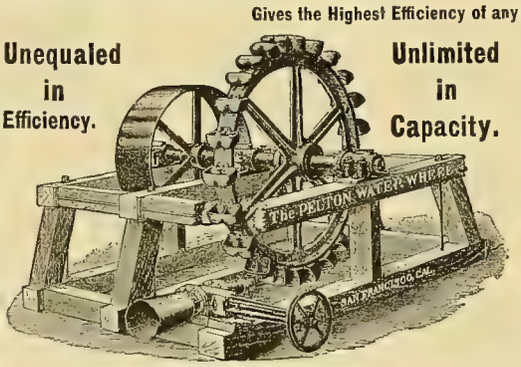

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Afford the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 10 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

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The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

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Greatest Adhesive Qualities. Causes Less Friction than any other Belt

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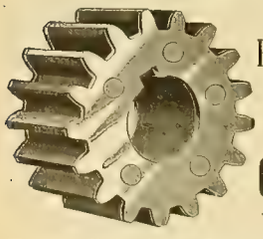

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ALL LEATHER. NO IRON ROD OR HINGE. OLD STYLE LEATHER LINK AND IRON ROD BELT AND ROPE TRANSMISSION SUPERSEDED.

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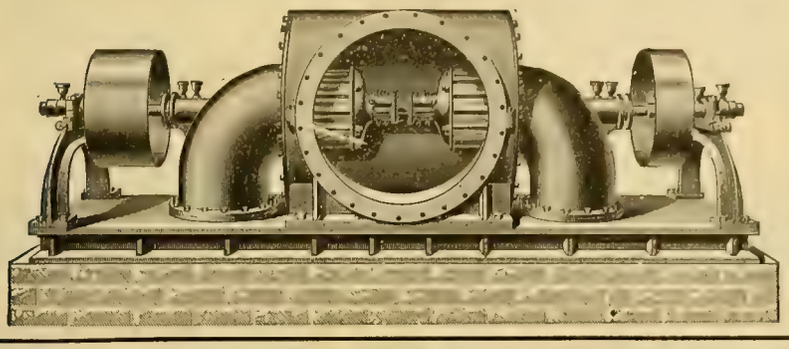

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The accompanying engraving represents a pair of 12 inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

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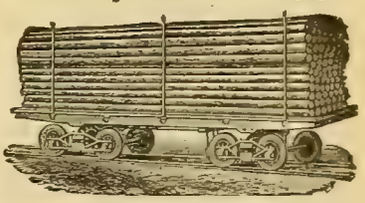

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VULCANIZED FIBRE CO.

ESTABLISHED 1873.

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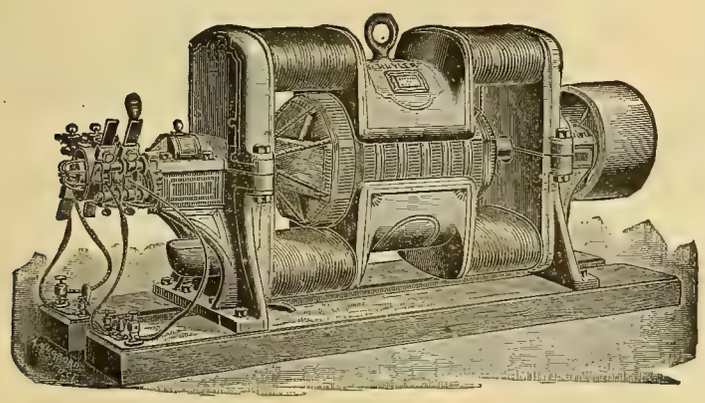

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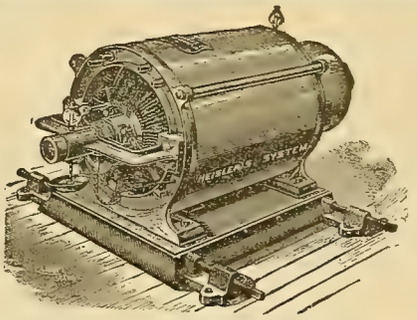

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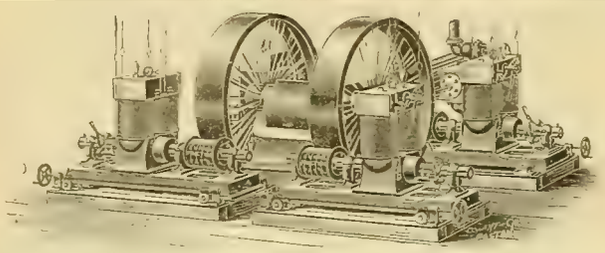

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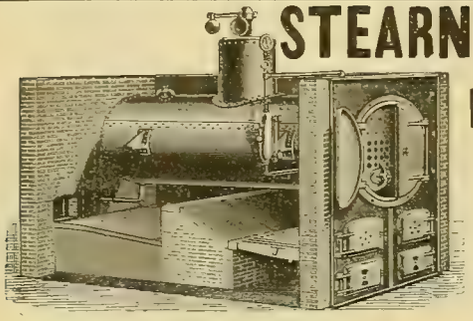

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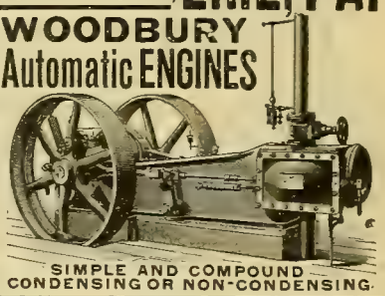

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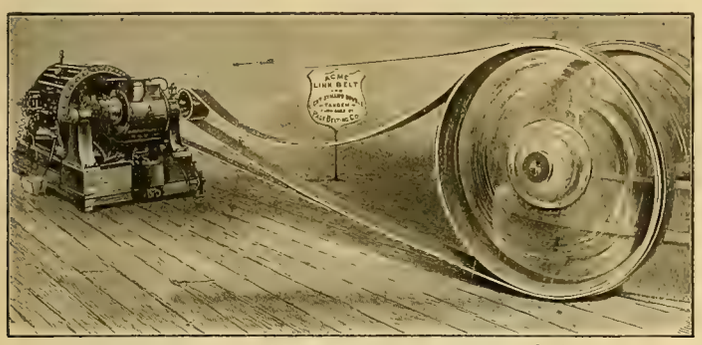

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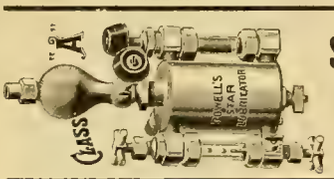

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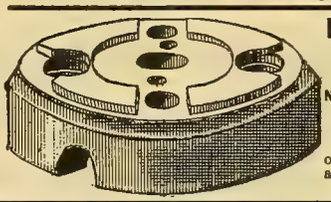

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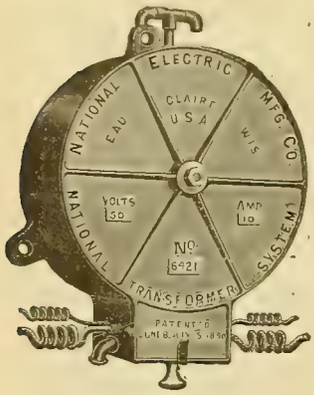

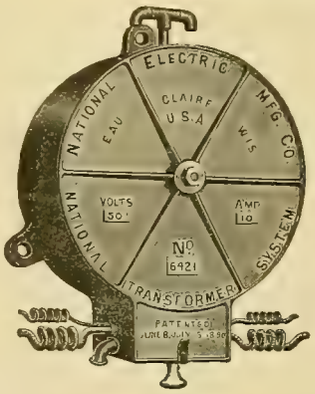

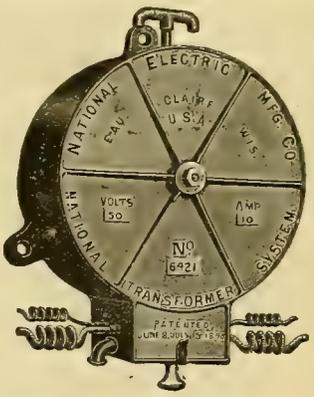

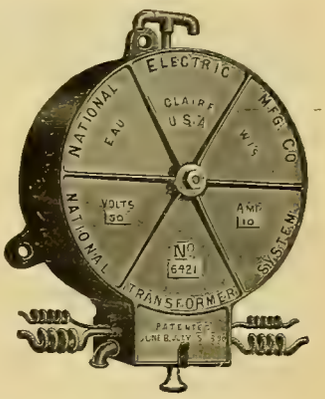

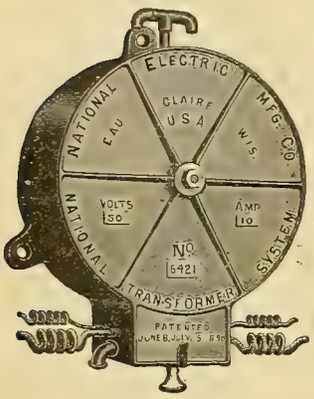

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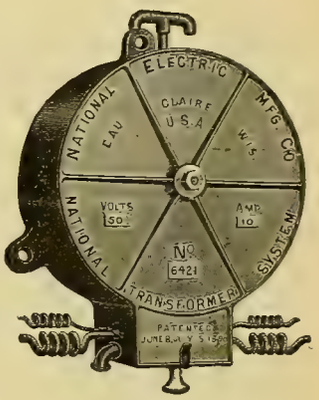

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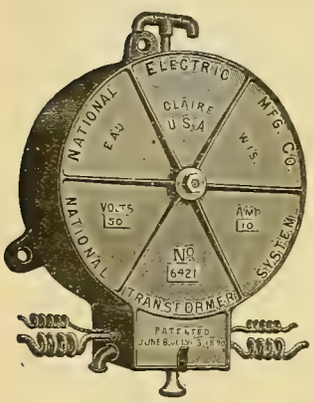

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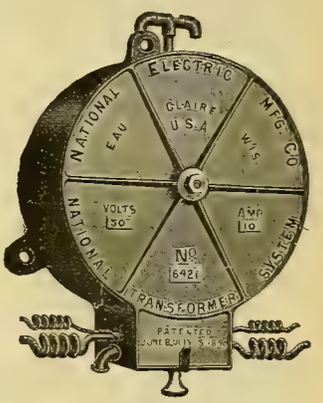

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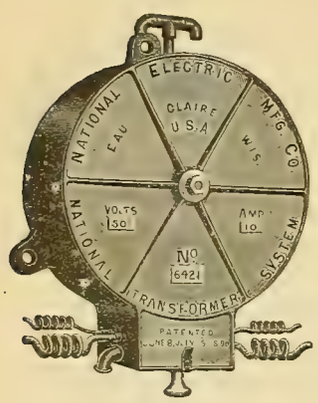

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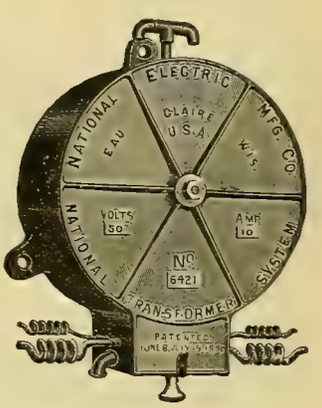

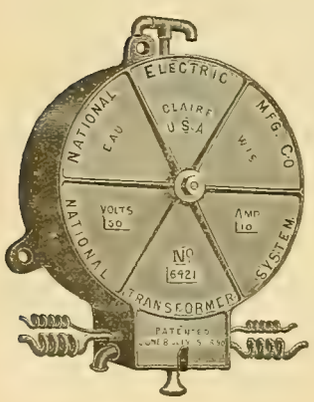

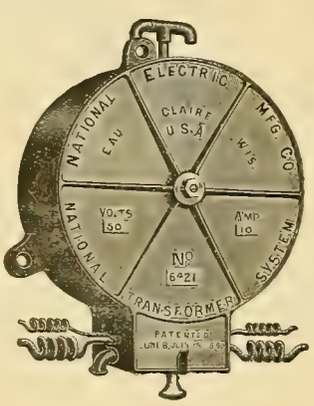

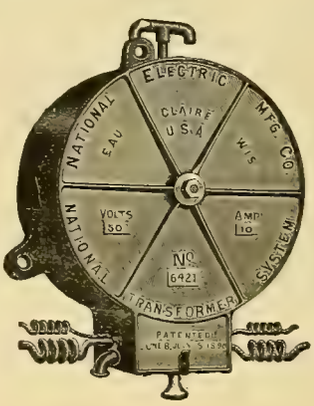

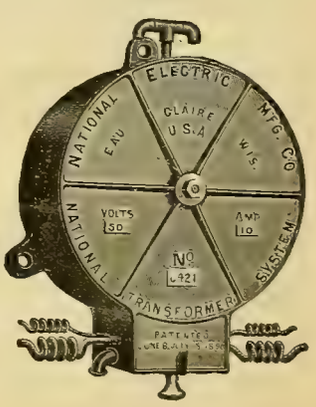

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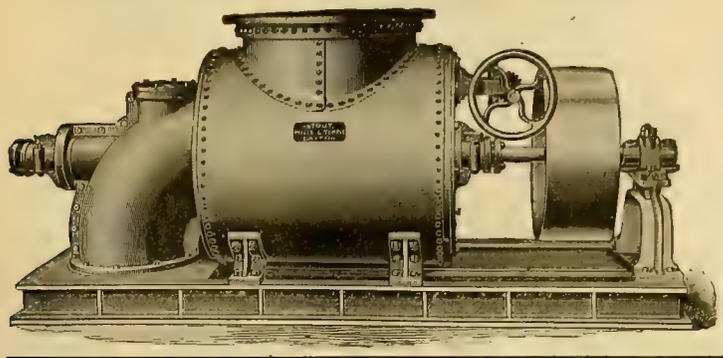

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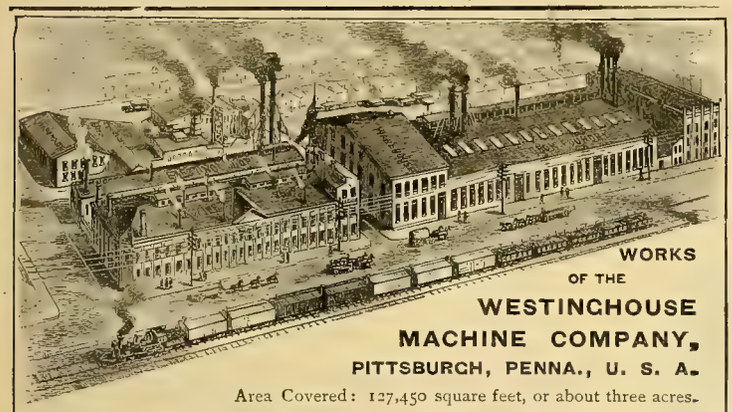

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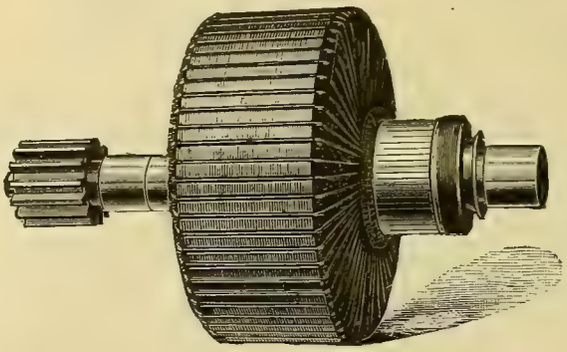

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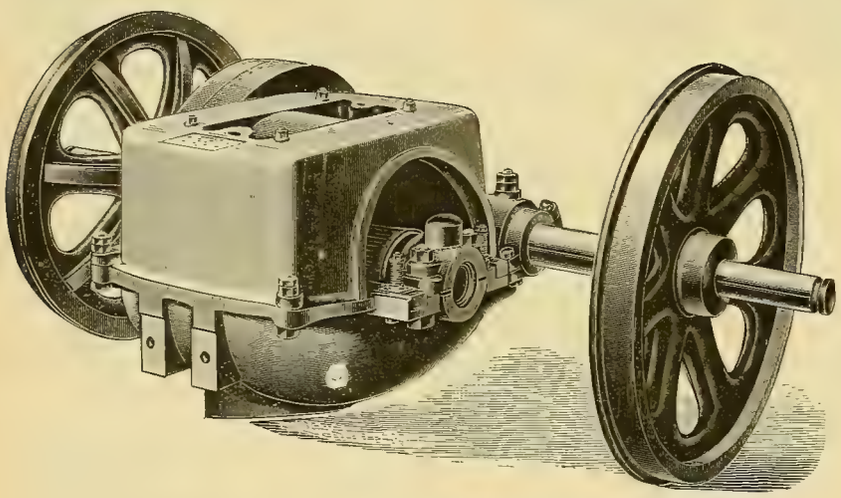

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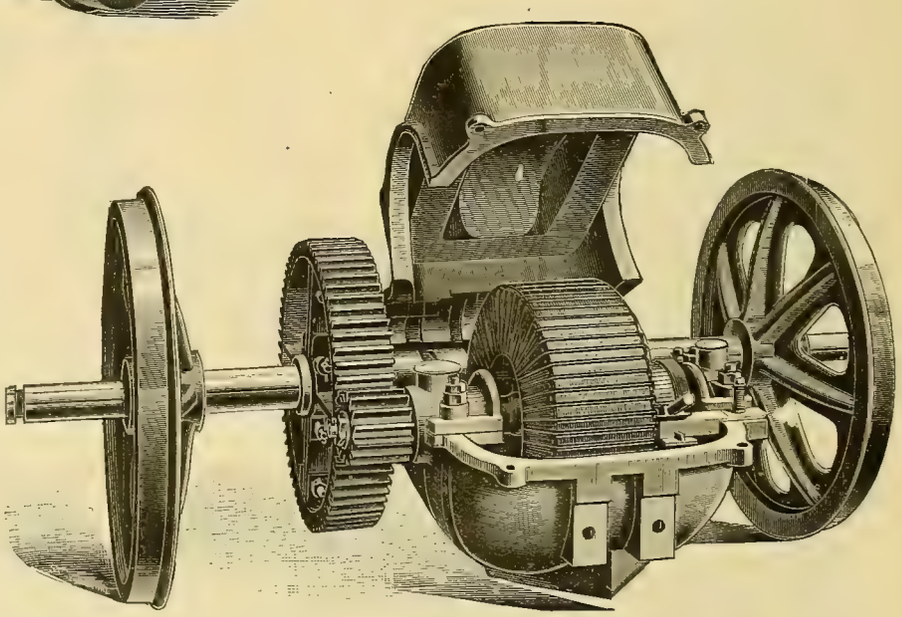

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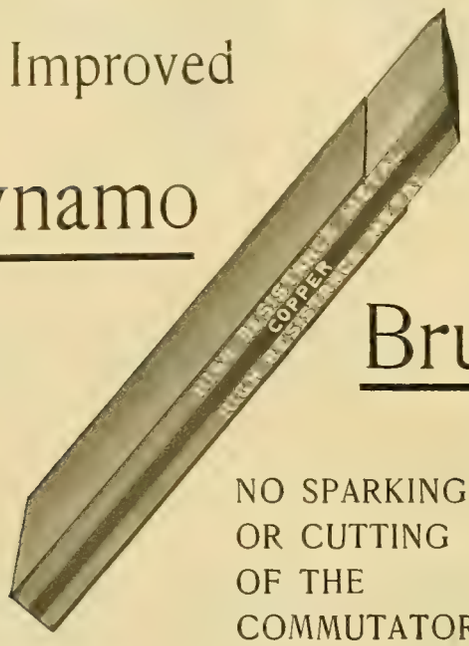

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READ WHAT PRACTICAL USERS SAY ABOUT IT.

OFFICE OF
THE CHICAGO COPPER REFINING CO.,
Office 620 and 621 Phenix Building,
138 Jackson Street.

CHICAGO, Jan. 20, 1892.

THE ELECTRICAL SUPPLY CO., City.

GENTLEMEN:—We have been using four No. 32 Wirt Dynamo Brushes for about a month. We find that they do not spark at all and cause but little wear on the commutator, keeping the surface of the latter smooth. The Wirt Brush is entirely satisfactory, and superior to any we have used. Yours truly,

THE CHICAGO COPPER REFINING CO.,
W. I. HITT, Sec'y.

THE COLUMBIA.
LEADING THEATER OF CHICAGO.

THE ELECTRICAL SUPPLY CO., Aug. 23, 1891.

GENTLEMEN:—The brushes are running with much less sparking than any I have ever tried. Evidently they are an improvement.

Respectfully, GEO. CARSON.

CITY HALL, CHICAGO, Aug. 27, 1891.

THE ELECTRICAL SUPPLY CO.,

GENTLEMEN:—We have been running your brushes on our Edison Dynamo for two months and find they are a decided improvement.

HENRY MUNSTERMAN,
Chief Engineer.

CHICAGO, Aug. 22, 1891.

THE ELECTRICAL SUPPLY CO.,
Michigan Avenue and Randolph Street, Chicago.

GENTLEMEN:—We have used a set of your Wirt Brushes on our dynamo, and have had no sparking and scarcely any attention required during that time. The brushes furnished by the makers of the same dynamo were always more or less troublesome, and required frequent resetting and dressing of the commutator. I would now consider it a hardship to be obliged to use the old brushes.

Yours truly, (Signed) R. C. PAGE,
Engineer Libby Prison Museum.

MARYSVILLE, O., Jan. 2, 1892.

THE ELECTRICAL SUPPLY CO., Chicago, Ill.

DEAR SIRS:—The brushes came in good order, and after giving them a trial I find them to be the best brushes we ever used, as they run smooth and do not cut the commutator, or spark. We will order more. Very truly, R. TURNER,
Chief Engineer Marysville Light & Water Co.

WEST KENTUCKY INSANE ASYLUM,

HOPKINSVILLE, KY., Dec. 20, 1891.

THE ELECTRICAL SUPPLY CO., Chicago.

GENTLEMEN:—Having used your Wirt Brushes for over a month I am satisfied they are all that you claim for them. Please send me your general catalogue. Yours respectfully,

JNO. G. LUTZ.

CHICAGO, Nov. 19, 1891.

THE ELECTRICAL SUPPLY CO., Chicago, Ill.

GENTLEMEN:—After trying one set of your Patent Dynamo Brushes, I have put them on all three of our incandescent dynamos, and like them so well that I would not be willing to use the old style of brush again. Yours truly,

D. B. RAMSEY,
Chief Engineer Union League Club.

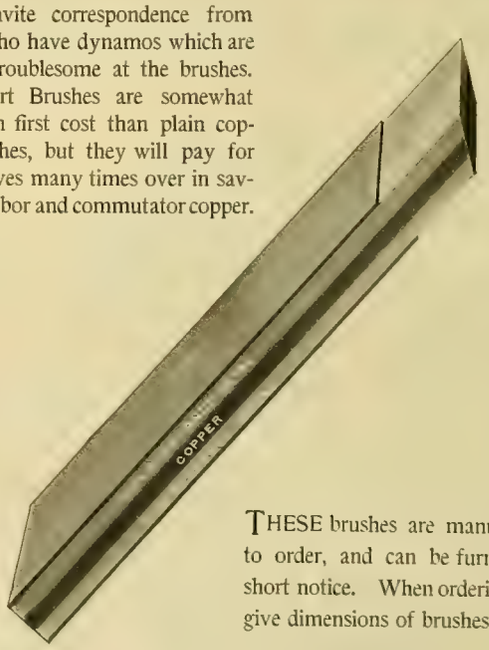
DENVER, COLO., Nov. 27, 1891.

THE ELECTRICAL SUPPLY CO., Chicago, Ill.

GENTLEMEN:—I am much pleased with the Brushes. I gave them the most severe test I know of, placing them on a commutator where *even carbon* brushes were not successful in reducing the sparking, and where there was a very heavy current at high potential, with a constant "chewing" up of the copper. Your Brush has eliminated all trouble, and I have asked our Company to order a number of them, when I shall use them on our other dynamos.

Yours truly, R. H. STERLING,
Electrician, Denver Consolidated Electric Co.

WE invite correspondence from those who have dynamos which are at all troublesome at the brushes. The Wirt Brushes are somewhat higher in first cost than plain copper brushes, but they will pay for themselves many times over in saving of labor and commutator copper.



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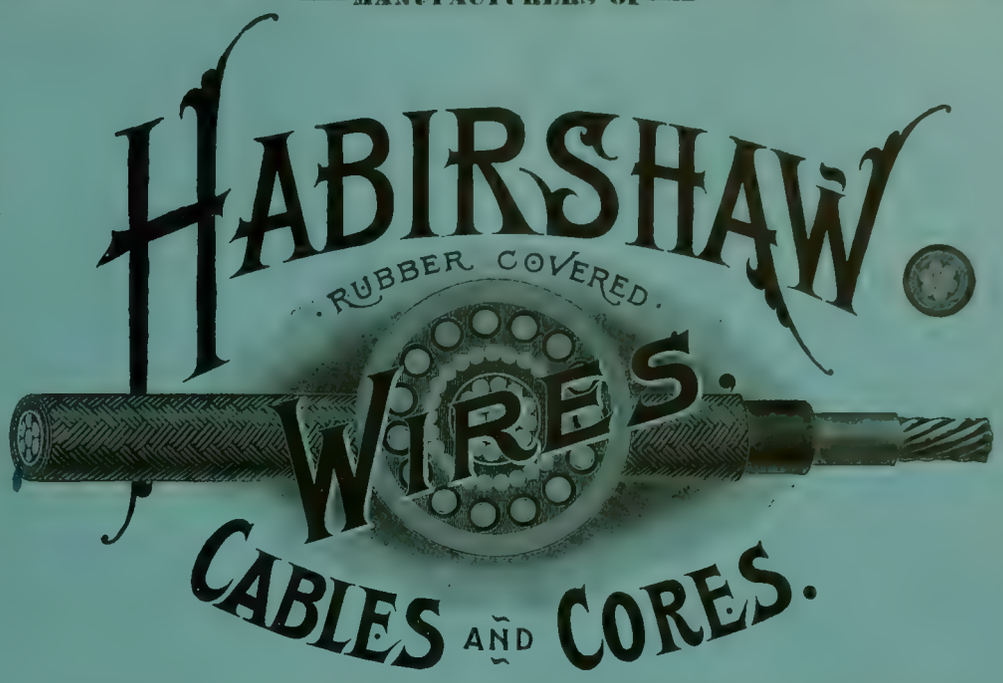

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CABLES of High Insulation and Long Life, all milage.

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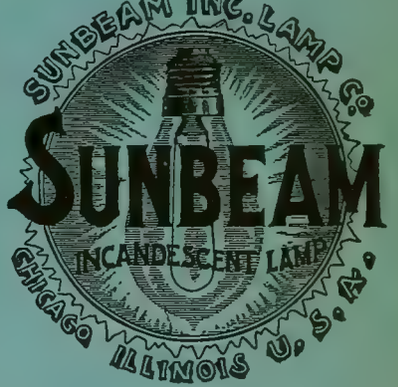
CHICAGO, - - ILL.



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SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

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REPAIRS Form the Uncertain Element In Operating Expenses.

The "Incidentals" (Loss of Revenue, Labor, Extras, etc.,) Cost More Than Material.

SPRINGFIELD, ILL., Feb. 2, 1892.

DETROIT ELECTRICAL WORKS, Detroit, Mich.

Gentlemen:—In reply to yours of Jan. 28th, would say that last fall, during the State Encampment, we had, most of the four weeks, three trail cars to each of your motors, and pulled up a 3 per cent. grade with perfect ease from 250 to 300 persons, but with your last improved or inverted motors, we had four trailers, and brought in, by actual count, 422 persons, without any trouble whatever. We did the same during our Fair in September last, and if I did not think your motors do the most work with the least power, I should not have given you lately an order for five more motors.

On January 18, 1892, we had a very heavy snow storm here; our cars never stopped, made their regular trips, while the City Railway Company, with their T.-H. equipment, had to quit running in the afternoon at 5 P. M. We had no trouble in pulling through the heavy snow drifts.

We have two Edison Motors, but they being out of repair at that time, we could not give them a fair trial to see how they would go through the snow.

Yours very respectfully,

(Signed) PEOPLE'S ELECTRIC RAILWAY CO.,

Per J. H. Schuck, President.

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Western Electrician.

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Vol. X. CHICAGO, MARCH 26, 1892. No. 13

"AJAX"

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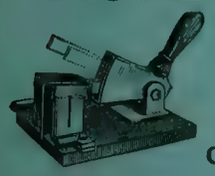

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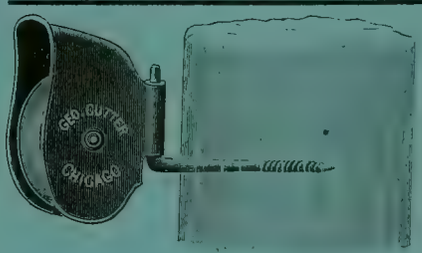

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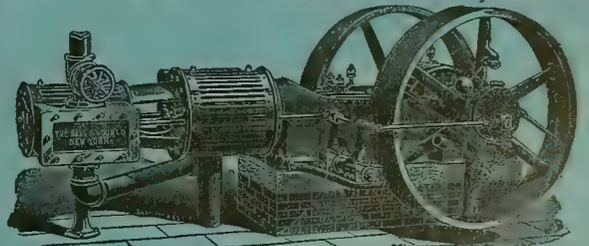

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Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Rae, Frank B.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrical and Mechanical Engineers.
Pierce, Josiah Jr.
Rae, Frank B.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
La Roche Electric Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Engravers.
Braun Illustrating Co.

Electrical Specialties.
Andrae, Julius.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Hussey & Co.
Ries Electric Specialty Co., The.

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Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

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Brush Electric Co.
Colburn Electric Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.

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Keller & Degenhardt.
Leonard & Co., H. Ward.
Rae, Frank B.

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Link Belt Machinery Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Morse & Co., A. M.
Pearson & Co., W. B.
Pond Engineering Co.
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Smith, Thos. G. Jr.
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Taylor Engine Co.
Westinghouse Machine Co.
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Chicago Electric Motor Co.
Diehl & Co.
Edison General Electric Co.
Stanley Electric Mfg. Co.

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Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

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Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

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Evans Friction Cone Co.

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Electrical Supply Co.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

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Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
American Electrical Works.
Andrae, Julius.
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Chicago Electric Mfg. Co.
Columbia Inc. Lamp Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Cons. & Supply Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
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International Okonite Co., The.
Kartavert Mfg. Co.
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Munsell & Co., Eugene.
New York Insulated Wire Co.
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Vulcanized Fibre Co.
Western Electric Co.

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American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Cushing, F. W.
Cutter, Geo.
Day's Kerite Insulation.
Detroit Electrical Works.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
New York Insulated Wire Co.
Roebling's Sons Co., J. A.
Sperry Elec. Mining Machine Co.
Western Electric Co.

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Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Inc. Lamp Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Great Western Elec. Supply Co.
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Knapp Electrical Works.
New York and Ohio Co.
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Ferracute Machine Co.

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Bowers Bros.
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Schoonmaker, A. O.

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Detroit Electrical Works.

Mining Apparatus, Electric.
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Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

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Crocker Wheeler Electric Co.
C. & C. Electric Motor Co.
Chicago Electric Motor Co.
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Diamond Electric Mfg. Co.
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Western Electric Co.

Platinum.
Schawel & Co., Jas.

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Brownlee & Co.
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Electrical Supply Co., The.
Holmes, C. H.
Lefmann, Julius.
Lond, H. M. & Sons' Lumber Co.
Milliken Bros.
Schindel & Schindel.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Detroit Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co., The.

Securities, Electrical.
Gilman & Co., E. R.
Perry & Noyes.

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Hine Eliminator Co.
Pond Engineering Co.

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Boston Braid Mfg. Co.

Slate.
Murphy, T. J.

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Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
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Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway.
Detroit Electrical Works.
Electric Merchandise Co.
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Tapes, Insulating.
American Electrical Works.
Andrae, Julius.
Central Electric Co.
Chicago Insulated Wire Co.
Cushing, F. W.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Standard Paint Co.

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Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

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Detroit Electrical Works.
Western Electric Co.

Test Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

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Diamond Electric Mfg. Co.
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National Electric Manufacturing Co.
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Short Railway Generators

ARE NO LONGER A NEW TYPE. THEY ARE

STANDARD,

And the record they have made for themselves cannot be surpassed. Inquire in Rochester, Jamestown, Covington, East Liverpool, Muskegon.

The Jamestown Street Railway Company report as follows: **JANUARY 6, 1892.**

* * * * * * * * * * * * * * * * * * *

On Sunday morning last it commenced snowing very hard, and so continued all day Sunday, Sunday night and Monday. We were obliged to put forth every effort to prevent blockading of the road, which we succeeded in doing.

* * * * * * * * * * * * * * * * * * *

On Sunday morning we started your Generator No. 2 at 6:30 a. m., and continued to use the same until Tuesday morning at 3:30 a. m., when we shut it down. This Generator was in continuous service during the entire time, and was not even sanded, nor the brushes touched. It did not use to exceed one-half quart of oil. We consider this remarkable because of the hard work the Generator was doing. * * * * * * * *

Yours very respectfully, GEORGE E. MALLBY, Superintendent.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, OHIO.

MANUFACTURERS

ORGANIZED 1881.
INCORPORATED 1883.

ARC LAMPS

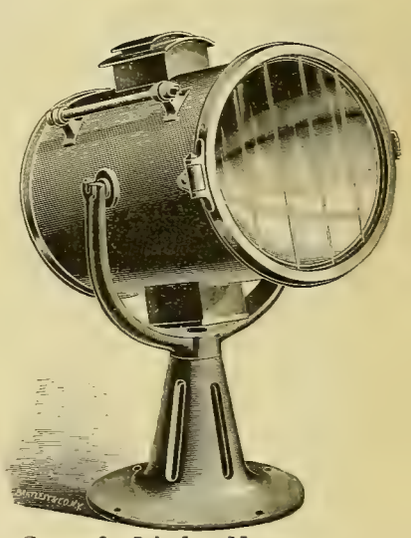
FOR INCANDESCENT AND STREET RAILWAY CIRCUITS.

AN ESTABLISHED FACT: THE ONLY ARC LAMP THAT WORKS SATISFACTORILY ON AN INCANDESCENT CIRCUIT.

SPECIAL APPLICATIONS:
PHOTO-ENGRAVING, THEATRICAL, AND SEARCH LAMPS.

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

PHENIX BUILDING, CHICAGO. TELEPHONE BUILDING, NEW YORK.



Search Light No. 13.

Individual Arc Light and Motor Cut-Out.

EACH CLASS HAS ITS OWN "COMBINATION."

SAVES MILEAGE OF CIRCUITS. SECURES PAYMENT FOR ALL CURRENT USED.
GIVES CENTRAL STATION CONTROL OF EVERY LAMP. MAKES SCATTERED BUSINESS PROFITABLE.

MONEY-SAVING. RELIABLE. EASILY APPLIED. INEXPENSIVE.

Individual Lamps or Motors, or groups of these, cut in and out at will from Central Station, without affecting others in same circuit. For Terms and Particulars, Address

Electric Secret Service Company,

45 BROADWAY, NEW YORK.

THOMAS STURGIS, President. *WM. C. LANE, Sec'y and Treas.* *C. P. MACKIE, Gen'l Manager.* *S. S. BOGART, Gen'l Agent.*

FACTS.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES have the indorsement of the best electrical experts and electricians in the world.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES will not deteriorate, but improve with age.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES will not crack when exposed to severe changes in temperature.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES will not deteriorate when placed in lime or mortar.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES are not affected when immersed in sulphuric acid.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES will stand a greater amount of kinking and torsion than any other wire in the market.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES are immersed in water for three days (72 hours), and then carefully tested with Thompson's Reflecting Galvanometer.

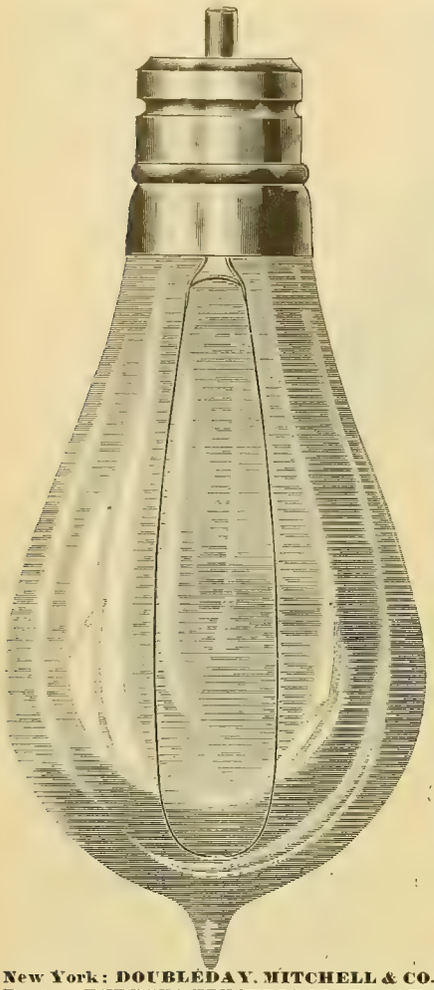
IT IS A FACT that OKONITE INSULATED WIRES AND CABLES are tested in addition to the Galvanometer, with a dynamo current of 2,000 volts.

IT IS A FACT that the OKONITE INSULATED WIRES AND CABLES were awarded the GOLD MEDAL at the Paris Exposition, 1889.

IT IS A FACT that the OKONITE INSULATED WIRES AND CABLES are giving better satisfaction, are more carefully made, and are not only the best, but cheaper in the end, than any other wires on the market.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin Street, CHICAGO.



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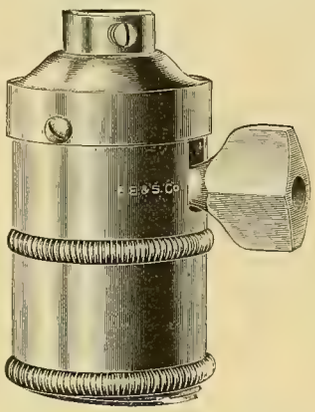
LONG LIFE, HIGH EFFICIENCY.

FULL RATED CANDLE POWER.

Users pronounce them the best in the market. Try them and be convinced of their superior quality.
All Candle Powers. Bases to fit all standard Sockets.

Special Railway Lamps. Satisfaction Guaranteed.



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Of Best Quality, Standard Styles.

PRICE OF SOCKETS:
In small lots.....25 cents each net.
Lots of 100.....23 cents each net.
Lots of 500.....22 cents each net.

WRITE FOR PRICES.

The Columbia Incandescent Lamp Co.,

1912 and 1914 Olive St., ST. LOUIS, MO.

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STANLEY TRANSFORMERS.

WE ARE CONSTANTLY ADDING

NEW FEATURES

OF GREAT VALUE TO STATIONS.

150 light and **200** light transformers adopted for **OUT-DOOR USE**

THE SAME AS THE SMALLER SIZES.

THESE TRANSFORMERS ARE REMARKABLE FOR

HIGH EFFICIENCY AND LOW LEAKAGE.

Correspondence Solicited.

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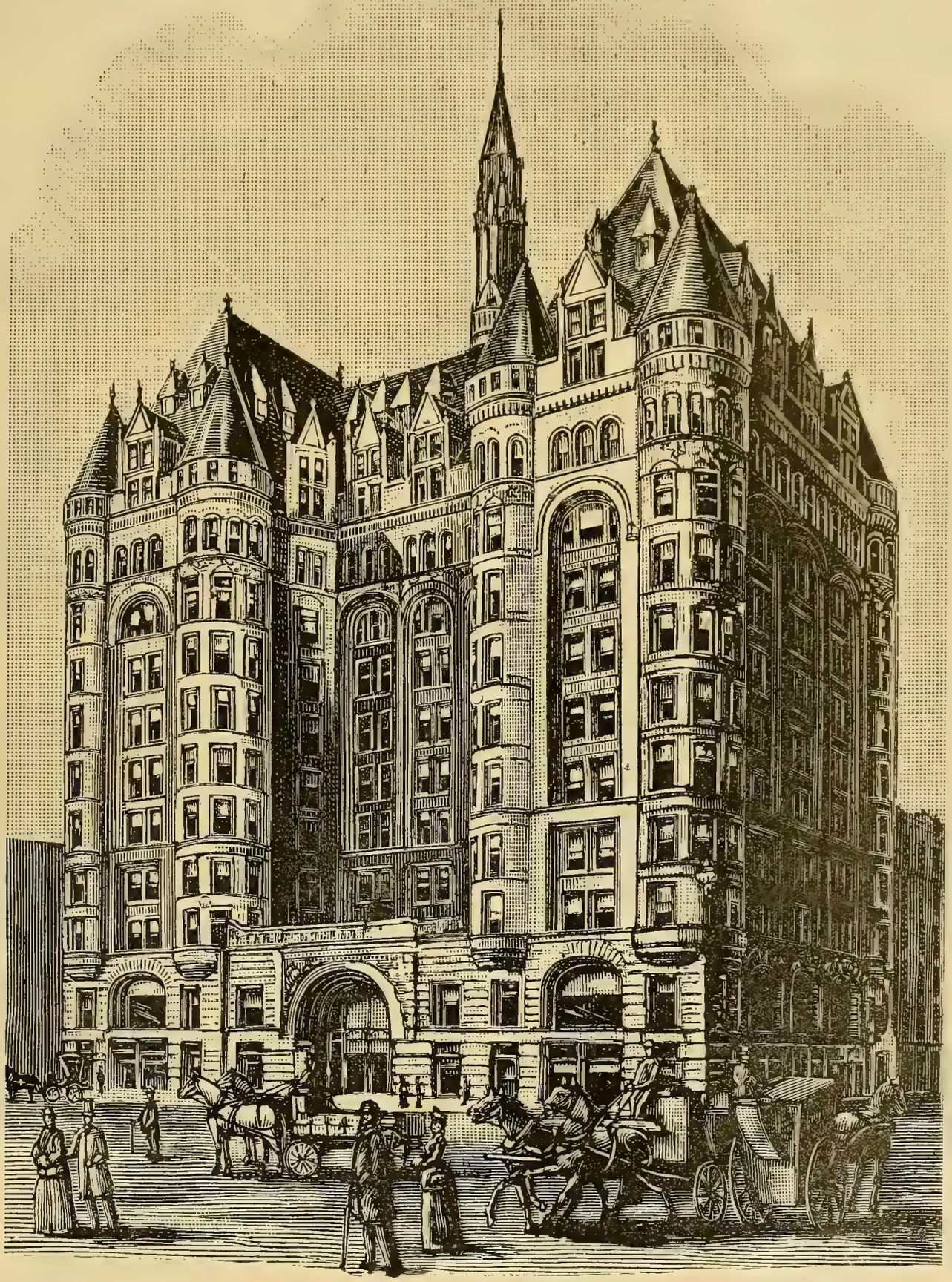
Randolph St. and Michigan Ave., CHICAGO, ILL.



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The Women's Christian Temperance Union Building, Chicago.

This Building is Wired Throughout With Kerite Wire.

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SAFEST! BEST! CHEAPEST!

Incombustible Appliances.

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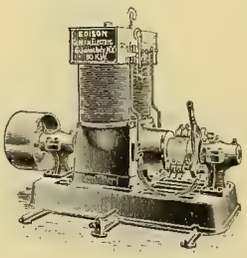

Artistic Fixtures.

MOTORS.

BEST ILLUMINANT. LONGEST LIFE.

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SAFETY DEVICES.

WIRE, CABLES.

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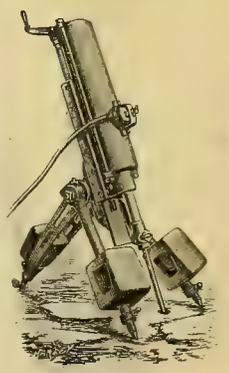

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"REGENT" Double Core, Rubber Covered WIRES AND CABLES.

SEND FOR SAMPLES AND PRICES.

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ANY BASE, ANY VOLTAGE.

A strictly high-grade lamp, giving FULL CANDLE POWER throughout its life. HIGH EFFICIENCY and LONG LIFE commensurate with its other qualities.

SEND A TRIAL ORDER FOR A FEW DOZEN.

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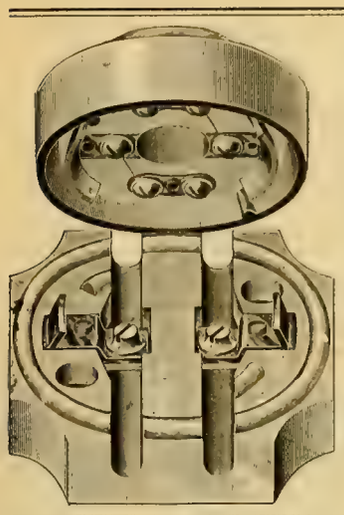

THE DOVETAIL CEILING CUT-OUT.

Accidental disjunction impossible. Broad contacts.
The cap is adjusted without the use of screw driver.

No. 101	For Cleat Work.	Round Base.
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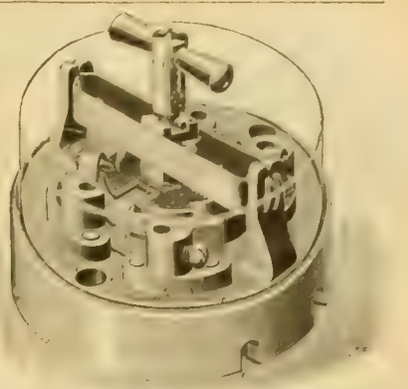
" 106	For Moulding Work.	See Cut.



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5 & 10 Amp. Ratchet, Single Pole.
10 to 150 Amp. Double Pole. See Cut.
3 Way Switch.
4 " Series Switch.

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THE PERKINS ELECTRIC SWITCH MFG. CO.,

P. O. BOX 816. HARTFORD, CONN.

FOR SALE CHEAP!!!

Five 240 Ampere compound wound T.H. Incandescent Dynamos, 110 Volt.
Two 2,000-light 2,000 c. p. American Arc Light Dynamos.
One 50-light 2,000 c. p. Sperry Arc Light Dynamo.
600 Goose Necks, T.H. municipal sockets complete.
One 10-light Weston Arc Machine and Double Lamps.
Three 500-light, 120 volt Edison Dynamos, Modern Pattern, used 2 years.
One 600-light T.H. Alternator Complete.
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Thirty 2,000 c. p. American Double Lamps.
Forty 2,000 c. p. American Single Lamps.
One 150 h. p. Buckeye Engine, high speed.
Automatic and Corliss Engines and Boilers.

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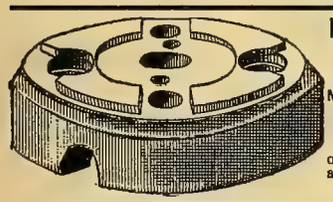

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MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

HARVARD UNIVERSITY.

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During the summer of 1892, courses of instruction will be given as follows:

Chemistry, four courses, viz.: Fundamental Principles of Chemistry; Qualitative Analysis; Quantitative Analysis; Organic Chemistry.
Botany, two courses, viz: Vegetable Morphology and Physiology, and Microscopical Anatomy of Phaenogams; Cryptogamic Botany.
Physics, two courses.
Geology, three courses.
Engineering, three courses, viz.: Topographical Surveying; Railway Surveying; Electrical Engineering; Mechanical Drawing.
Physical Culture, two courses.
Physiology and Hygiene.
American History.
Socialism and Social Problems.
Trigonometry.
Horticulture.
English.
German, two courses.
French, two courses.
History and Art of Teaching.
Elocution.
Courses at the Medical School.

Circulars descriptive of these courses and other information may be obtained on application to the *Secretary of Harvard University, Cambridge, Mass.*

In addition to the above mentioned courses, lectures on methods of instruction will be given by teachers in the several departments represented by the schools. These lectures will be open, without charge, to the persons who are enrolled as members of any of the summer schools in the University.

In general these courses are adapted to the needs of those who intend to be teachers in the several subjects. Several of the more elementary, however, are intended to meet the needs of beginners and may be taken by students in lieu of the corresponding courses in the College and the Lawrence Scientific School, and may be counted towards a degree.

During the session of the schools the College Library will be open from 9 A. M. till 5 P. M. The Museum of Comparative Zoology, the Peabody Museum, and the Mineralogical Collection are also accessible to students during the summer vacation.

In general the fees of the above mentioned courses, except those in Chemistry, Engineering, Physical Training, and Elocution, are $20 for each course.

Board and lodging may be obtained in Cambridge during the summer vacation at a cost of from $5 to $10 per week.

LAWRENCE SCIENTIFIC SCHOOL.

This school, which is under the control of the Faculty of Arts and Sciences of Harvard University, offers seven courses of study leading to the degree of Bachelor of Science, viz;

I. *Civil Engineering.*
II. *Chemistry.*
III. *Geology.*
IV. *Biology.*
V. *Electrical Engineering.*
VI. *General Course in Science.*
VII. *Anatomy, Physiology, and Physical Culture.*

The last named course is especially designed for those who intend to study medicine, or to teach physical training. For further information address

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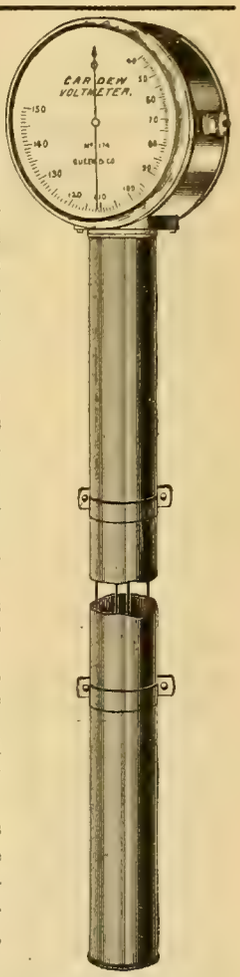
THE CARDEW PATENT STANDARD VOLTMETER.



We have recently acquired the American Patents which cover this celebrated instrument, and beg to recommend it as a voltmeter without an equal for switch-board use. Extensive preparations have been made in our factory and laboratory for the production of these voltmeters, and we now make Cardews in the best manner possible, as regards mechanical workmanship, and calibrate them to the most accurate degree. The characteristics of the Cardew Voltmeter, and which, ***collectively***, are possessed by no other instrument, are:

1st—The needle is dead-beat, indicating instantly the voltage to be measured.
2d—The scale is direct reading for both alternating and continuous currents.
3d—The instrument contains no permanent magnets or other parts liable to change, so that it does not require re-calibration.
4th—There is no appreciable change due to heating, hence the instrument is accurate when left constantly in circuit.
5th—The indications are strictly accurate and correct within one per cent. under all conditions.

The attention of Central Station Managers and Dynamo Builders is especially drawn to the unequaled merits of this standard voltmeter. Correspondence is solicited, and our illustrated catalogue No. I-66 will be mailed upon application, to intending purchasers.

QUEEN & CO., Philadelphia.

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FRANKLIN S. CARTER. CHARLES M. WILKINS. E. WARD WILKINS.

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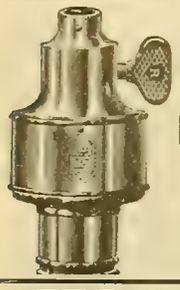

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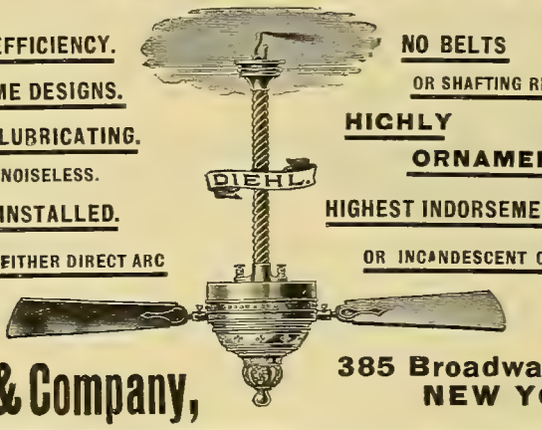

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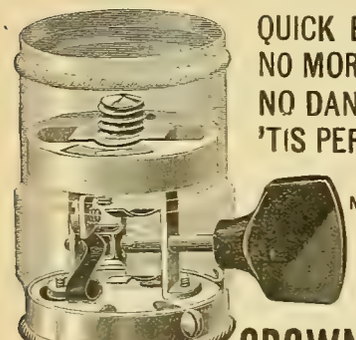

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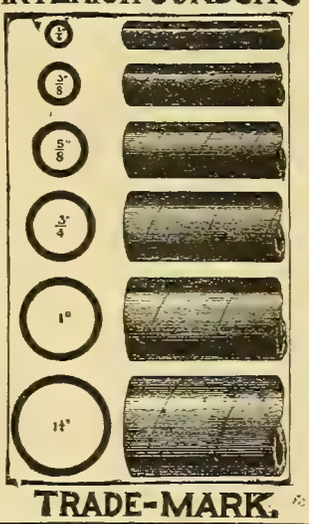

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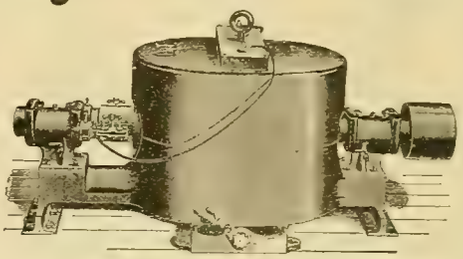

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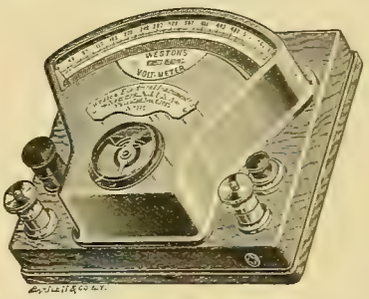

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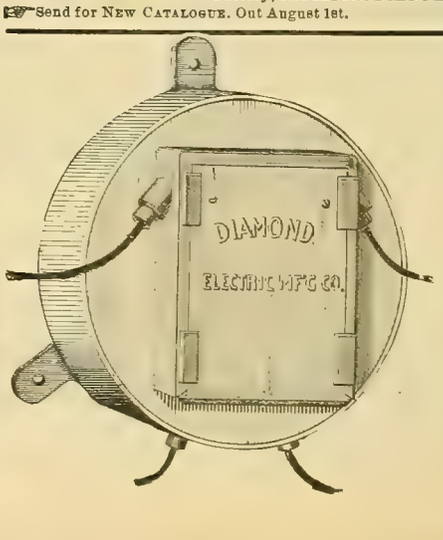

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Vol. X. CHICAGO, MARCH 26, 1892. No. 13

Swindling with a Bogus Ticker in a Chicago Bucket Shop.

One of the most audacious swindles that has yet been perpetrated on the confiding Chicagoan who now and then "takes a little flyer" in stocks in the secluded confines of the numerous alley stock "exchanges," or, as the vulgar call them, bucket shops, has just been unearthed in the World's Fair city. The scheme, by reason of its boldness and the clever, yet simple, manner in which the "brokers" utilised a few bits of electrical apparatus to further their deception, was of a character that should entitle the originator to a prominent position, at least, in the machinery department at Joliet. An account of the manner in which the case was worked up by Detective P. C. Dick for Prosecuting Attorney Stephen A. Douglas will be of interest.

A few days ago a visitor to Attorney Douglas' office dropped a careless remark to the effect that there was running, within the shadow of the city hall, a bogus stock ticker that was proving itself a most efficient money maker, at least in so far as the "broker" was concerned. Although, perhaps, not intended for him, Attorney Douglas took the hint, and forthwith detailed Detective Dick to investigate, at the same time giving him instructions to take plenty of time, and make no decided move until it was certain that sufficient evidence of a character to make a good case had been obtained.

The place in which the suspicious machine was supposed to be in operation was the new "Chicago Public Stock Exchange," in the old Brunswick billiard hall, 126 Washington street, and the thorough manner in which the exposé was accomplished on Thursday of last week, bears out Mr. Douglas' theory that the day is past when, as he expressed it in speaking of the case, "the knock 'em down and drag 'em in detective" can be of much use in the finer class of detective service.

In order to make a good case against the swindlers, and one that would bear the severe test of the courts, the detective had not only to make the raid and confiscate the swindling paraphernalia, but he had likewise, in order to be able to give valuable testimony, to post himself most thoroughly as to the details of the construction and the working of what, to a novice in electrical work, was, of course, intricate machinery. All this had to be done, too, in such a manner as to excite no suspicion.

After Detective Dick had spent several dollars in a vain effort to win the favor of Dame Fortune, as impersonated in a certain "mining ticker" in the "exchange," he became imbued with the idea that it was through the "mining" quotations that the concern made its handsomest profits. This particular "ticker," then, received his closest attention, and he soon saw enough of its working to convince him that the apparatus furnishing the figures on mining stocks was controlled by the operator at the tape; in other words, was "fixed" in such a way that the quotations might be delivered to the "suckers" just as the exchange "brokers" saw fit.

All that had been learned concerning the "mining" ticker was now reported to headquarters, and on Thursday of last week the request was made that Detective Dick be furnished a detail of men to raid the place.

On investigation it was found that the previous conclusions had been correct. All the tickers except the one furnishing the quotations for mining stock were found to be genuine stock tickers. But there was a revelation when the police turned their attention to the "mining" ticker. What already printed upon it, as shown in Fig. 2, was hidden from view in a flat metal tube until it passed out between the two brass rollers. In order that the machine should make its accustomed clicking noise, the battery, shown in the base of the stand, was attached to the electro-magnet in the ticker proper, and so connected that it would make the necessary noise, and at the same time be controlled by the little switch in the top of the stand. On the outside of the stand there will be seen a bunch of spools. These contained resistance to regulate the small Edison motor moving the tape. From the above it will be understood that through the little switch at the base of the ticker, and the other switch at the resistance-spool on the side, the operator, whose position was at the tape, had both the movement of the tape and the clicking noise of the apparatus absolutely under his control, so that they could be regulated to a nicety, and made to work in every way similar to the genuine tickers. In the "Exchange" this instrument was set up behind an inclosure, but was within full view of the speculators.

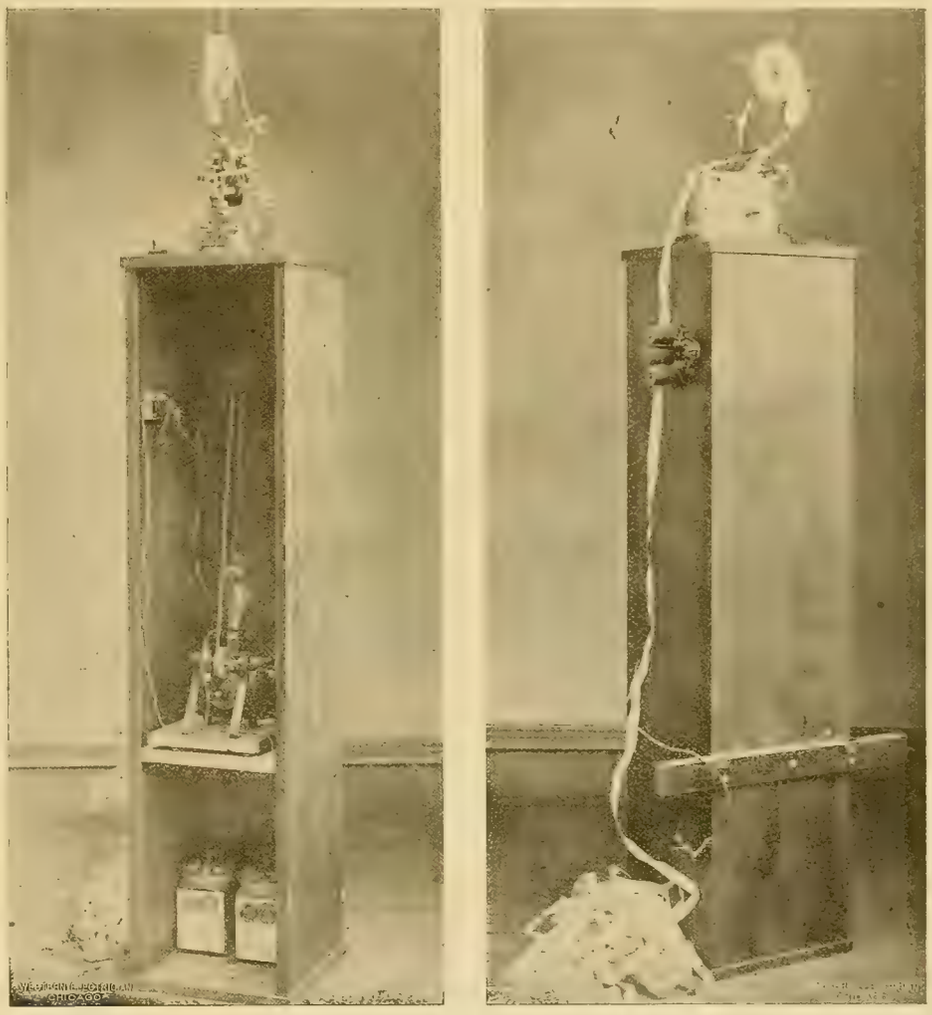


FIG. 1. SWINDLING WITH A BOGUS TICKER IN A CHICAGO BUCKET SHOP.

was laid bare can best be appreciated after an inspection of the accompanying cuts of the confiscated machine, taken from photographs obtained through the courtesy of Superintendent McClaughry.

In Fig. 1 is given a front and back view of the bogus ticker on its stand. Fig. 2 is an enlarged view of the ticker, showing the printed tape on the reel before it reaches the rollers of the machine, at which point it is supposed to receive the impression of the type. Fig. 3 is a diagram showing the electrical connections.

To anyone familiar with electrical machinery the entire outfit will be understood at a glance. There was not the least connection with any outside wires, and the tape, printed on a typewriter, perhaps days before, was made to run off the roller by means of the small motor and worm gearing concealed in the base of the box, and driven by current from the house-lighting wires. The tape, with quotations

The Next Electric Light Convention.

President James I. Ayer of the National Electric Light association has already begun to make extensive preparations to entertain the delegates to the annual convention of the association, which meets in St. Louis next February. Isaac Taylor, the architect who has charge of the building of the new Mercantile club house at Sixth and Locust streets, has promised to complete the building by February in order that the convention can meet there. The faculty of Washington University, the Mercantile club, St. Louis, Engineers' club, and the Merchants' Exchange will heartily co operate in entertaining the delegates. President Ayer has received a letter from E. R. Weeks, general manager of the Kansas City Electric Light company, instructing Mr. Ayer to call upon him for any assistance he may be able to render in making the convention a success. There will be about 300 delegates present.

Storage Battery Litigation.

Judge Green, of the United States Court for the District of New Jersey, handed down a decision, on March 18th in the case of the Brush Electric company and the Consolidated Electric Storage company against the Accumulator company, favorable to the complainants. It will be remembered that the complainants obtained a perpetual injunction last December against the Electrical Accumulator company of New York, which was succeeded nearly two years ago by the Accumulator company, incorporated in New Jersey. The complainants were, therefore, compelled to go before the United States Circuit Court in New Jersey in order to obtain an injunction against the Accumulator company. This injunction was issued last Saturday.

Cedar Rapids and Marion Electric Street Railway.

The accompanying views show respectively the interior of the power station of the Cedar Rapids & Marion Street Railway company, and the overhead center pole construction along First avenue in Cedar Rapids.

In constructing this road neither pains nor expense was spared to make it as perfect as possible, and a letter recently received from the company seems to bear out this statement. "Cars have been run," writes Secretary John S. Ely, "for three months, and the wear and tear of operation has been a very small item, far less than what reports received from other lines led us to expect. This we place largely to the credit of a substantial road bed and track, and to the quantity and quality of copper used, especially in the feeder wires."

The power station is of brick, 70x70 feet, with a 50x50 foot boiler room attached. The car house is 80x140 feet, and in it there are six tracks. Three of the tracks have pits each 100 feet long, making it an easy matter to clean the motors. The power house has high ceilings, is well lighted, and is thoroughly equipped with appliances for repairing and cleaning the cars.

The steam power equipment consists of three horizontal tubular boilers, 16 by 5 feet. The boilers supply two 14 by 42 inch Corliss condensing engines.

As will be seen from the cut of the interior of the power station, Fig. 1, two Thomson-Houston quadrupolar generators supply the line current. Each of the two generators has a capacity of 80,000 watts.

As to the overhead electrical construction, iron center poles made by the Walworth Manufacturing company are used in the business section of the town. Wherever there is side construction, cedar poles 7 inches at the top and 30 feet long are used. The trolley wire is of "0" copper. On the Marion line there are fourteen miles of overhead conductor. Twenty miles of "000" insulated copper wire is used for feeders, and holds the voltage to within 10 per cent. loss at the most distant point, 6½ miles from the power station. The road is double tracked 1½ miles from Sixteenth street east to Second street west. This section of the overhead construction is all hung from iron center poles. Fifty-eight pound girder rails are laid on this portion of the road, and the street is paved the entire distance excepting two blocks.

In addition to the 1½ miles of double tracked line there are 11 miles of single track. Six miles of the 11 are equipped with the cross suspension system, and 5 miles of the line has the side bracket construction. Forty-five pound steel rails are used on the single track. The rails were furnished by the Illinois Steel company. The gauge of the road is four feet, eight and a half inches. The rails are bonded with "0" copper wire, and are cross connected at intervals of 90 feet. The maximum grade on the road is 6 per cent.

At the present time there are running on the line 13 cars all of which were built by the St. Louis Car company, and are fitted with McGuire trucks. Three of the cars, Fig. 2, are 34 feet in length, and are each equipped with two 25 horse power Thomson-Houston waterproof motors. There are seven 16 foot cars, and three 12 foot cars, each carrying one 15 horse power single reduction motor. A number of open and trailer cars are also in use.

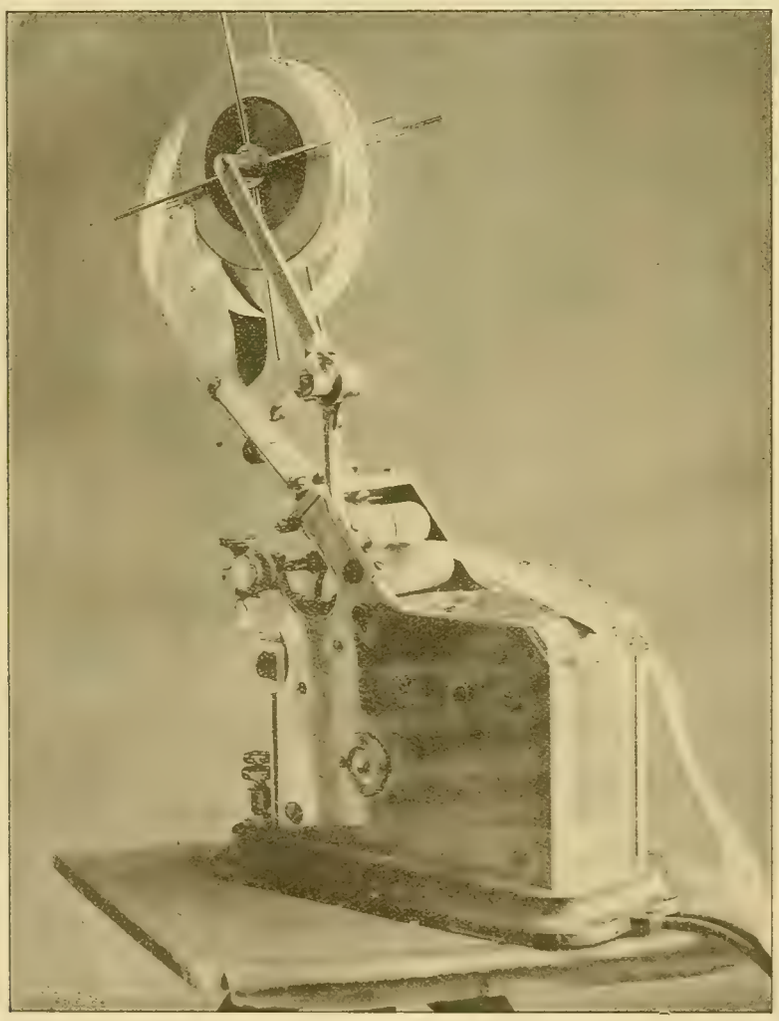


FIG. 2. SWINDLING WITH A BOGUS TICKER IN A CHICAGO BUCKET SHOP.

High Potential Transmission.

By Elihu Thomson.

The electrical engineer, when he has before him the problem of conveying electrical energy through comparatively great distances, without excessive loss and without excessive amounts of copper in the conductors, is compelled to consider the use of high potentials.

Of course, potentials are high or low relatively to others taken as standards, but by a sort of common consent it has come to be regarded that, when the electro motive force is sufficient to cause the current to leap, or when there is a striking distance which is easily perceptible, the case may properly be called "high potential."

It implies the existence of thousands of volts potential difference. The strain on the dielectric or insulating material is such that a high insulation resistance is demanded to prevent large leakage. The current passes at a "high tension," or is a "high tension" current.

The time at the author's disposal will not permit more than a brief reference to different combinations of apparatus in which high potentials may be effectively employed.

Let it be desired to transmit several thousand horse power from a water power to a distance of, say, twenty miles or more, and deliver it at one point as power. What

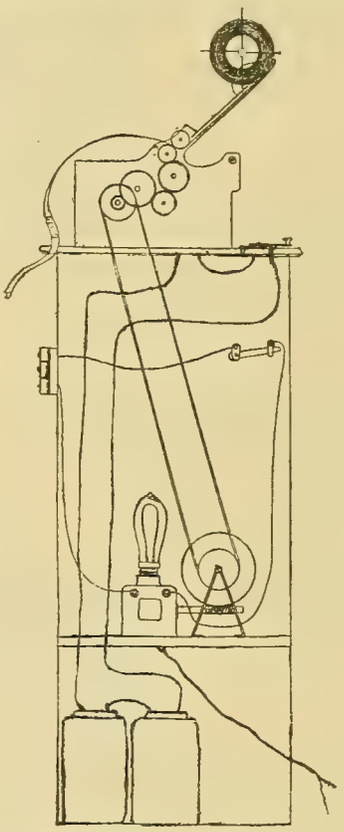


FIG 3. SWINDLING WITH A BOGUS TICKER IN A CHICAGO BUCKET SHOP.

plant should we use? Direct current or alternating current?

Owing to the difficulty of constructing commutators which are suitable for such high potentials as five thousand volts, especially where the current is large, it is evident that neither dynamos nor motors can be used in which the full potential is either generated or used. This assumes the use of a direct or continuous current as the means of transmission. In such case, either the voltage must be kept down to, say, 1,500 to 2,000 volts, or the dynamos and motors must be run in series sets.

It is questionable whether commutators can be commercially successful on which the pressure exceeds 1,500 to 2,000 volts, with large currents flowing. They are very difficult to construct and to maintain. Besides they require to have so many segments between the brushes that the armature winding and connecting is made more delicate and liable to injury. The cost of construction becomes excessive. When the voltage does not exceed 1,000 volts these difficulties do not present themselves. Hence to use continuous currents in the case assumed and to take advantage of a high line potential to secure immunity from line losses and allow a moderate outlay in copper to suffice for the transmission, it will be necessary to connect several dynamos in series in the generating station and several motors in series at the receiving station. These machines may be belted to a common shaft. With this arrangement it would be possible, by mounting the machines on insulating bases, to work with such high potentials as 20,000 volts by having twenty machines of 1,000 volts each, connected in series at each end of the line. This with each machine of 500,000 watts output would transfer energy at the rate of 16,000 horse power.

The machines, both generators and motors, could be series wound and be practically self regulating as to speed under varying loads, providing all the machines are mechanically driven together as one or deliver power together. The construction presents no great difficulties and the efficiency under all loads, except quite light loads, could be made high. But the condition of combined driving, and delivery of power, destroys much of the attractiveness of such a system. Considerable portions of the plant could not be thrown off without destroying the conditions.

There is no method of transformation for direct currents which would not involve the commutator difficulty. It is evident that we must look to alternating currents as a means of transmission at high potentials.

For large transmissions it in evident that the system adopted should permit the construction of dynamos of as

large capacity as 1,000 horse power, so as not to multiply machines to too great an extent. It is also requisite that the construction be such that parts are readily accessible and easy to repair in case of accident.

In the employment of alternating currents we have choice of various ways of working.

It is probably not easily practicable to construct alternating dynamos or motors to make use of currents at over 3,000 or 4,000 volts without transformation. It would appear, then, that if the distance is great enough to compel the use of currents at higher pressures than three or four thousand volts, transformation will become necessary; in which case the voltage of the generating dynamos and of the receiving machines can be as low as desired.

But the interposition of a set of transformers for raising the potential at the generator end and another set for lowering it at the receiving end, is an added expense for plant which must be balanced against saving of cost of construction of the machines and line. The precentage of loss involved in the use of transformers, due to losses incurred in the transformation, is not necessarily so great as to be serious. It can probably be brought down to about 5 to 6 per cent. under full load for the double transformation.

In the transmission of power by such a method the losses, then, are those of the line, the double transformation and the dynamos and motors. The total loss need not exceed 25 per cent. under full load condition.

If the transmission is for lighting, and the transformation down at the receiving end is made to give the voltage required for the lamps, the motor losses would be supplanted by losses on the local mains, or local distribution. If motors be run from such lines, losses are of course increased by the drop in reaching them, depending on their distance from the transformers which feed current to them. It will sometimes be found practically impossible to transform down directly to lamp potential from the high potential of transmission. This is the case when it is not permissible to carry the high potential lines to transformers placed here and there in a city. In such cases an intermediate transformation may be resorted to, but it, of course, involves more cost of plant and another three per cent. loss or thereabouts. Dear fuel and very abundant water power may sometimes warrant such procedures.

In all such cases of cumulative drop, difficulties arise from the fall of potential under load, and adjusting devices at the transformers or on the lines may require to be employed.

Fortunately, variations in the voltage may, with alternating currents, be effected by the use of variable reactive coils instead of resistances, and regulation may be obtained with fair economy. As regards the single phase alternating currents, involving the use of but two lines, which is the system commonly used, nothing more is required for such work as lighting, and it is to be hoped that self-starting effective motors may be forthcoming for use on such systems. Progress has certainly been made toward securing such motors, and a year or two hence we may find many in active service on existing lines.

For power transmission a reversed alternating dynamo, if of a good type, is also a good motor when brought to synchronism, and it has the advantage of maintaining a speed as regular and constant as the speed of the generators at the other end of the line, but it has also the serious disadvantage of requiring to be brought up to full speed before it will work at all. It is essentially non-starting. Too much complication is introduced into the plant by the introduction of elaborate devices for starting. It has been proposed to start such motors by connection with a small, not necessarily very efficient, motor of the self-starting variety, of which there are several quite suitable for the purpose, working by alternating currents of single phase.

Where the power is to be delivered *en masse* at a receiving station it is possible that such methods of working may become important. Alternating dynamos are now constructed which, when even of moderate capacity, have a commercial efficiency of considerably over 90 per cent. and therefore approach, if not equal, the best types of continuous current apparatus. These machines, reversed and used as motors, may be expected to have an efficiency equal to their rendering as dynamos, and are easily made self-exciting.

Great interest has recently been excited from the use of the three-phase alternating current, or rotary current, in the Lauffen-Frankfurt transmission. This experiment, covering a distance of over a hundred miles, was successful, so far as the technical matters involved were concerned. It was not intended as an exemplification of a commercial transmission. It served its purpose in proving the possibility of working with alternating current of very high potentials, and also showed, in a striking manner, certain features of the multiphase system.

Let us assume that we have a station in which the dynamos are excited by a continuous current, and that the armatures are provided with a three branched conductor similar to a Thomson-Houston arc machine, but with three collector rings instead of the three commutator segments, three separate brushes bearing on the rings, or, if the field of the dynamo revolves, the connections are made directly to the stationary armature coils. The three wires may, in other cases, be connected to points in a continuous or Pacinotti winding, such that they are virtually taken at 120° apart in a bipolar machine, 60° in a four-pole, etc. In such cases we will have three lines leading from the generators, in which lines alternating currents may flow with the waves displaced relatively 120°, or in which, when any one current wave is at its maximum, the two others are

FIG. 2. CEDAR RAPIDS AND MARION ELECTRIC STREET RAILWAY.

nearly at their mean value one rising, and the other falling. This has been called a "rotary current" abroad, but it is no more rotary than any current is. In fact, it is no more rotary, as a current, than is steam which is fed by three steam-pipes to three cylinders of an engine, in which the cranks are set 120° apart around the shaft. It is true that such currents are capable of producing a rotary magnetic field, just as is a two-phase system, but a rotary field is also produced by the rotation of a set of brushes around a commutator attached to an armature of the ordinary continuous current type, such a current being passed in by the brushes.

By the use of transformers, the three-phase alternating currents can be transformed up or down, as with a single-phase current. Specially constructed transformers permit a combination of the magnetic circuits of such transformers in a manner to form, as it were, a triplicate transformer, having certain advantages, which will not here be dealt with. It is evident, however, that the advantages of high potential transmission may be obtained in this system by transformation, while low or moderate potentials may exist at the dynamos and motors.

In the reconversion of energy of three phase currents back into power we have choice of two types of motor: first, reversed three-phase generator, which synchronizes in speed perfectly with the generator; second, the three phase non-synchronous motor, which changes in speed, or requires regulation for differences of load.

The former requires its field magnets to be excited with continuous currents, and will not necessarily start itself. It will, however, start along with the generator while the latter is starting, and if the fields of both be excited strongly and no great load be on the motor machine.

The machine is simply a three-phased dynamo reversed, current being delivered to the three connections of the three-branched armature conductor, and the field excited continuously, as in the dynamo.

The non-synchronous type of motor becomes, by proper proportioning, practically capable of maintaining a speed which does not vary over a few per cent. from light to full load; it requires no exciting current, and starts under load. In construction it is simply a structure in which the rotating field, set up by three currents of a three branched suitably-arranged conductor in a laminated iron mass, called the field, drags around a movable armature carrying a system of closed conductors, in which strong currents are set up by the moving lines from the field, which acts to close its magnetic circuit through the armature iron. Thus the rotating bundles of magnetic lines, in cutting the armature conductor, push such conductor along by virtue of the reaction of the opposing currents set up in the armature conductors or closed circuit. Such motors, not being reversed dynamos, cannot act to generate current if revolved by power. Their great advantage is that they may be placed anywhere where convenient to receive current from the mains direct or from transformers, they may be started or stopped at will, and have no commutators. That they may be made quite efficient is evident; that is only a question of proper designing. Both forms of motors mentioned for three-phase currents will doubtless have their uses. While lights may be run from three-phase current systems by transformers, or directly from the mains if the potential be proper, such systems possess no peculiar advantages over the single-phase systems except that in the generation of three-phase currents a smoother action of the dynamo is obtained, and probably, therefore, a slightly increased economy, or perhaps a little greater output.

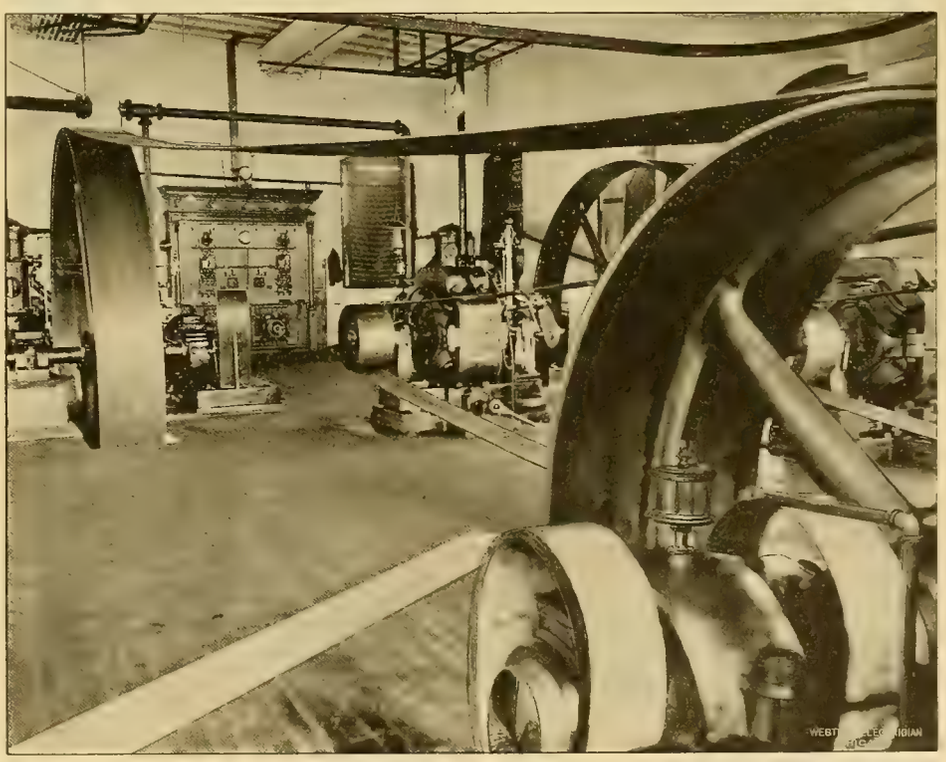


FIG. 1. CEDAR RAPIDS AND MARION ELECTRIC STREET RAILWAY.

There is another important way in which the three-phase currents may be utilized at the receiving end. They may readily be transformed into continuous currents of low potential or of any potential practicable for commutation. The means for transformation in this case is a motor generator of special construction. It possesses an armature winding and connections suitable for three-phase currents, a field magnet system excited by continuous cur-

rents from any suitable source and acting on the armature, a secondary winding on the armature, or the same winding as that connected to the three-phase mains, with the usual numerous connections to the segments of a continuous current commutator, upon which brushes suitably adjusted take off continuous currents. These may be used for lighting, for running continuous current motors, etc. Motor generators giving 500 volts continuous current, 220 volts, and 110 volts, are easily worked from the same system of three-phase mains. The excitation of these machines may be obtained from their own commuted currents, they are self-propelling after having been started along with the generating plant, or may easily be brought to speed before connecting with the three-phase supply by continuous current from another machine in work. They can be compounded for drop of potential in themselves and the lines leading to and from them.

The future supply of electricity in a large city, for all purposes, at any desired voltage of continuous or alternating current, would seem to involve a system about as follows:

A generating station conveniently located for obtaining water for condensing, cheap fuel delivery, and ready disposal of ashes, containing huge triple compound condensing engines driving large dynamos, delivering either directly or through transformation upward high potential three-phase currents; a system of high potential mains for three-phase currents, probably consisting of sets of three conductors with a heavy open braid or net work covering, tightly woven on, and drawn into an iron pipe filled with insulating oil placed underground to avoid atmospheric disturbances; sub-stations containing compounded three phase motor generators feeding into the street mains at the desired potential for lights and continuous current motors; motor generators feeding currents of suitable potential for street car propulsion; alternating current transformers delivering currents of alternating character at desired voltage for lighting, and for driving commutator-less three-phase motors.

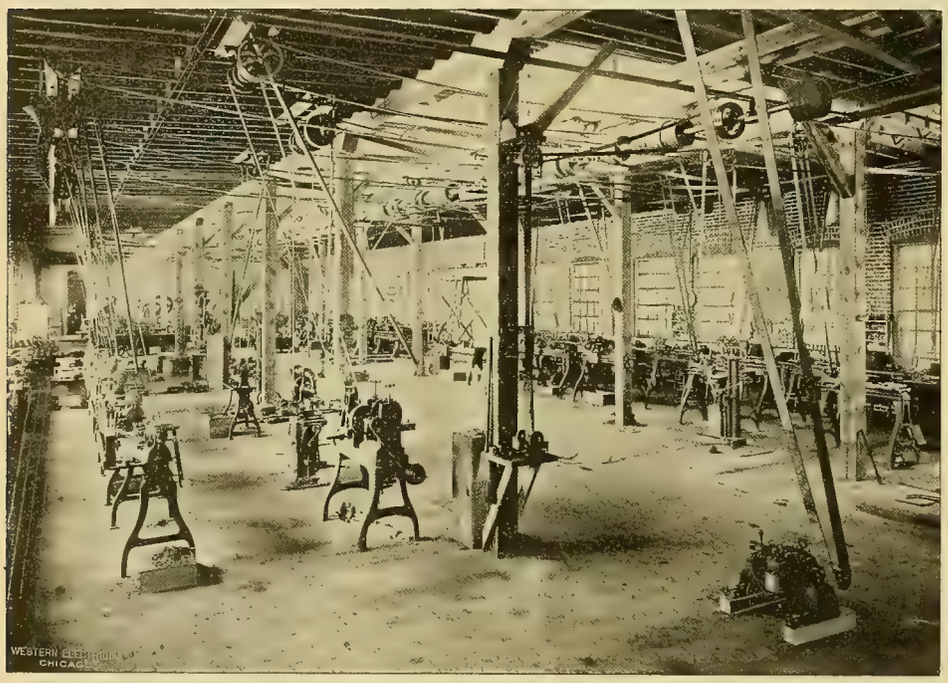
There is no electrical service which could not receive its supply from such a system. The time is perhaps not quite ripe for such a comprehensive scheme, but its advantages are obvious to those familiar with the present conditions of supply in large cities.

Time has not permitted the extension of this paper to cover matters of detail, however interesting, and an attempt has simply been made to review in a brief manner the salient points of several systems involving high potential transmission.

The purpose of the paper has not been to present any of the history of the growth or development of these various systems touched upon, nor to enter into any of the refinements of theory or practice with such systems, a proper consideration of which question would be very lengthy and consume more time than is at our disposal.

The question may be asked, What are the highest potentials which can ever be made available in electric transmission. Any answer given will necessarily imply foretelling the future practice, a very hazardous thing to attempt. Such answer, may, however, be taken to relate to either a single-phase alternating system or a multiphase, the only difference being in the number of conductors employed. In fact, it is conceivable that the number of conductors in a single phase system be reduced to one central conductor surrounded by a tube or by several conductors all enclosed and insulated from a surrounding pipe. Let the pipe be filled with oil and the conductors be separated by being wound with an absorbent net of dry cotton, and let the covering of oil extend over the conductors and be unbroken, practically, over the whole of the high potential conductor, including the fine coils of the transformers at each end of the line and we have a system in which the employment of very high potentials may become quite feasible. If we provide in the thickness of our oil insulation a sufficient margin of safety from puncture, and so calculate our line that its self induction and capacity compensate for one another's effects, it would seem that there would be no difficulty from leakage, or from Ferranti effects, as they are called. The condenser effect of the Ferranti cables is large, while the self-inductive effects are small. Condenser action tends to accelerate the phase at the dynamo and self-induction retards or lags the phase of the currents, and it would seem that by distributing the capacities and self-inductions properly the normal phase without either acceleration or lag could be maintained.

A layer of good insulating oil one inch thick between rounded smooth metal surfaces will equal in resistance to puncturing a potential which will cause a spark in air over thirty inches long. At least the author's tests on this subject point to an approximate relation of 1 to 35 or 40 in dielectric strength between air and good heavy paraffine oil. As nearly as can be estimated, a spark between rounded surfaces at thirty inches in air, represents not less than 500,000 volts and the author's experiments go to show that such potentials can be "kept down," so to speak, in a bath of oil. Whether the condenser effects of a long line would introduce serious difficulties it is impossible to say, but provided that the rate of alternation or periodicity be kept low and the insulation maintained by covering every inch of the high pressure conductors in, say, two inches thick of oil, it might even be possible to work with 500,000 volts. Allowing a loss of only 10 per cent. or 50,000 volts with a double conductor conveying 200 amperes, each conductor having about $\frac{1}{12}$ of a square inch section, a distance of about 240 miles would be covered and the energy carried would be 100,000,000 watts or over 130,000 horse power. These are striking figures and are only given by way of illustration. They may never be needed to be used in practice, yet the difficulties of realization are less than at first appears, the condenser action of the line being the most serious matter to be dealt with. Such a line is even safer, so far as life risks are concerned, than an overhead line of much less pressure. In fact it may be said to be practically safe. Any interference with the line is difficult on account of the pipe enclosing it, and on the first weakening of the insulation or before a break in the pipe became complete, a short circuit of a moderate current would ake place and the fuses be blown at the ends of the line.



DETROIT MOTOR COMPANY'S SHOPS.

Pipe lines are laid for the conveyance of oil,—why should they not be laid for the conveyance of electric energy where it can be done economically? Looked at from the standpoint of very high potentials, Niagara may be said to be gradually approaching the surrounding cities.

Detroit Motor Company's Shops.

The progress of the electrical work can best be illustrated by the rapid and steady growth of the numerous manufacturing concerns which have sprung up during the last ten years, and which are devoted to electric machine making. One of the most promising of these concerns is the Detroit Motor company, which was established in 1886, and which to-day occupies a leading position in this line. At the inception of this company it occupied small quarters at 47 Rowland street, Detroit, but after a time required larger quarters, and removed to 212 Griswold street. The growth of the business again required a change, and it was determined to erect a building. This was done in 1890, and in September of that year the works at the Michigan Central railroad crossing of Cass avenue were completed, and the company at once took possession. Many changes have since been required, as the business developed, and to-day the company has a well equipped factory in which eighty men are permanently employed. A view of one of the rooms in this factory is herewith presented. The building is 100 feet long, and 300 feet deep. The company has pushed its business in all parts of the country, and to-day it has 100 agencies established in the principal cities of the country. The present executive officers of the company are: Hon. Wm. C. Maybury, president; J. Huff Jones, vice-president; B. P. Van Court, general manager; F. A. Blades, secretary and treasurer.

A Proposed System of Alternating-direct Current Transformation.

At a meeting of the American Institute of Electrical Engineers on February 16th, a paper by Lieut. F. Jarvis Patten was read on "A Proposed System of Alternating-direct Current Transformation." This paper was published in the WESTERN ELECTRICIAN of March 12th. In the discussion which followed Dr. M. I. Pupin described a machine he had constructed for the transformation of alternating polyphasal currents. He said in the course of his remarks:

"If we have two armatures—ring armatures, say—and we send a three-phase current through the coils of one armature, we create a rotating field. Now, say that between the outside and the inside armature there is a piece of iron which has a small magnetic resistance in one direction—serves as it were, to bridge over the lines of force from the outside armature to the inside; and if this iron bridge, as I may call it, is rigidly attached to a shaft which carries brushes, the result will be that if the inside armature is stationary and the outside armature is stationary and the field rotates, that it will carry this iron piece with it, and with the iron piece it will carry the brushes, and therefore if the inside armature is connected to a commutator we shall be able, as soon as the brushes are in synchronism with the rotating field, to take off the direct current from the commutator.

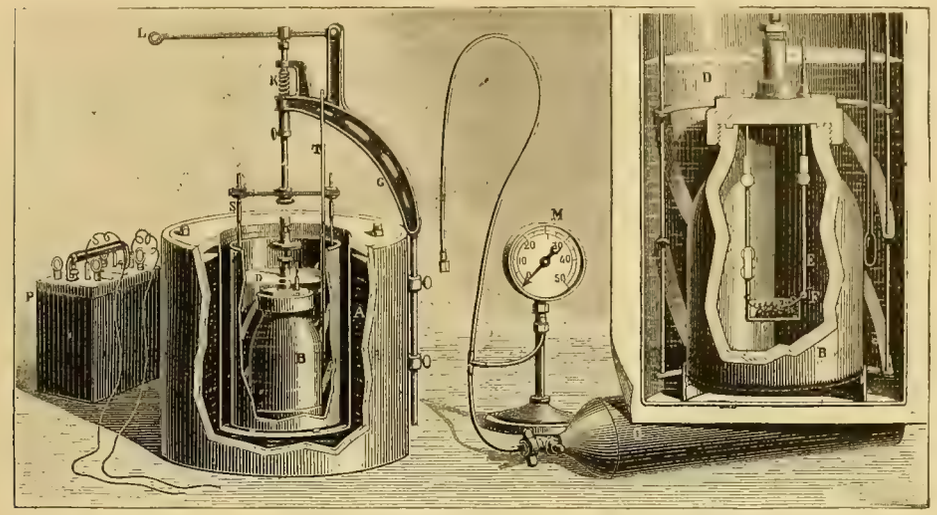
"It is understood, of course, that the brush-carrying iron bridge must be provided with a reaction coil which will start it and bring it into synchronism with the rotating field.

"The arrangement can be also made to have the outside and inside armature in contact and provide a small three-phase motor to carry the brushes and bring them into synchronism with the rotating field. The three-phase motor will be capble of getting into synchronism with the rotating field if the reluctance of its armature is very small in one particular direction as compared to its reluctance in any other direction.

"I would like to call attention to an experiment made some years ago by Prof. Braun, of the University of Tubingen (Braun, F., Deformationsstrome, Wiedemann's Annalen, vol. 37, p. 97, 107; vol. 38, p. 53; vol. 39, p. 130). He found that a wire made of a magnetizable substance, when twisted one way, would generate an electromotive force acting in one direction, and if twisted the opposite way would produce an electromotive force acting in the opposite direction. Prof. Rowland called my attention to a current interrupter constructed on the principle where a twisted wire is made to untwist by sending a current through it."

Prof. Elihu Thomson submitted the following interesting note: "The proposed system of Mr. Patten is based on the commutation of alternating currents. This appears to be the fundamental idea, out of which he develops his various figures and methods. These are very pretty in theory, but not very practicable, in my opinion. To commute an alternating current of any considerable potential is not practicable by means such as Mr. Patten shows. There would need to be an absolute fixedness of phase, and a theoretically perfect commutation. Neither of these is attainable in practice. Short circuits and burning at the commutators would be inevitable, except in small models. Even if the potential of the currents to be commutated is made low, the difficulties of commutation do not disappear, and much larger commutators would be needed. When Mr. Patten succeeds, practically, in commutating alternating currents representing, say, 10 to 20 horse power, by the plan shown in Figs. 1 and 2, the con-

sideration of his other plans or figures based thereon would seem to be in order. The difficulty is that electrical currents will not always do what has been marked out for them on paper, and Mr. Patten falls into the error of presenting as solutions of various problems and even emphasizing them in italics, merely diagrams on paper, which might represent actual conditions if the currents dealt with had only a small potential and at the same time small strength. In practice, the facts of self-induction and distortions, and the fact that a commutator of alternate positive and negative segments with brushes which ought to be exactly on the line between the segments when the current is zero is not a very easy thing to work, and keep in order, are rather against such systems as are proposed in the paper before us."



TO DETERMINE CALORIFIC POWER.

To Determine Calorific Power.

The apparatus illustrated in the cut was designed by Pierre Mahler for the determination of the heating power of combustibles. The work was undertaken by him under a commission from the French Society for the Encouragement of Industry. He attempted the design of a simple apparatus for determining calorific power because, as he stated, existing means were either inaccurate, too delicate and required too long time, or involved the use of too expensive apparatus.

As the vessel for holding the material to be burned Mahler uses a steel shell *B*. Surrounding it is the water of the calorimeter *D*. The space within the frame is filled with some substance which is a non-conductor of heat *A*. Within the shell, supported by a slight platinum wire, is the plate *C*, on which is placed the material to be burned. A second platinum wire *E* is connected to a battery.

The operation is very simple. The jar is removed from its position and a gramme of the substance to be tested is placed on the plate, and a small thread of iron wire *F* is attached to the end of *E*. The cover of the containing vessel is screwed down on a lead washer. The jar is then filled with oxygen from the reservoir *O*, and is placed in the calorimeter *D*. The thermometer, which reads in tenths of a degree, is placed in position, and a reading is taken. The circuit from the battery *P* is closed, and the combustible is ignited. The agitator *S* is worked slightly by the lever *L*, so that the heat coming from the jar is thoroughly distributed in the water. When the mercury has reached the highest point the reading is taken, and the mechanical work of the operation is finished. The reading is corrected in accordance with well-established rules. All the data necessary for the determination of the calorific power are now obtained.

The oxygen used is that furnished by a local company, and is generated by an electrolytic process. It is not chemically pure, so that an excess of the gas beyond the amount theoretically necessary for complete combustion is allowed to enter the jar. The cut is reproduced from *La Nature*.

Chicago Electric Club.

The electric railway motor was the subject taken up by the Chicago Electric club at the last meeting, Monday evening, March 21st. The entertainment took the form of a debate, in which Elmer A. Sperry advocated the use of 'One Motor for Car Equipment," while W. L R. Emmet championed "Two Motors for Car Equipment." A general discussion followed, in which Messrs. Arnold, Sullivan, Grier, Sperry and Perry participated. After the literary meeting the club voted that the chair appoint a committee of two to frame appropriate resolutions on the death of C. J. Van Depoele, and Messrs. Arnold and Sperry were the members named to act in the matter.

Electric Motors in Houses.

According to the Rochester *Post-Express* 3,000 people in the flour city utilize electric motors in making their living. Many of these people live in the outskirts of the town and do their work at their homes.

George Redman, superintendent of the Brush Electric company, is quoted as saying that so rapidly has the means recently adopted by the tailors of utilizing the electric current for sewing machines been taken advantage of that the Brush company has extended lines to 275 tailoring shops, nearly all of which are in the rooms of the owners' homes. This number includes several that have been adopted by seamstresses and workers on a small scale. The company has 800 motors in different parts of the city, varying from one-eighth to twenty-five horse power. A large number of them have been put in during the last year. There is quite a large demand for them among dressmakers, small printing offices, and dentists. Mr. Redman predicts that before another year has passed street cars and many small offices will be heated by electric currents. According to the same authority there are several new inventions utilizing the electric current that will soon be introduced in Rochester. In the company's offices can be seen a flat-iron invented during the last few months which is being tested for use in large laundries. The iron has a wire attached at the back for heating it, and it is estimated that the iron can be brought to the necessary temperature in this way twenty-five to thirty per cent. quicker than by the usual method. Near the iron stands a soldering iron, also being tested for use, and ranged about the rooms are the small sewing machines with motors attached.

A French Telegraph Story.

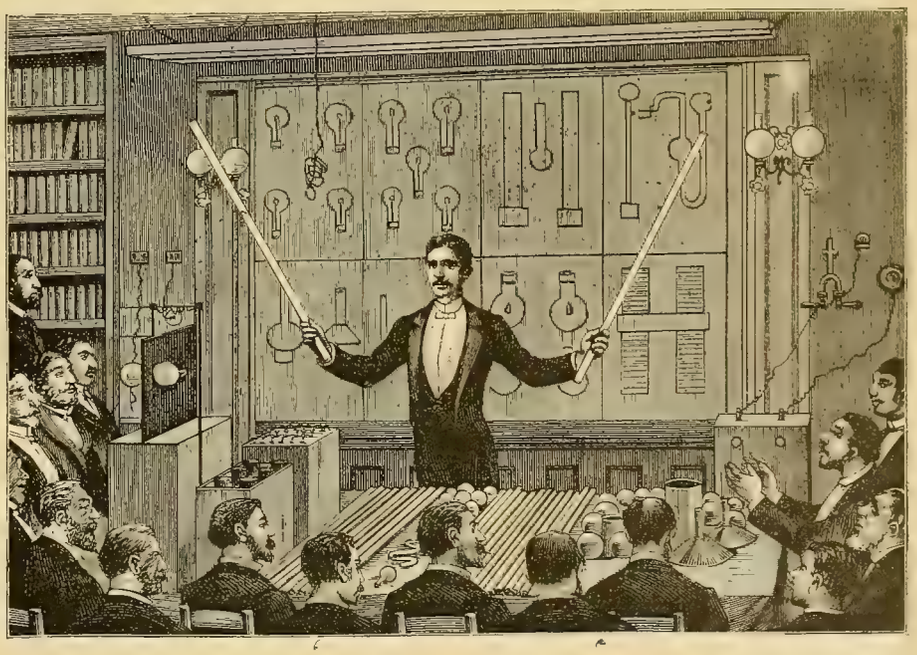
In the Franco-German war of 1870 the Uhlans played havoc with the French telegraph wires. On arriving at a village they would ride up to the telegraph office, cut out the connections, and carry off the apparatus, or else employ it to deceive the enemy. They were outwitted, however, on one occasion, and by a woman. Mlle. Juliette Dodu, a girl of 18, was director of the telegraph station at Pithiviers, where she lived with her mother when the Prussians entered the town. They took possession of the station, and, turning out the two women, ordained them to live in dwelling on a higher floor. It happened that the office from the office in running to the post on the roof passed by the door of the girl's room, and she conceived the idea of tapping the Prussian messages. She had contrived to keep a telegraph instrument, and by means of a connection with the wire was able to carry out her purpose. Important telegrams of the enemy were thus obtained and secretly communicated to the sub prefect of the town, who conveyed them across the Prussian lines to the French commander.

Mlle. Dodu and her mother were both arrested, and proofs of their guilt were soon discovered. They were brought before a court martial and speedily condemned to death, but the sentence had to be confirmed by the commander of the corps d'armee, Prince Frederick Charles, who, having spoken with Mlle. Dodu on several occasions, desired her to be produced. He inquired her motive in committing so grave a breach of what are called the "laws of war." The girl replied: "Je suis Francaise" (I am a Frenchwoman). The prince confirmed the sentence, but, happily, before it was executed, the news of the armistice arrived and saved her life. In 1878 this telegraphic heroine was in charge of the postoffice at Montreuil, near Vincennes, and on the 13th of August she was decorated with the Legion of Honor by Marshal MacMahon, President of the republic.

Mr. Tesla in France.

Nikola Tesla has made a profound impression abroad, and the lectures which he delivered in England and France last month were received with positive enthusiasm. In the latter country the reception was naturally of a more demonstrative character, and one of the French scientific journals in a frontispiece fairly represents Mr. Tesla as a prestidigitateur. The illustration is presented herewith. The engraving is supposed to illustrate the joint meeting of the Société de Physique and the Société Intenationale des Electriciens, which was held on February 20th. To quote from the journal in question, "The young savant is as thoroughly convinced as a forerunner, almost, we might say, as an apostle. There is so much enthusiasm and sincerity in his explanations and experiments, that faith is born within one, and he believes he is present at the dawn of a revolution in artificial means of illumination. * * * The warm plaudits that his lectures have received in England and France prove that he has excited the enthusiasm, if not the conviction of those men who are most capable to appreciate the grandeur and importance of his work. For the skillful experimenter we wish all success in the new field in which he is engaged. We trust that when next he comes to Europe the light of the future will have become the light of the present."

When his work excites such rapturous comments as this, and when he is regarded almost as a magician, Mr. Tesla must regard his trip abroad as decidedly successful.



MR. TESLA IN FRANCE.

While Americans do not perhaps indulge in such high-sounding phrases, they none the less appreciate the marvelous work that Mr. Tesla has accomplished, and are no less ready to give him the hearty and enthusiastic praise that he deserves. His lectures abroad are not merely repetitions of his paper before the American Institute of Electrical Engineers, but are important developments of that remarkable production.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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FROM all accounts published up to the present time it would appear that the Chicago city council had allowed itself to be more impressed by the efficiency of the mighty dollar than by the efficiency of compressed air as an agent for power transmission. Perhaps, after all, it will be some time before canvassers seeking to introduce air as a competitor against the electric motor will enter the field. It is to be hoped, though, that the grand jury in purifying the council chamber will not be obliged to hinder the South Side Railway company in executing its present plans for supplying improved service on the cross town lines. Whether this ordinance was passed as it should have been or not, Chicago needs, and in fact should demand, that these now but little used lines be equipped with a modern system. Of course, with the fair in prospect and but little time at the disposal of the company, there is but one solution of the problem, the overhead electric railway system. The South Side Railway company, knowing this full well, has already agreed to put in electric power, and the work should not now be hindered.

CHICAGO has given the world another example illustrating the fact that the public desires to be humbugged, and it would seem that the birthrate of credulous individuals must have increased most rapidly of late. One of the boldest and at the same time one of the simplest swindling arrangements that could be imagined has just been disclosed by a Chicago detective. In another column there is an interesting description of the clever manner in which the "brokers," by an ingenious combination of an old stock ticker, a small motor, a couple of batteries and a box, managed to deliver quotations printed days before to the innocent "lambs." To an electrician, the mechanism of the bogus ticker will no doubt appear very simple, but when it is understood that in order to make a good case against the swindlers the detective had to study out and grasp every detail of the machine without appearing to be even interested, one agrees with Prosecuting Attorney Douglas than an efficient police officer must be a man of intelligence. As an illustration of this it may be mentioned that in another raid made a few days after the one just referred to, the detectives, although quite positive in their belief that a confiscated ticker was bogus, had to allow one of the brokers to disconnect what some one described as "the seventy wires!"

ADVOCACY of governmental control of the telegraph and telephone until recently has been confined to a small body of so-called reformers who entertained peculiar notions about private enterprises and public works and their respective fields. Designing politicians are always willing to make use of misguided men to procure their own advancement and further their ambitious projects and in the present case it can be seen at a glance that great advantages were to be gained by the not over-scrupulous politicians who espoused the cause of postal telegraphy. In the event of the successful termination of the controversy, the party in power would command vast patronage and thereby insure its continuance in office. On the other hand, defeat would only mean continued agitation of the subject, and the struggle might be protracted indefinitely.

The last contribution to the literature on this subject is found in the *Arena* for March. The Hon. Walter Clark contributes an article in which he argues that it is not only within the power of the government to assume direction of the telephone and telegraph, but that under the constitution it is its duty to make them parts of the postoffice system. This is Judge Clark's construction of the provision that "Congress have power to establish postoffices and post roads." Yet he would not advocate, at present at least, the absorption of the railroads of the country which he abruptly dismisses as having "no connection with this matter." A reduction in the cost of the service is held out as a reason for making the change. "It is very certain," says Judge Clark, "that the telegraph and the telephone, as parts of our postal service, would not only wonderfully improve the means of intercourse, but it is believed that a very cheap uniform rate—probably five cents a message—would pay a handsome revenue to the government." He would not restrict the general use of the telegraph and telephone to the centers of population but he would have the farmers enjoy the blessings of this great discovery. "News of approaching frosts could be promptly distributed through the country districts and many a valuable crop saved." These and many other advantages to residents of the rural districts are presented.

One of the "advantages" so called, under the proposed system, is that messages "for all distances under 200 miles the telephone can be employed, and the present postmasters can of course use them. A few telegraph centers, —one or two for each state—could be established, to which all long distance messages would be sent, to be there despatched by telegraph." But right here comes in the objection that business men generally do not care to have their communications handed about indiscriminately and that in such a system numerous mistakes would be unavoidable. Then again there could be no privacy guaranteed for communications of a personal nature and this would rob the system of one of its most attractive features. On this point Judge Clark says: "This will not prevent railroads from having their own telegraph lines for their own business, nor forbid telephone exchanges in cities and towns. As now persons and corporations can send their own letters by their own messengers, so they can send telegrams and telephonic messages on their own business by their own wires." But if this be true, where is the advantage of the proposed change? The only communications that one desires to transmit by telegraph or telephone are those of immediate importance and under the proposed system patrons would find it necessary to send these over "their own wires." In a word instead of reducing expenses the project contemplates an increase. The public at large would be taxed for a worthless governmental toy in order that an army of political hangers-on could be kept in positions and the business men to whom the telephone and telegraph are valuable would be obliged to support "their own wires." This indeed is reform with a vengeance.

THE gentlemen who are managing the affairs of the World's Columbian Exposition have spent a considerable portion of their time for the last week or so in denouncing the principal electrical corporations of the country. This is due to the fact that but one bid, practically, was received by the bureau of construction in response to advertisements for the supplying of 6,000 arc lights, each of 2,000 nominal candle power capacity. The specifications contemplate the furnishing of dynamos and lamps by the contractor—one third to be delivered on July 1, 1892; one third on August 1st, and the remainder on September 1st. The whole installation is to remain in position until November 1, 1893—an average period of fifteen months. But one offer to do the work entire was received, and that was from the Thomson-Houston Electric company, which was willing to furnish the necessary machinery for the time named at the rate of $38.50 per lamp. When this fact became known, a great cry went up, led by the officials of the bureau of construction and the members of the committee on grounds and buildings. Columns in the newspapers were devoted to setting forth the assertion that the electrical companies had "combined" to "hold up" or "sandbag" the exposition, as the action of the Thomson-Houston company was variously described in the easy and unrestrained phrase of the local press. It was even hinted, if not openly charged, that the entire scheme of consolidation of the Thomson-Houston and Edison companies was brought about chiefly for the purpose of "squeezing" the World's Fair. All this talk was caused by the fact that the construction department expected to get the lights for from $15 to $20 each, being led to this belief, it must be admitted, largely by the statements of electrical men made two or three months ago. The bid referred to was promptly rejected by the committee on grounds and buildings, and at the present writing the bureau of construction is endeavoring to find a way out of the difficulty either by going to Europe for machines or by giving the work to one or several smaller companies.

While the electrical fraternity has a cordial interest in the World's Fair, and only the best wishes for its success, as evinced by the elaborate preparations that are making for the display in the electrical department, those who are conversant with all the facts in the case will have but little sympathy for the construction department in its present dilemma. Throughout all the intercourse of the representatives of the electrical interests and the bureau of construction, the conduct of the latter has been marked by a determination to "run things" with a high-handed disregard of the opinion of those better qualified by training and experience to judge of the matters in dispute. The important position of chief of construction, occupied by Mr Burnham, must of necessity be filled by a man of great energy and force of character, but these requirements should not involve the refusal of advice manifestly good. So long ago as last summer Chief Barrett and others, including the WESTERN ELECTRICIAN, foresaw that trouble might arise over the service lighting plant, and it was suggested that the work be parcelled out among the different companies at a uniform minimum price, to be arrived at by a general conference of those interested or otherwise. Each company was to do a share of the work proportionate to its exhibit, none, however small, to be slighted if it desired to contribute to the general lighting. This plan met with general approval, subject to such modifications as might be found necessary. But Chief Burnham, who, it was decreed, was to have charge of the service lighting, would have none of it. He determined that the work should be done in his own way, and the result is that the Exposition company will probably have to pay a good commercial price for its lights, whereas arrangements could undoubtedly have been made several months ago by which they could have been obtained at a much lower figure. Mr. Burnham and the directors who sustained him have only themselves to thank for the present state of affairs.

Then, again, if the specifications had not been unaccountably delayed the time for furnishing the machinery would not have been so short that none but the very largest concerns could undertake to do the work. The 1st of April will arrive, undoubtedly, before any company can get to work on the contract, and yet the specifications call for 2,000 lamps and, say, forty dynamos by July 1st, the remaining 4,000 lamps and eighty dynamos to be delivered at Jackson Park by September 1st. This condition is enough to induce small companies to refrain from bidding. The time elapsing between the date of the specifications and that set for the opening of bids—about six weeks—was so short as to be practically prohibitive of European competition. This seems strange in view of the present outcry and the fact that the World's Fair authorities are now looking abroad for relief. In short, the business appears to have been mismanaged from the start, and the exposition stands an excellent chance of being called on to pay the fiddler

Charles J. Van Depoele.

The announcement of the death of Charles J. Van Depoele at Lynn, Mass., March 18th, was received with surprise by his friends throughout the country as it was not generally known that Mr. Van Depoele had been seriously ill. The deceased occupied a most prominent position among electricians and was a pioneer in electric lighting, railway and mining work. He took out many valuable patents in these departments. It is estimated that more than 100 patents were issued to him on electrical inventions. Most of these patents are now controlled by the Thomson-Houston Electric company, in whose service Mr. Van Depoele was engaged as expert and inventor at the time of his death.

Mr. Van Depoele was a native of Belgium and was educated at the College of Poperinghe. At the age of ten years he engaged in the study of electricity and from that time devoted most of his life to electrical development. When the first telegraph line was built between Bruges and Poperinghe, Van Depoele, who was at that time a mere child, evinced great interest in electrical appliances and as his father's position enabled him to secure access to the operating rooms of the telegraph, he made use of his opportunities and soon engaged in experimental work. These operations he followed up with much success, and he prosecuted his studies with enthusiasm. When fifteen years of age he exhibited an electric light of his own design fed from a battery of forty Bunsen cells. Shortly after this his family removed to France, and the young enthusiast was encouraged in his work by several prominent scientists who had been attracted by his experiments and exhibitions. From 1864 to 1869 he attended the Imperial Lyceum at Lille and took an active part in the work at that institution.

He did not remain in France long, believing that America was the best field for his operations. He came to this country accordingly, locating at Detroit. Here, however, many difficulties were encountered. He was comparatively unknown in this country and was without means to carry on his experiments on a large scale. For a few years he found it necessary to engage in mercantile pursuits, but did not altogether abandon his studies. He found an opportunity for displaying his lamp and took occasion to present his views to many American capitalists who, however, did not feel inclined to venture into the new enterprise. At this time Mr. Van Depoele had built several types of dynamos and lamps, but he was not satisfied until he had produced a commercial arc lamp. He was a firm believer in the ultimate success of electric lighting, long before any practical steps toward the solution of the problem had been taken.

It was this belief, no doubt, that led him to give up an excellent business in Detroit to devote himself entirely to his experiments. His persistence was rewarded. He succeeded in lighting several public buildings in Detroit, and this attracted the attention of capitalists, who became interested in the work and promised support to the young inventor. A company was formed for the purpose of exploiting the Van Depoele system, but little was done in this direction and Mr. Van Depoele decided to make Chicago his headquarters. Here another company was formed, the Van Depoele Electric Manufacturing company, and the work was vigorously pushed.

Mr. Van Depoele then turned his attention to the electric railway problem and soon had an experimental road in operation. He had conducted some experiments in this line at an earlier date but had not followed them up. As early as 1874, while Van Depoele was engaged in Detroit experimenting with electric generators, motors, etc., it occurred to him that trains of cars and ordinary street cars could be run by electricity. This he explained to many of his friends, who received it with some skepticism. On many occasions, however, the transmission of power by electricity was exhibited by him in his shop in Detroit; the belt of a ten horse power engine was disconnected from the main shaft driving the machinery, and the engine was made to drive a large dynamo, which supplied current to another dynamo, belted as a motor to the main shaft in the shop. The question of making an experiment upon street railways in Detroit to exhibit what could be done in the way of driving vehicles by means of electricity was then discussed, but at that time there was naturally more attention given to the principles of electric lighting than to motors for electric railways. However, it was proposed by Van Depoele to use overhead conductors to transmit current from a generator to electric motors on cars to be thus driven, and the mode of thus transmitting the current was well understood by him at that time. Many different modes of transmitting the current were discussed —underground transmission as well as overhead. Exhibitions of the transmission of power by electricity were given at various times, after 1880, in the shops of the Van Depoele company, at Chicago.

In September, 1883, an electric car was operated at the Chicago Inter-state Fair on the Van Depoele system.

Mr. Van Depoele has devoted much time during the last few years to the application of electricity to mining machinery, and he secured valuable patents in this line. Since the Thomson Houston company absorbed the Van Depoele interests Mr. Van Depoele has been engaged in expert work at Lynn. He was a man of great ability, an indefatigable worker and according to those who knew him best, fairly worked himself to death. An excellent portrait of Mr. Van Depoele reproduced from a photograph taken just before leaving Chicago, is presented.

CHARLES J. VAN DEPOELE.

Mr. Van Depoele was 46 years of age. He leaves a wife and several children.

Electricity at the World's Fair.

Trouble has arisen over the bids for the arc lighting at the World's Fair, which were opened just before the WESTERN ELECTRICIAN went to press last week. As was then stated, there was practically but one bid for the work—that from the Thomson-Houston Electric company, which offered to furnish the lights for $38.50 per lamp, which would amount to about $231,000 for the entire installation of 6,000 2,000 candle power lamps. The Western Electric company also put in a bid, but it was only for 500 lights, and the company sent over to the office of Chief Burnham, of the bureau of construction, to withdraw the bid just before the time set for opening the proposals. The notification was disregarded, however, and it was discovered that the Western Electric company proposed to furnish 500 lights at the rate of $31.25 each. The specifications under which the bids were made were exceedingly broad and general. A perusal of the following synopsis will enable the reader to understand the situation more intelligently:

The machinery and apparatus required comprise dynamos, with full complement of station apparatus, including switch-boards; also lamps, opalescent globes and globe nets. The erecting of machinery and apparatus in position, the external circuit, and connecting the latter to switch-board and lamps are not included in the specifications. All systems and generators of any capacity are eligible. Generators may be operated in series, but it is not desirable to operate any circuit at a difference of potentials exceeding 3,000 volts. The lamps may be of any candle power, but units of 2,000 nominal candle power are preferred. Ten per cent of the lamps shall be capable of burning at least fourteen consecutive hours without removing the carbon. The circuits will be erected and maintained by the exposition. The successful bidder shall furnish one competent lamp man and one competent dynamo man to supervise the installation, operation and removal of the plant. The erection will be done at the expense of the exposition authorities. The lessor shall deliver the machinery and apparatus furnished under the specifications, free on board cars at Jackson Park, as follows: One-third of the capacity not later than July 1, 1892; one-third of the capacity not later than August 1, 1892, and the remaining one-third not later than September 1, 1892. The plant is to remain at the park until November 1, 1893. It is to be operated a few days at the dedication, October 12, 1892, and every evening that the fair is open, from May 1 to November 1, 1893. The machinery and apparatus supplied may be listed and classified as an exhibit by the national commission of the World's Columbian Exposition, subject to the rules and regulations governing exhibits. The bids need not necessarily be for the whole number of lights, and the bidders are requested to state the terms at which they will furnish capacities up to 500, 1,000, 1,500, 2,000 or more lights.

Immediately after the bids were opened there was a great commotion among the authorities of the World's Fair, who were much chagrined that there was but one bid and that so much higher than was expected. It seems that when the estimates for the electric lighting were under consideration a few months ago a representative of the Edison General Electric company stated that he thought that the arc lights for the World's Fair could be furnished for the period needed at the rate of $15 each. B. E. Sunny, western manager of the Thomson-Houston company and a World's Fair director, was also consulted, and he gave it as his informal opinion that $20 per light would cover the cost to the exposition authorities. Reasoning from these premises, it is perhaps not strange that the World's Fair people were at once convinced that the price demanded was an exorbitant one, and consequently there was a great outcry that the electric companies had wickedly combined to "sandbag" the fair. The Chicago newspapers devoted columns to the reiteration of this assertion, and the alleged greediness of the electric companies was bitterly denounced. The following interview, published in the *News* and attributed to a member of the grounds and buildings committee, is a fair sample of the lot:

At least fifty manufacturers were asked to compete, and the specifications were made purposely so the smaller firms could bid on the same basis as the larger ones. Only two responded—the Thomson Houston and the Western Electric companies. Just before the bids were opened the Western Electric people sent a man to withdraw their bid, and the Thomson-Houston representative, who was present, insisted that his rival should be allowed to draw out. Of course Mr. Graham, assistant chief of construction, refused to allow withdrawal and both bids came before our committee. But when we opened the proposals we were fairly paralyzed. We had thought the companies might possibly ask as high as $20 per lamp rental for the plant. Instead of that the Thomson-Houston asked $38.50 a lamp or $231,000 for the plant. The Western Electric company offered to lease the plant at the rate of $31.25 a lamp, but only bid on 500 arc lights. What made this price more surprising was the fact that B. E. Sunny, who is a World's Fair director, a member of the electricity committee and general western manager for the Thomson-Houston company, had assured Chief Burnham that the service ought not to cost more than $20 a lamp. Mr. Sunny's estimate is in writing and was submitted voluntarily to Mr. Burnham as recently as Jan. 23d. It means a difference to the exposition of $100,000 to $140,000 on this one contract, and nobody knows what outlandish figure they will ask for the big plant for incandescent lights when we get to that. The idea of the Edison company refusing to come in on a contract as big as this is enough to make us all sick. It indicates, too, we think, that the big companies have struck hands and divided up the work to be done on some basis satisfactory to them.

A few of the gentlemen connected with the World's Fair took a more liberal view, however, and regarded the bid as an emphatic protest against the action of the authorities in supporting the bureau of construction in the rather high-handed manner in which the latter has so far disregarded the electrical department and run the electrical features at Jackson Park to suit itself. One man "thought it likely that the fiasco was intended as a warning to the Exposition company that the electricians of the country propose to have some voice in the arrangements for electric power and light." It was also

meekly suggested that as the construction department was running the whole thing and "asking no odds" of the electrical people it should be willing to pay the fiddler. In relation to the large number of bids expected by the member of the grounds and buildings committee it is proper to explain that the time elapsing between the date when the specifications were issued and that set for the opening of the bids was so short that it was practically impossible for foreign companies to properly consider the specifications and return bids to Chief Burnham's office in time. At the time it was asserted that this fact had been taken into consideration by the exposition authorities, who were unacquainted with any foreign arc dynamo that would meet the service requirements contemplated. The difficulty of getting the strange machines here and in operation on time was also considered.

At all events the committee peremptorily rejected the bids on the day on which they were opened—March 15th—and directed Chief Burnham to seek new proposals. This was easily accomplished, but then the question arose, "How is the exposition to be lighted?" At this writing this query still remains unanswered. Chief Burnham did not lose heart and told the reporters that everything "wou'd come out all right." But nobody seemed to know just how this desirable result was to be achieved unless by accepting the Thomson-Houston bid, which was declared to be out of the question. One plan that received favorable consideration contemplated a voyage to Europe by Fredrick Sargent, electrical engineer to the department of construction, who was to solicit tenders from the large electrical manufacturers of England, Germany and France. But this plan is open to several objections. Comparatively little attention is paid to arc lighting in Europe, and it is asserted that no machine is manufactured across the water from which more than twelve lamps can be operated in series. Then again it is held that if the dynamos and lamps are imported for the service plant, and not as exhibits merely, they must pay duty, which would very likely bring the price up to about that asked by the Thomson-Houston company. There is a difference of opinion on this point, but the act of Congress allowing the free entry of exhibits expressly says: "All articles which shall be imported from foreign countries *for the sole purpose of exhibition* at said exposition * * * * shall be admitted free of payment of duty." The question of time must also be taken into consideration, as the specifications required that one third of the plant should be delivered in Jackson Park not later than July 1st next. These considerations have doubtless had weight with the World's Fair people in restraining them thus far from sending abroad for bids.

In the course of a brief chat on the situation Mr. Sunny of the Thomson-Houston company told a representative of the WESTERN ELECTRICIAN that it was true that he had given it as his opinion in January that the lights could be had for about $20 each, and he regretted the fact that he might unintentionally have misled the exposition authorities. Since that time the conditions have changed, and the bid was put in on a commercial basis. The electric companies had been pinched at the Paris exposition and at the New Orleans and Louisville exhibitions in this country, and the data of the lighting of these exhibitions was in the East and not accessible to Mr. Sunny when he made his estimate. Since then the matter had been carefully canvassed at the home office in Boston, with a result that a bid of $38.50 was made. If the bid was accepted, the company proposed to install Thomson Houston, Brush, Wood and Schuyler machines. There was no desire to "squeeze" the fair; the bid had simply been put in on a fair commercial basis. Mr. Sunny had no doubt that the matter would be settled satisfactorily.

The attitude of the Western Electric company is interesting. To a *Tribune* reporter Enos M. Barton, the president, said:

Our estimates were withdrawn because we came to the conclusion that it would not be desirable to bind ourselves at the figures we had decided upon. We were working entirely upon supposition. We did not know where our lights were to be placed, and the only thing we saw before us was a great deal of work at little or no profit. Although I do not wish to question the success of the fair, for that seems to be assured, the sealing of a lighting contract would mean an immense outlay on our part without seeing our way through, and we concluded not to attempt it. Of course our company has the best wishes for the fair and we intend to make an exhibit, but we cannot afford to suspend dividends for a year in order to manufacture the machinery requisite for filling such a lighting contract. Therefore we drew out while we had a chance.

In the same connection C. D. Crandall, general manager of the Western Electric company, said to a representative of the WESTERN ELECTRICIAN:

We don't want to make a cent out of the World's Fair, nor do we expect to do all the lighting there. We put in a bid for 500 lamps, because we thought that that number was all we cared to furnish without making any money. We were also willing to furnish 100 lights free for the electricity building. We didn't propose that these lamps should be used to light the grounds or other buildings, but we expressly donated them for use in the electricity building. After putting in our bid we repented of offering to supply 500 lights at the uniform price of $31.25 for periods ranging up to sixteen months, and endeavored to withdraw our bid. The installation would require constant attention, and at the end the dynamos would be nothing better than second-class machines. We should prefer either to rent our machines to the World's Fair, letting it take entire charge of the plant, or else sell the dynamos and lamps outright, allowing the exposition company to dispose of them at the close of the fair. In the event that new bids are requested, we have not decided exactly what course to pursue, but I do not think that we shall offer to supply more than 500 lamps. The specifications are not all that could be desired, and we were not asked to make suggestions of any kind. I do not like the plan of asking competitors to furnish simply the dynamos and lamps, and not the wiring. In justice to the bidder he should be allowed to install the entire plant, from the generator to the lamps.

It is stated that the whole responsibility for the present plan of doing the lighting rests with the bureau of construction. Various plans of equitably dividing the work among the electric companies at a fixed price were suggested by Prof. Barrett several months ago, but were rejected by the bureau of construction. The old controversy as to the relation of dynamo exhibits and the service plant, and the decision of the construction department to operate the latter, are also referred to as having their effect in bringing about the present awkward dilemma of the World's Fair authorities. In reference to this point the *Chicago Tribune* says:

The present position of the World's Fair directors in the matter of electric lighting is due, according to the opinions of several men who are interested in electrical affairs, both within and without the board, to the short-sighted policy pursued by the directors more than a year ago, when they had the opportunity of placing contracts and dictating terms. At that time most of the big companies were anxious to sign contracts to put in their electric plants and furnish a certain number of arc lights. They were inclined to charge just enough to insure them against loss. Their aim was to establish and operate their plants as exhibits. But the directors would not listen to such propositions. They demanded that the company put in the plant and then they reserved for themselves the monopoly of operating them. The big companies, they say, rebelled against such proposals and defended their positions by uniting against the directors. Had contracts been made at that time the World's Fair would have already advanced far toward solving the problem of illumination and would have insured the saving of many thousands of dollars.

Lieut. E. J. Spencer, one of the special World's Fair representatives of the Thomson-Houston company, arrived in Chicago on Thursday night, and on Friday afternoon he appeared before the committee on grounds and buildings, and presented the following argument for the acceptance of the bid of the company:

I beg to submit to you the following statement with reference to the bid of the Thomson-Houston Electric company for arc lighting for the exposition.

It is unnecessary to state that this is an extraordinary project, calling for the largest central station plant known in the world, with three times the number of machines and lamps operated by the Chicago Arc Light & Power company, calling for the product of our factory in this class of machine for the next eight months to come and for all lamps, at present rated production, that can be turned out in six months, disregarding all present and pledged orders. In order to meet your requirements for delivery of apparatus on July 1st, August 1st and September 1st next, it was necessary to call upon our allies. It is to you a matter of indifference whether their bid be submitted separately or in conjunction with our own. It was our purpose to serve the Columbian Exposition at a fair price, and to do what no other corporation in existence can do, to get this enormous amount of apparatus with the engineering skill, necessary to superintend its installation, maintenance and operation, within the short period of time that your specifications permit.

The bids submitted to you are based on the cost of apparatus, allowing for freight and eighteen months' interest, insurance, depreciation, repairs and attendance. You want half a million dollars' worth of apparatus to use for eighteen months, from August, 1892, to February, 1894. Figure for yourselves the interest upon this amount at 6% per annum, but remember that our preferred stock must pay 7% accumulation. In other words, in order to produce this apparatus we ourselves are borrowing money at 7% per annum. Remember also, that any manufacturing stock worthy of quotation should earn from 8 to 12% per annum.

I would have no right to tie up a half million dollars worth of the capital stock of my company without securing for that half million dollars, the rate of interest that is paid by the company. Nor would the directors of any concern be authorized, in a scheme of such a magnitude with the return in advertisement, etc., so out of proportion to the expenditure, to tie up this amount of money in apparatus bringing no returns.

You want 120 of our largest arc machines and 1,200 boxes of our arc lamps, 25 to 30 carloads of material. Figure for yourself the freight, the cost of boxing, etc., on this consignment.

As I said before, you want 6,000 arc lamps, three times the capacity of the Chicago Arc Light & Power company, to furnish which we must resort to five different concerns, making five different classes of apparatus and requiring for satisfactory handling not one dynamo superintendent, as mentioned in your specifications, but five, and not one lamp man, but five, and all of these not men of ordinary capacity, but first-class engineers and executive officers commanding good salaries. This we contemplated providing in our offer to you of these arc lights.

Then compute the interest upon this material while in progress of manufacture, while in transit, during the period of its use, during its return to the factory and the continuance of its repair, which amounts to almost entire renewal. You want this apparatus to use for a period of from 17 to 19 months. At the end of this time, it will be old, unsightly, greasy, and we will be compelled to sell at half its original value or return it to our factories for overhauling. The machines will have to have new armatures, new shafts, new bearings, new commutators, new air blasts, new fittings throughout in order to fit as first-class machinery salable and new. The lamps must be taken apart, piece by piece, cleaned of rust, re-buffed or re japanned, the frames re-wired, many of the delicate parts entirely renewed, all re-assembled, all readjusted, the lamps re-tested and re-inspected by our inspectors before they can be allowed to go to the shipper to fill his orders. We have figured all these items most carefully, and I can say to you that the price is fair, sufficient I hope to insure us from loss and not so high as to assure us of any profit.

In dealing with other contractors, you have scarcely expected that they would provide material and labor free of expense to the exposition. Your buildings have been paid for at fair prices. Service of every other character has been paid for at fair prices.

The lighting provided for the exposition will be the means of opening the grounds for evening entertainment. The estimated receipts from these entertainments are, if reports reaching me are correct, enormous.

We propose to give you in this service first-class apparatus, first-class engineers and superintendents to relieve your administration bureau from all annoyance and uneasiness on account of failure of this service at any and all times during the exposition.

The task that we are assuming is something beyond the capacity of any other firm on the face of the earth, and the nerve in submitting an estimate for the entire installation is something that should receive due credit from your committee.

That prices are fair, I will endeavor to assure you from the figures taken from other expositions.

In 1881 Paris gave the first exposition that had ever attempted on any extended scale night entertainments. In order to light the grounds and buildings, there were needed for this purpose 1,383 arc lamps of various candle power actuated by 1,350 horse power of steam. To provide for this entertainment, the exposition authorities offered the parties undertaking the lighting 10,000 francs and one-half the gate receipts from evening visitors. The admission fee was one franc. The evening receipts in the three months of the exposition proved to be 337 696 francs, one-half of which, 188,848 francs, plus the 10,000 originally paid, made for the lighting syndicate 198,848 francs. By certain allowances for overtime this was increased by one or two thousand francs, making per lamp, for the three months' lighting, 144 francs each, or per month per lamp, 48 francs, or for 18 months per lamp 864 francs or $172.80 per lamp. It is true that in this case the lighting syndicate also furnished the steam power.

Good central station practice allows for power 20 per cent. of the cost of the light; for all attendance, thirty per cent.

In the case of the Columbian Exposition the most expensive part of the attendance, to wit, superintendence in and out of the station, becomes a part of the contractor's duty. I have, therefore, assumed that power and attendance should be figured as 40 per cent. of the total value of service rendered. Taking 60 per cent., then, of $172.80 as the price of lighting at this exposition when placed on the same basis as lighting for the World's Columbian Exposition, we find that the price per light would be $103.68. Compare this, gentlemen, with $38.50.

The first exposition in this country to attempt night entertainment was the Louisville Exposition of 1883. This was lighted by the Edison company with 5,000 incandescent lights, as again the following year, both cases proving serious losses to the Edison company. The plant from Louisville in 1884 was transferred to New Orleans and there installed to light the buildings of the World's Exposition in that city. The estimated losses of the Edison company amounted to about $20,000.

Subsequent expositions at Louisville were lighted by the Fort Wayne-Jenney system at the price, I am informed, of $100 per lamp. This price was also charged by the Fort Wayne company at New Orleans, both expositions lasting for a period of three months only. In all these cases the exposition provided power.

You may say that this was in a time when electricity was an experiment; that apparatus was more expensive and assistance of technical nature not so easily obtained. True, but it was also at a time when electricity was endeavoring to advertise itself; to bring itself into prominence; when people of hopeful dispositions were willing to sink thousands of dollars in experiments that promised to ultimately advance the use of electricity for lighting.

We have, however, one exposition of later date, upon the experience of which this Columbian Exposition is largely basing its projects. This was the Paris Exposition of 1889.

When the matter of lighting for evening entertainment was considered, the task was found to be so enormous that the various lighting companies were compelled to form themselves into a syndicate in order to provide the

apparatus called for by the Minister of Commerce and Industry, who had this exposition in charge.

The public lighting by this syndicate required 1,000 horse power for arc lights and 1,000 horse power for incandescent lights. The private lighting required 625 horse power of arcs and 500 horse power of incandescent lights. All these lights were confined to an area less than 600 yards square.

Basing their first contract, on the experience of the previous exposition, the syndicate was offered a lump sum and a certain proportion of the gate receipts. The exposition, being unexpectedly successful in the sale of coupon lottery tickets, arranged with the syndicate a further and second contract, being what was expected to be a fairer basis to the exposition company. The agreement was to pay to the syndicate 1,800,000 francs in equal installments of 300,000 francs monthly.

The actual lamps furnished by the syndicate for public lighting under this contract consisted of 1,045 arcs and 8,837 incandescents, the equivalent of less than 2,000 arc lamps. This then was at the rate of 900 francs per lamp for six months' service, $180 per lamp, or, subtracting again 40 per cent. as the proportional part of expenses borne by the World's Columbian Exposition, it would make the price to ourselves $108 per lamp. Compare the two cases! We propose to furnish you for three times six months three times the number of lamps for one-third the price of the Paris Exposition syndicate, per lamp; in other words, the rate that you obtain is one-ninth of the rate of this syndicate to the Paris Exposition!

It is certainly a matter of congratulation for every American citizen that the United States has made such progress beyond continental Europe in the application of electricity for industrial purposes that a single firm can undertake three times the amount of work that required a syndicate, sanctioned by the government of France, to perform less than three years ago, and it is certainly a matter of most serious consideration by yourselves that in spite of a rate one-ninth as low as that of Paris we should have been criticised through lack of proper information as determining to take advantage of the World's Columbian Exposition.

We are interested in the exposition to the extent that we do more than most of your contractors have done. We propose to furnish material, apparatus and service at less price than any central station in the world can afford.

Suppose you should call upon the Chicago Arc Light & Power company for your lights; 600 lights all night at 50 cents per light, and 5,400 lights until 12 o'clock at 33⅓ cents per light, a total for power and attendance of $1,900 per night or, subtracting 40 per cent. as the value of power and labor furnished by the Exposition, $1,140 per night for the illumination of your grounds. Take this for 450 days, and what is your bill for lighting? $513,000 as against an offer by ourselves of equal service for $232,020! The Chicago Arc Light & Power company is furnishing light at less than the average rate, a rate that requires for proper returns to stockholders the most rigid economy, the most careful supervision of all expenditure. A comparison should be sufficient to convince every one of you that we have endeavored to be fair; that we have made you a bid as low as sound business principles will permit.

I have, therefore, to submit a formal request that the action of Tuesday last, in rejecting this bid, be reconsidered.

The subject was discussed at some length in the committee, but no action was taken.

On Monday Mr. Sargent stated to a representative of the WESTERN ELECTRICIAN that it had been definitely decided that either he or Mr. Pierce, his assistant, was to go to Europe to confer with the manufacturers of electrical machinery in reference to lighting the World's Fair. No time has been set for the departure, however. It is reported, also, that the exposition authorities have been in conference with representatives of western electrical companies that did not put in bids for the arc lighting. It is further stated that one of these companies, with the backing of a great manufacturing concern, has offered to do all the arc lighting called for in the specifications at a less rate than that of the Thomson-Houston company.

Bids for the exclusive privilege of operating passenger boats to be propelled either by electricity, steam or naphtha, on the lagoons of the World's Fair grounds, were opened on Thursday of last week. There were nine proposals, but three were thrown out because the certified check for $10,000 required in each case was not included. Three of the bids were for electric launches. General C. H. Barney, representing the Electric Launch Navigation company of New York city, offered to construct and operate from twenty to sixty boats 34 feet long and pay the Exposition company 33⅓ per cent. of the gross receipts on any rate of fare that might be established. The Columbian Launch company of Chicago offered the Exposition company 31 per cent. of its gross receipts. In case, however, the World's Fair people would accept without cost a boat for police service, another for fire protection, and a third for life-saving service 27 per cent. of the gross receipts would be given. This company proposed to use either electricity or steam. D. R. Proctor of Chicago offered to furnish boats operated either by electricity or steam, giving the exposition authorities 33⅓ per cent. of the gross receipts.

On Friday of last week the bids for the furnishing of power generators for the motor service in the manufactures, machinery, agriculture, mining, transportation and several smaller buildings were opened. The machines are to be leased on the same conditions as the arc dynamos. Five bids were received. The Eddy Electric Manufacturing company of Windsor, Conn., offered to furnish the 300 horse power generating apparatus for the transportation building free of cost. The National Electric Manufacturing company of Eau Claire, Wis., offered to furnish the apparatus for this building for $2,500. The Western Electric company proposed to furnish about 400 horse power for $6,500. The Mather Electric company of Manchester, Conn., bid on the mines building, and offered to furnish 600 horse power for $2,450. The Thomson-Houston company put in a bid for furnishing all the apparatus (2,500 horse power) for $52,900. This company also asked for the exclusive right of furnishing exhibitors such power as might not be included in the general plant, and charge therefor $40 per horse power. It also wanted the sole right to furnish all supplies, and the right to sell or lease meters for the measurement of the amount of power used. No action was taken on the bids.

No action has as yet been taken by the committee on grounds and buildings in relation to the bids for the elevated railway at Jackson Park. It is said that other companies than the two that sent in bids will be given an opportunity to make proposals for the work. Nothing has as yet been done with the proposition to build tracks for street railway systems parallel to the steam railway tracks in the southwestern corner of the park.

Work on the electricity building is progressing satisfactorily. The structural iron work is all on the ground, the carpentry is well advanced, the towers are now being put up, and the roof rafters are being put in place.

The prospectus of the department of electricity has at last been issued, and an edition of 10,000 copies is now being sent out. A synopsis of the contents of the pamphlet has already appeared in this paper. The only illustration is a perspective view of the electricity building—a reproduction of the drawing made for the double-page supplement to the WESTERN ELECTRICIAN of May 9 1891. Accompanying each copy of the prospectus Chief Barrett is sending out a circular which contains the following paragraph: "In order that exhibitors in this department may begin their preparations, I have decided to immediately begin the assignment of space. Those who have not already made application will please do so at once. Immediate action on your part is the more necessary because of the fact that the demand for space is many times in excess of the amount available."

Formal application for space in the electricity building has been made on behalf of France and Belgium.

A press dispatch from Columbus, O., states that the Ohio Gaslight association has indorsed the action of eastern gas associations in resolving to use their influence to prevent the $5 000,000 government loan to the World's Fair "unless the World's Fair commission deals more fairly with the gas people, as between them and the electric light people."

The Lamp Trimmer's Work.

In an interesting article on arc lamp trimmers and their work the *Providence Journal* says:

"The city trimmers, as a set, are not very old, and although they are not large in frame they are well developed in body, arms and legs. They must be strong if they intend to work at trimming lights over a week. The muscles of a man's leg and arms must be fully developed to stand the constant strain upon them during working hours. Whoever is subject to cramps or rheumatic pains in his legs has no business to climb electric poles for a living. To do his work a man is obliged to be as healthy physically as possible, for he is out of doors in all kinds of weather, rain, wind or snow, and at times wet from the top of his head to the soles of his feet. The work has to be done, and it may be from one to six hours before he is able to make a change in clothing. No class of men other than the hardy can perform this duty.

"The only real danger in this business is in the climbing and working on the poles 15 feet above the ground. Recently the job has been anything but pleasant. The weather, most of the time, has been very bad, and a good part of the time poles and mast arms have been encased in ice. Even the little steps which everybody has noticed on two sides of the pole have been icily covered, and to a man climbing up these poles on those days a misstep would undoubtedly mean something more than a pocketful of broken carbons. A man is obliged to have his wits about him from the time he inserts the small detachable steps at the base of the pole until he is ready to go to the next one. It wouldn't do for an absent-minded man to try to set carbons, for he might forget where he was standing and try to walk on air after putting the lamp in trim."

The Chattanooga, Tenn., Electric Light & Power company, is talking of erecting a plant for the purpose of furnishing power to small industries.

Lightning Arresters, and the Discovery of Non-arcing Metals.[1]

By ELIHU THOMSON, PH. D.

PART I.

During thunderstorms electric wires become charged from the atmosphere with an electric potential, different from that of the earth; there is then a tendency to establish an equilibrium, that is, for a discharge to or from the earth, as the case may be. If this discharge be left to choose its own path, it will select one or many of the weaker points, usually the most vital part of the system, and there rupture the insulation. It therefore becomes necessary to rid the line of this charge in some suitable manner, and without allowing it to damage any portion of the system. This is usually accomplished by the well known air gap lightning arrester. Benjamin Franklin, nearly one hundred and fifty years ago, drew sparks across an air gap from a charged conductor very much as we do it to-day. He, however, did this to demonstrate the presence of the charge, while we do it for good riddance.

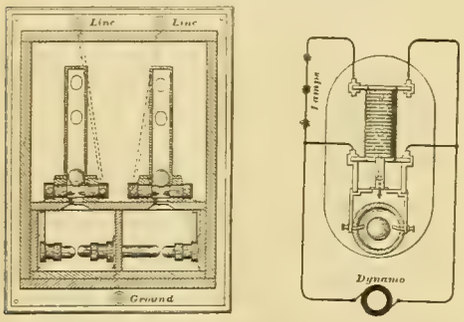
Shortly after the erection of the first telegraph line by Morse, in 1844, it was found necessary to provide means for discharging the line during thunderstorms, and numerous devices were brought out and patented for this purpose. The main features of lightning arresters from that time till recently have been the "spark" and the "kicking coil," the latter being interposed between the discharge circuit and the apparatus to be protected. The spark gap arrester on telegraph lines answers the purpose admirably. When, however, electric lighting was introduced, the lightning arrester problem became more difficult, in consequence of the dynamo short circuit that invariably follows the discharge. It then became necessary to provide means for promptly interrupting this short-circuit, and so the fuse was added, and then there followed all kinds of automatic devices for interrupting the short circuit and restoring the arrester in its normal condition. But most of these devices have been more or less defective and unsatisfactory, and now that high potentials are used, the proper interruption of the short circuit becomes more difficult than ever. The ideal lightning arrester would be a simple discharge gap of such character as not to permit a short circuit of the dynamo, or, better yet, metallic connections to the ground without dynamo leakage.

When I first became interested in this subject, I was naturally guided somewhat by previous practice, which had been to provide with each arrester and discharge circuit an automatic circuit interrupter. Fig. 1 illustrates my first practical step in this direction, and represents the Winsor-Wurts lightning arrester, the fundamental idea of which originated from Paul Winsor, who proposed that a discharge gap be placed in the neck of a bottle, the idea being that the heat of the arc formed by the short circuit would sufficiently expand the air in the body of the bottle to blow out the arc. With this idea as a nucleus, the arrester depicted in Fig. 1 was evolved. Referring to the figure, it will be noticed, without going into detail, that the arrester is double pole, and that each discharge gap is placed in the center of an air-chamber. In the upper part of each of these there is a slotted passage, which might correspond to the neck of a bottle, and in which there is placed a second air-gap in series with each of the others. The second air-gap is bridged with a carbon ball, the latter being held in place by tubes having vent holes in the sides, and rubber bumpers at the top. The action which takes place when a discharge to ground is made with a resulting short circuit is as follows: The arc at either or both of the jumping spaces instantly heats and expands the air in the respective air chamber, which, rushing up through the slotted passages, blows either or both carbon balls to the top of the tubes. The arc formed where the circuit has been broken by the projected carbon ball is at the same time instantly blown out, thus completely rupturing the circuit. The only demonstration is a quick puff as the air rushes out of the holes near the upper ends of the tubes. The object of the holes is obvious. As the balls are confined in the tubes they at once drop back to their former positions, and thus automatically place the apparatus in a condition ready for another discharge and short circuit. In testing this arrester the terminals are connected to the circuit of a thousand-volt generator. The air spaces are bridged over with a fine wire to take the place of an actual discharge. Then, by the throw of a switch the full pressure of the machine is placed on the arrester. There is an enormous rush of current, the temporary wire bridges fuse, arcs are formed, the air expands with an explosion, the balls fly up, more arcs are formed, tongues of fire shoot out of the holes in the tubes, the upper arcs are blown out, the balls drop back to their normal positions, and all this happens like a pistol shot, without causing more than insignificant flicker in the lamps. It is very curious to notice that if this short circuit is made on the crest of a wave of an alternating current, the report of the explosion is much sharper and louder than when the circuit is closed at the instant the wave is at or near the neutral point. I might add here, that, after short-circuiting a thousand volt 300 light machine through such an arrester about 400 times, there was not the slightest deterioration to be noticed anywhere. Those who are not familiar with this kind of work will hardly appreciate this last fact, or realize what is accomplished each time the arrester "goes off."

Soon after this arrester was completed, steps were taken to adapt the same principle to an arc circuit lightning arrester, which resulted in the one illustrated in Fig. 2. By referring to the figure, it will be noticed that a vertical solenoid provided with an iron core is connected in the main circuit beyond the point of contact with the discharge circuit. The discharge electrodes are curved arms which swing freely through the sides of a cylindrical air chamber, and the construction is such that while the core falls, the discharge electrodes will be forced out. The action is then

1. Read before the American Institute of Electrical Engineers, March 15, 1892.

as follows: Under normal running conditions the core is held up in the solenoid, but if a discharge occurs from both sides at once, short-circuiting the machine through the discharge points, the solenoid will at once lose its power, the core will fall and force the discharge arms out through the holes in the walls of the chamber. This action would draw out arcs three inches long, and the heat thus generated is sufficient to cause a sudden expansion of air in the air chamber, and thus blow out the arcs even though the current be but ten amperes and the pressure 3 000 volts Without the device just described for lengthening the arc,



FIGS. 1 AND 2. LIGHTNING ARRESTERS, AND THE DISCOVERY OF NON-ARCING METALS

the heat developed would have been insufficient. In short circuiting a 50 light machine through this arrester, there is a scarcely perceptible flicker in the lamps, the core drops, the short circuit is opened and the core drawn back into its normal position ready for further action, all in an instant of time. Although I have used an electromagnetic device in the construction of this type of arrester, it will be noticed that the placing of a coil in the lightning arrester circuit has been avoided, so that even though every discharge has to pass through this coil to reach the discharge points, yet from this point on, the discharge has a non-inductive path to earth through the arrester in preference to the dynamo.

Neither of these arresters would interrupt a short circuit on a 500 volt direct current generator, so after some further experimenting the arrester shown in Fig. 3 was evolved. Referring to this figure, it will be noticed that there are two air chambers, in each of which is a fixed carbon discharge point. Above these chambers is a curved carbon swinging freely from one chamber to the other through suitable openings, so that either end of the curved carbon, as the case may be, shall come into close proximity to either of the fixed discharge points. The action is as follows: When a discharge takes place, it passes to one of the fixed discharge points, depending upon the position of the curved carbon, then across the air space to the curved carbon, and from there to the ground, as shown in the figure. The dynamo current then following, causes an arc to be established between the curved carbon and one of the fixed points and the heat generated by this arc expands the air in its respective chamber, increasing the pressure therein, and causing the curved carbon to be instantly blown from one chamber to another. This ruptures the arc and adjusts the arrester for the next discharge. In testing this arrester, 500 volt and 1,000 volt generators have been repeatedly short circuited through it, and in every case the circuit has been instantly broken without injury to the dynamo, and the arrester has as quickly reset itself in readiness for future use. In one of the tests made to demonstrate its promptness and reliability, the fixed points were so adjusted as to touch the curved carbon in either of its two normal positions. A 1,000 volt gen-

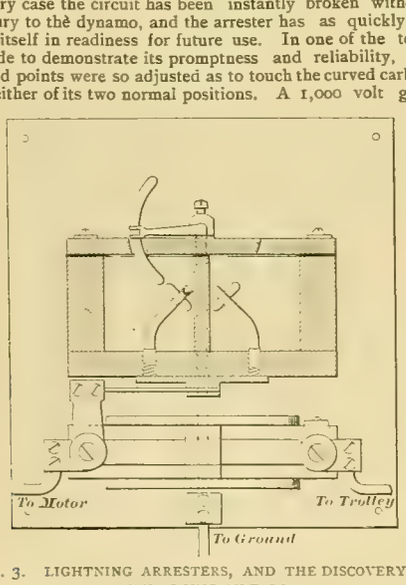


FIG. 3. LIGHTNING ARRESTERS, AND THE DISCOVERY OF NON-ARCING METALS.

erator was then short-circuited through the arrester, which resulted in the circuit being repeatedly opened and closed without injury to either dynamo or arrester. This power circuit arrester was afterward much improved, and finally took the form shown in Fig. 4, and the arrester shown in Fig. 1 was also finally changed to this form. This arrester is made of iron and marble, and its advantages over the others are its non-combustibility and the double break in connection with the air blast. Fig. 5 illustrates the same arrester, fitted into an iron box lined with asbestos, and in this shape is adapted to either car or pole use.

So far you will observe that my one object had been to provide a simple, reliable and non-inductive circuit interrupter. In this I had succeeded as far as immediate wants were concerned, but with the prospects of higher voltages in the near future the problem seemed but imperfectly solved. The experiments of Lodge, Hughes and others were carefully studied, and I finally decided that it might be well to repeat some of them. So, one day, while casting about for some suitable means of experimenting, I happened to be passing under a driving belt; my hair stood on end, and my body became charged. Of course somebody had to touch my ear (that seems to be the proper thing to do under the circumstances), and my body became discharged. That evening, while thinking over the events of the day, my thoughts rested on this belt, the electrified atmosphere around it, and the charging and discharging of my body, and I wondered whether the phenomena observed were not similar to those experienced during thunderstorms. On the following day I stretched about four feet of No. 14 insulated wire under a belt, parallel to it, and about two inches below it. I then brought the ends to a convenient place where I could ground the wire or not, as I chose. The room was then darkened, the belt set in motion, and a most beautiful sight presented itself. Between the belt and the wire were seen soft purple streamers, giving the appearance of a film connecting the belt and wire. In some places these streamers were more dense than others, and in this were suggestive of the Northern lights. There was no disruptive discharge at all between the belt and wire. On bringing the bare end of the wire within one-quarter of an inch of a ground a continuous discharge took place. When one end was well grounded no spark could be drawn from the other end. When one end was grounded through a choke coil consisting of about 40 turns of No. 14 wire, small sparks could be drawn from the other end, showing the impedance offered by the coils to the discharge. When neither end was grounded both ends showed "side flash" every two or three seconds. So far, these results seemed to correspond with the experience met with in electric systems when exposed to the influence of thunderstorms. The conditions also seemed to be very similar. Here was a wire stretched through an electrically disturbed atmosphere; the wire became charged, and the charge passed readily to ground through a metallic discharge circuit containing an air gap. An induction coil impeded the discharge, and when there was no ground connection there was side flash. All these results seemed to correspond with practice.

The thought then occurred to me, "What would happen

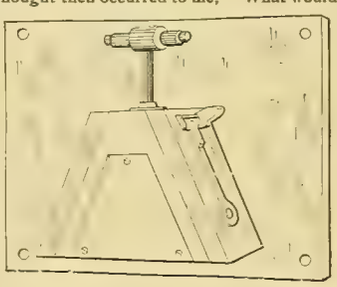


FIG 4. LIGHTNING ARRESTERS, AND THE DISCOVERY OF NON ARCING METALS.

if I were to string a second wire near and parallel to the first, and ground it, leaving the first wire insulated?" A second wire was quickly strung, but before making the ground connection the following observations were made: The purple streamers seemed equally divided between the first and second wires, and either would give about equal sparks. On grounding the second wire no indication of a charge on the other could be obtained. The streamers were now all directed to the second wire, and the first was as inert as a block of stone would have been. If, now, in these laboratory experiments, there were reproduced the conditions existing between electric wires and the atmosphere during thunder storms, then, to prevent wires from becoming charged, all that would be necessary would be to stretch a grounded wire near and parallel with the wire to be protected, and, in fact, it would seem as though one such grounded wire would protect all the wires that could be strung on any one line of poles. An explanation of these phenomena is not far to seek. An insulated wire lying on the surface of the earth cannot become charged from the atmosphere, because the latter is at the same potential as the earth; but an insulated pole line can be, and is charged when exposed to the influence of thunderstorms, because the atmosphere surrounding the wire is at a different potential from the earth; therefore, with an insulated pole line, and an adjacent grounded parallel wire, the grounded wire, in effect, transfers the earth to the level of such wires, but if a grounded wire near and parallel to an insulated wire in effect causes the earth to be transferred to the level of the insulated wire, then the insulated wire cannot become charged. The grounded wire running over the poles will relieve the atmosphere in its neighborhood of any difference of electric potential that would otherwise exist between that neighboring atmosphere and the earth, and the insulated line would then fail to become charged. Soon after performing this experiment, I learned that such an overhead grounded wire had been used to great advantage, and, that being the case, was greatly surprised that it was not in more general use.

I next replaced the wire I was using, which was much battered and bruised, with a new wire, and found the charge much diminished by the superior insulation. The latter was then replaced by a bare wire, insulated with a glass tube. The spark now was scarcely perceptible, being about the size of the spark obtained from a Leclanche cell, and even this could be obtained only after several minutes of charging. These results seemed to indicate a gradual charging of the wire by more or less perfect contact with an atmosphere having a different potential from that of the earth. With the idea of gradual charging in mind, the following plan was hit upon for a lightning arrester. The first conception was to alternately ground both poles of a generator over a very small air-gap, and at rapidly recurring intervals. The improved plan, however, was to alternately dead ground the poles of an alternator at every neutral point in the electromotive force wave, the idea being to so constantly discharge the line in this manner as to effectually prevent a charge from attaining any considereble intensity, and at the same time avoid the short circuit which now invariably follows the discharge over the air-gap of our present ar-

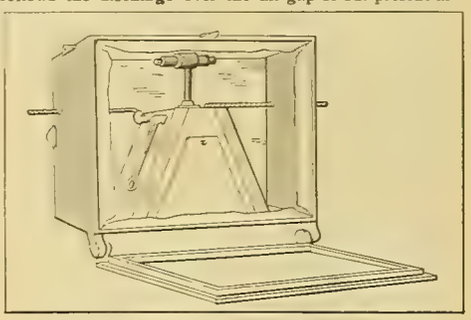


FIG. 5. LIGHTING ARRESTERS, AND THE DISCOVERY OF NON-ARCING METALS.

resters. The method of carrying out this plan will be understood by a glance at Fig. 6. Upon experimenting, I found that an alternator could be short-circuited at the neutral point without a spark. If the short-circuit occurred a little before the neutral point, that is, on a decreasing electromotive force, there was a slight sparking, but no tendency to hold on. If the short circuit occurred at all after the neutral point, a furious arc was established which would hold on indefinitely.

This form of arrester has not yet been tested in actual practice, but it will be during the coming season, and I have great hopes that it will not only successfully discharge the line, but effectually prevent any considerable accumulation of the charge. Of course this form of arrest is only adapted to alternators.

The Roy Valve.

New valves though well tested when made, oftentimes leak when put in service. One of the most important features of a valve is a seat that will not be injured by the ordinary wrench applied to the valve handle. In the Roy valve any kind of malleable material best suited to resist corrosion is used.

The ring in this valve rests on a conical base and its action to compensate for distortion of the joint is as follows: The ring resting on a conical base will make contact on its entire inner edge, if both ring and base are true. If the base be distorted, the ring will touch on two or more spots, depending on the degree and nature of the distortion. When a pressure is put on the upper edge of the ring by means of a flat disk, as is shown in the accompanying cut, the ring is forced outward by the prominent points on the conical base, and drawn inward to fill the depressions. The plane of the top surface of the ring remains undisturbed, but is free to move laterally on the face of the disk. It is obvious that an extraordinary degree of distortion is provided for.

The method of inserting the ring is as follows: The annealed or soft ring is placed in the recess intended for its reception in the valve body. The bonnet is then screwed down in the usual manner, and the spindle operated to close the valve. The ring coming in contact with the disk is resisted in its passage to the lower part of the recess by the conical base, which causes the ring per-

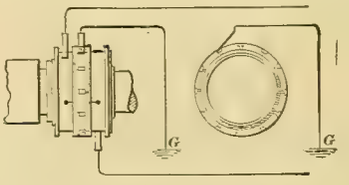


FIG. 6. LIGHNTING ARRESTERS, AND THE DISCOVERY OF NON-ARCING METALS.

manently to expand its lower edge, thereby locking it under the outer wall of the recess.

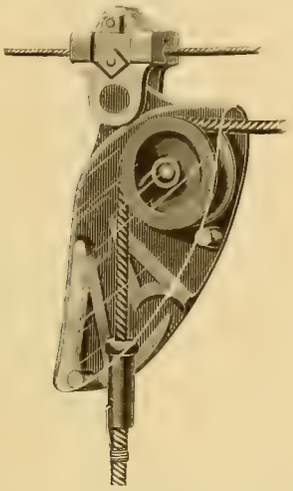
The application of the ring is quickly made, and its removal may be accomplished by a pair of plyers or similar means that will collapse the ring to a slight extent inwardly, and thus at once free it from the recess.

The Roy Valve company, New York, is the manufacturer of this valve.

The *Lynn Press* is responsible for the statement that a real baron is employed in a subordinate capacity at the works of the Thomson-Houston Electric company in Lynn. His name is Baron E. Van Wilmowsky. He was employed as an assistant to Prof. Thomson and is described as a capable chemist and a companionable man. It is said that Wilmowsky left his title behind him in Poland when he came to this country and although he never volunteered any information as to his origin, the secret leaked out.

Cutter's Lamp Supporting Pulley.

The safety of arc lamps demands the use of a pulley which will hold the lamps securely, no matter what happens to the hoisting rope. Cutter's lamp supporting pulley,



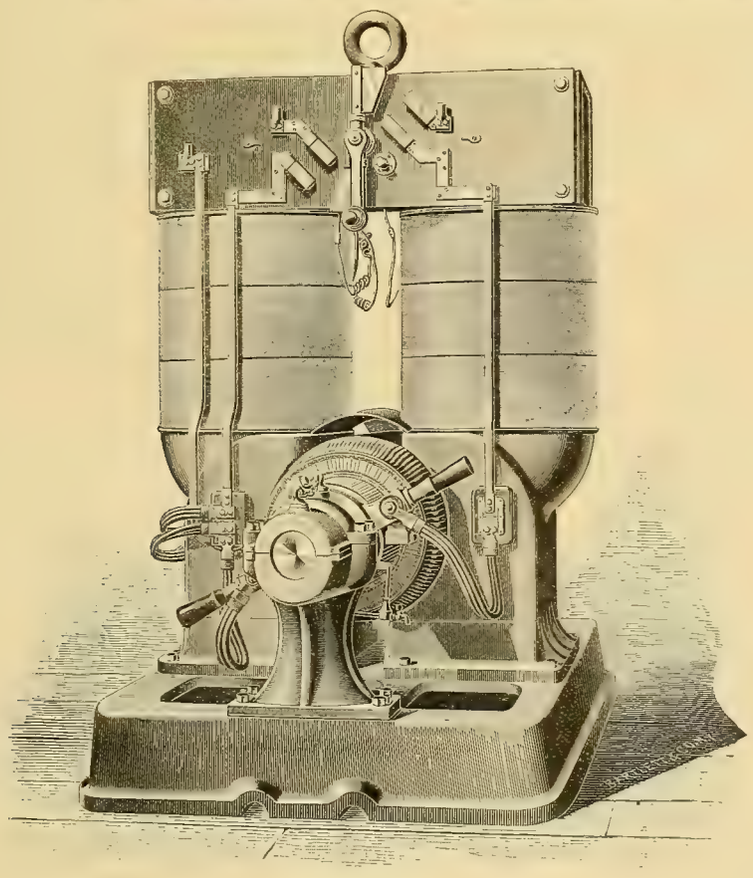
CUTTER'S LAMP SUPPORTING PULLEY.

which was recently placed upon the market, has been materially changed in order better to carry out this idea in the most severe practice. The cut shows the pulley as it appears when in use, the lamp being rigidly fastened to the knob, which is supported by suitable guides. The new clamp will fit the several sizes of iron wire or cable commonly used, and the swivel feature allows the pulley to work quite freely. The device is placed on the market by George Cutter, Chicago.

Edison Generator for Railway Work.

In the accompanying cut is illustrated the latest form of an Edison 200 kilowatt generator of the familiar bipolar type. The series field is built up of sections, wound on spools which are slipped over the cores and then connected up. Should a defect exist it can be located, and the spool in which it appears can be removed, repaired and replaced, or another substituted with little loss of time.

To adapt this generator to the demands of electrical



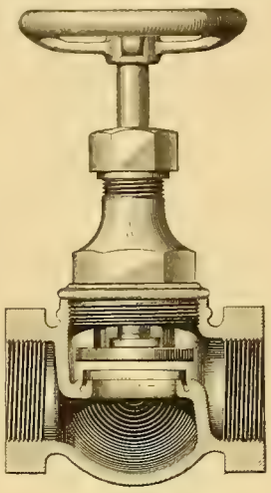
EDISON GENERATOR FOR RAILWAY WORK.

railway service, the field has been provided with a compound winding, easily adjusted to meet the necessary requirements by means of a shunt coil, conveniently placed in the back board of the keeper. The bearings being located close to the base frame, the center of gravity of the armature is low, and great stability is thus secured. Self-oiling bearings and carbon brushes contribute to diminish the attention necessary to the operation of the generator to a minimum.

The Knowles Lamp

The Knowles arc lamp for incandescent circuits, illustrated herewith, embodies several interesting features, in its construction and operation. Fig. 1 shows the lamp complete and ready for use, while in Fig. 2 the case is removed so that the working parts may be seen.

There is no projecting horn on the top of the lamp, no projecting globe holding tube on the bottom, and no projecting binding posts. It is so designed that it may be



THE ROY VALVE.

hung close to the ceiling of a room, and its length is such that even in a low studded room it will be clear of the heads of persons passing beneath it. Its feed movement is simple and accurate in construction and operation. The lamp case is dust and weather proof and can be easily removed. The lamp is ventilated in such a manner that any heat generated in the magnet coils, is rapidly carried away and dissipated.

The lamp operates normally at about 50 volts pressure, and requires from 6½ to 7 amperes. The lamp will run on any desired current from 5 to 10 amperes, and when once adjusted needs no alteration of adjustment for any variation of current between these limits.

The lamp when trimmed with a proper size and kind of carbon will burn with a current of from 6½ to 7 amperes at 50 volts pressure, for about 12 hours, thus making it a practical all-night single carbon lamp.

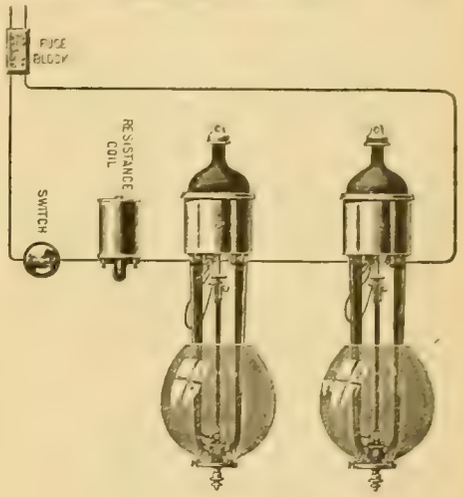


FIG. 3. THE KNOWLES LAMP.

Fig. 3 shows the manner of connecting and arranging the lamps when two are run in series upon a 110 volt circuit. The diagram is the same for other combinations of lamps, as for example when four are run in series upon a 220 volt circuit, or 10 in series upon a 500 volt circuit, merely substituting the required number of lamps for the two shown.

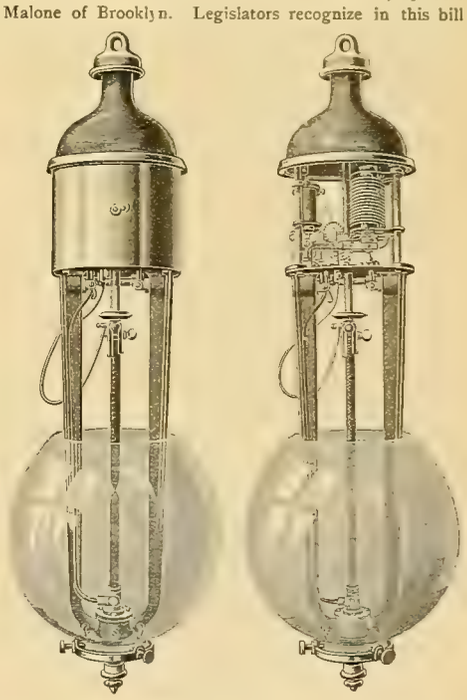
The lamp is provided with a ceiling hanger-board when used indoors, and with a substitute resistance equal to that of the lamp when more than two are run in series upon a constant potential circuit, and with an automatic cut-out when run in series upon a constant current circuit.

This lamp is the invention of Edward R. Knowles, chief electrician of the Schuyler Electric company.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 19.—The Telephone Subscribers' association is still digging away at its herculean task of securing legislation favorable to lower telephone rates in New York. On Tuesday last Secretary Gardner of the association had the pleasure of seeing his bill to create a telephone commission introduced in the Assembly by Mr. Malone of Brooklyn. Legislators recognize in this bill



FIGS 1 AND 2. THE KNOWLES LAMP.

the familiar features of the bill which Mr. Blumenthal fathered last session. Practically there is no difference between the two, but it is hoped that the last bill will meet with a better fate than that of the first. Reports from Albany state that members of the Legislature generally think it strange that action in this important matter has been postponed until this late day. Either of the bills which have been sleeping so long in the committee, could have been amended and reported weeks ago if any inter-

ested person had applied for a hearing. Members who put in those bills say they tried to awaken an interest on the part of Mr. Gardner's association, but failed, and each of the eleven members of the Committee on Gas and Electricity says practically the same thing. It must be admitted that there is a general undercurrent of belief in Albany that no telephone bill will be passed. Some think it can't be done because the corporation has paid for "protection." Others believe that it won't be done because of a lack of earnestness on the part of Mr. Gardner himself. The representative of the Western Union Telegraph company and the Metropolitan Telephone company at the seat of war, however, seems to be much stirred up over the discussion, and says all such bills are "strikes" against a great and good combination of capital. He denies that there is anybody of importance in the so-called "Telephone Subscribers' Association." If there is, he says, why doesn't Mr. Gardner publish a few of the names? However this may be, New York subscribers are hopeful, and, it is to be presumed, will do all the "hustling" that may be necessary.

On Tuesday the New York Board of Fire Underwriters took a formal stand against the practice of grounding electric lighting wires. The board condemned as unsafe the Edison system in service in New York, and passed a resolution ordering the practice to be stopped on a penalty of the withdrawal of the certificate of the board. This resolution, which amounts to a peremptory mandate, is of considerable importance, as the Board of Fire Underwriters now includes every company doing business in New York with four exceptions. The investigation which resulted in this action was begun by the underwriters to throw light, if possible, on a large class of "mysterious" fires, which, it was suspected, were due to imperfect insulation, or the grounding of electric light wires in large buildings and dwellings. It was based on a report from the Committee on Police and Origin of Fires and took form in the passage of the following resolutions:

Resolved, That the Committee on Police and Origin of Fires be, and it is hereby directed to require all electric companies furnishing current for power and lights (to parties that have received certificates of approval of electrical equipments from this board) to make regular weekly reports of the tests of their currents, as called for in the requirements of this board, and in the event of failure on the part of the electric companies so to do, the superintendent of the Survey department is hereby directed to decline to grant certificates or make inspections of equipments supplied with current by said delinquent companies.

Resolved, That said committee give notice to all electric companies receiving certificates from this board that the intentional grounding of any portion of the equipments is a violation of the rules of this board and such practice must be discontinued. This board will refuse certificates of approval of all companies who do not comply with this rule.

Resolved, That the committee require of electric companies that all grounds now existing on electric circuits shall be removed on or before Oct. 1, 1892.

Those progressive gentlemen who proudly claim the World's Fair city as their home, will smile when they read that the statue of Diana which now surmounts the tower of Madison Square garden is to be taken from her lofty pedestal and will probably be sent to Chicago. It has been decided, it seems, that the present statue is just a trifle too large for the metropolis, so the new Diana which is to replace it will only be thirteen feet high. The present one is eighteen feet high.

The Coney Island & Brooklyn railroad company made application at Albany on Friday to the State Board of Railroad Commissioners for permission to change its motive power from horses to electricity on that portion of its line on Smith, Jay, Prospect, Main and Water streets, to the Fulton Ferry.

The bids for lighting the streets of Brooklyn were opened this week. They were as follows: Citizens' Electric Illuminating company and Municipal Electric Light company, $182.50 per lamp per year; Brooklyn Gaslight company, $19.80 per lamp per year; People's Gaslight company, Nassau Gaslight company, and Metropolitan Gaslight company, each $20 per lamp per year.

W. F. O.

St. Louis, Mo.

ST. LOUIS, March 22.—A. M. Morse, M. E., until quite recently of English, Morse & Co., Kansas City, has been appointed manager of the St. Louis branch of the Falls Rivet & Machine company, Cuyahoga Falls, O., which manufactures power transmission machinery. This company has equipped some of the most prominent electric light and railway stations in the country, among them being the plant of the Municipal Electric Lighting & Power company, St. Louis, and the Masonic Temple, Chicago.

The Emerson Electric company, finding some months ago that more factory room was needed, rented an entire building on St. Charles street, and is now getting the machinery in place, its offices fitted up, and everything in order for an active season. The building is 60x100 feet, three stories in height, and is suited in every way for a future growth of the business that now seems certain. In addition to the change in location, a change in management has also taken place within the last month. Judge Emerson of Ironton, Mo., a large stockholder and president of the company, being somewhat advanced in years and wishing to retire, has sold his interest to H. L. Parker, who has been elected president and manager, the other officials remaining as before. Mr. Parker is an eastern man, but for some years has held a responsible position with a railway company in the City of Mexico. A large amount of working capital has also been provided, making the capitalization $75,000. In addition to the fan motor for an alternating circuit, put on the market last year, this company will make a small motor for the same current, to be used as a motor for general purposes. The company has, since its organization about a year ago, brought out several appliances that have attracted attention and have been adopted as standard by some of the leading railway and lighting companies of the country. With several other specialties in hand, and with the increased facilities already provided, the prospects for this company appear to be particularly bright.

The St. Louis Electric Supply company has leased an adjoining room, largely increasing its store and office facilities, and will soon have one of the most complete stock of supplies carried by any house in the West. Archways connecting the two stores are being cut through, and no pains will be spared in fitting up. This company recently sent out a calendar that is a novelty in its way. On the face of the card there is a group of maidens representing the four grand divisions of this country. On the bare arms of the one representing the South is inscribed the well-known formula, $C=\frac{E}{R}$. Friends of the manager are at a loss, however, to know whether the mathematical meaning is the one intended, or whether the initials might not be a private mark.

A destructive fire took place on the 18th in a building occupied by the Liggitt & Myers Tobacco company. The following morning the *Republic* of St. Louis, and, I think, one other morning paper announced that the fire was caused by the insulation burning off the electric light wires, and the bare wire coming in contact with the wood. In the following issue of the paper Mr. Ruebel, of the St. Louis Electric Supply company, published a statement showing that his company had wired the building, and that there were no wires in the room where the fire broke out, or in that part of the main building. This was allowed to go without a retraction on the part of the newspaper.

The Columbia Incandescent Lamp company during the last year has rapidly grown in popular favor until the second enlargement of its factory is now necessary. During the last four months the factory has been run night and day, and still the orders are considerably behind. Since March 1st two orders of 10,000 lamps each have been received, and between March 1st and 15th the sales have been in excess of 30,000. Aside from the commercial lamp, a special lamp for street railway and motor cars is being made. A special feature of this lamp is that the filament is anchored at the bottom to prevent vibrations and early discolorations. This lamp is carefully tested in series for use on railway circuits. The factory is equipped with the latest and best machinery for the manufacture of high grade lamps, and the greatest care is taken to insure the proper rating in candle power and voltage, such tests being made before the lamps leave the factory. The tests for vacuum are very exhaustive. The exhaustion of the lamp by the method pursued, it is claimed, prevents the discoloration of the bulb and causes the lamp to retain its candle power to the highest degree. The "Columbia" ought to be a popular lamp during the next two years at least, and with the aggressive policy that has been decided upon by the company there ought to be no doubt as to the result.

D. H. O.

PERSONAL.

S. A Barton, president of the Brush Electric company, was in Chicago last week.

A. M. Morse of A. M. Morse & Co, St. Louis, was a visitor in the World's Fair City last week.

Geo. W. Cate, electrician of the Edison Illuminating company, Detroit, Mich., visited the World's Fair city last week.

Prof. H. S. Carhart, of Ann Arbor, Mich., was in Chicago on Monday on business connected with the World's Electrical Congress.

William D. Kurz, superintendent and electrician of the Edison Light and Power company, La Crosse, Wis., was in Chicago last week.

J. W. Johnson, manager of the isolated lighting department of the Chicago office of the Thomson-Houston company, is confined to the house by illness.

H. A. Kinney, formerly with the Omaha Consolidated Electric company, has accepted a position as salesman for the Detroit Electric Works, Detroit, Mich.

Secretary H. J. Stambaugh, of the Falls Rivet and Machine company, Cuyahoga Falls, Ohio, spent a day or two at the company's office in Chicago last week.

B. L. Dodge has resigned his position as superintendent of schools at Oak Park, Ill., to become manager of the Cicero Water, Gas & Electric Light company.

C. A Daigh, vice-president of the National Electric Manufacturing company, Eau Claire, Wis., was at his Chicago office in the Rookery several days last week.

J. H. Rhotehamel, president of the Columbia Incandescent Lamp company, St. Louis, has just returned home from a business trip through the East, lasting about ten days.

H. W. Shurtz, secretary and treasurer of the Northwest Electric Engineering company, Portland, Oregon, has just passed through Chicago on his way home after a wedding trip in the East.

R. A. Hewitt, secretary and treasurer of the American Electric Elevator company of New York, took dinner at the Chicago Electric club on Saturday, as the guest of Geo. P. Nichols.

NEW INCORPORATIONS.

Wolverine Electric Light company, Holland, Mich.; capital stock, $25,000; guaranteeing electricity for light; G. J. Diekema, Holland, Mich.

Omro Electric Light & Power company, Omro, Wis.; capital stock, $5,000; producing and furnishing electric light and power; Charles Folker, Oshkosh, Wis.

Escanaba Electric Street Railway company, Escanaba, Mich; capital stock, $50,000; electric street railway; Escanaba Electric Street Railway company, Escanaba, Mich.

Bayonne City Electric Light & Power company, Bayonne, N. J.; capital stock, $50,000; supplying Bayonne City with electric lightand power, etc.; Hildreth & Barker, 32 Nassau st.; New York city, N. Y.

Ridgway Electric Light company, Ridgway, Pa.; capital stock, $10,000; supplying light, heat and power or any of them by electricity to the public in Ridgway; Fred. H. Ely, Ridgway, Pa.

Elmira Municipal Improvement company, Passaic, N. J.; capital stock, $1,000,000; building, constructing and equipping of electric light, etc.; F. S. Smith, 54 Wall street, New York city, N. Y.

Electric Railway Construction company, Jersey City, N. J.; capital stock $50,000; building, constructing, repairing and equipping of railways, etc.; A. W. Kent, 52 William street, New York city, N. Y.

Fremont Electric Light & Power company, Manitou, Col.; capital stock, $50,000; to build and operate a plant for furnishing electric light, power and heat in the town of Fremont, El Paso county, Colo.

Spring Garden Mining company, San Francisco, Cal.; capital stock, $1,000,000; to develop and operate mining and agricultural property, water, electric power, sawmills, etc.; George F. Stone, Oakland, Cal.

Electric Launch & Navigation company, Camden, N. J; capital stock, $300,000; manufacturing, dealing in, furnishing and supplying electricity, light, heat and power, etc.; H. Weston, 31 Nassau st., New York city, N. Y.

Electric Construction & Supply company, Jersey City, N. J; capital, stock, $225,000; to manufacture, sell, lease, mortgage or otherwise acquire and dispose of electrical materials, etc.; F. DeLysle Smith, 18 Cortlandt street, New York city, N. Y.

Tower Electric Light & Telephone company, Duluth, Minn; capital stock, $60,000; to generate and sell electric current for light, heat and power, erect telephone lines, buy, sell, lease and deal in electric fixtures and supplies; E. C. Jones, Duluth, Minn.

Pneumatic Fire Telegraph Alarm company, Philadelphia, Pa., capital stock $250,000; carrying on the business of manufacturing mechanical or electrical appliances and devices; working or operating by means of compressed air; Colesberry & Shattuck, Fifth and Chestnut streets, Philadelphia, Pa.

Western Investment company, Seattle, Wash.; capital stock, $300,000; to build, construct, operate and own railroads, steamboats, street cars, electric light and gas works, water works, telegraph and telephone lines, docks, piers, coal and other mines, mills and real estate and buildings; John D. Boyd, 12 Colman block, Seattle, Wash.

Greencastle Gas & Electric Light company, Greencastle, Ind.; capital stock, $50,000; to manufacture and sell gas either for the purpose of illumination, heat or furnishing power, and also to generate electric light and power, to such persons or corporations as may require it, and the company shall have the right to lay pipes through the streets and alleys of the city and erect poles for electric light.

Kanawha Falls Water Power Electrical Manufacturing company, Charleston, W. Va.; capital stock, $1,000,000;

concentrating, utilizing and controlling the power of the water current of the St. Kanawha river and its tributaries for a distance of five miles to supply motive power to dynamos for generating electricity etc.; O. A. Patton Charleston, W. Va.

ELECTRIC LIGHTING.

The capital stock of the St. Louis Electric Light & Power company has been increased from $30,000 to $75,000.

The new electric lighting plant of the Canton, Miss., Water Works & Electric Light company is to be ready for operation by August 1st.

The city of Cincinnati is seeking bids for an isolated electric lighting plant for the waterworks pumping station on the corner of West Sixth street and Mt. Hope road.

The city council of Richmond, Va., has adopted a resolution appropriating $125,000 of 4 per cent. city bonds to be used for purchasing a site and erecting an electric light plant.

Two 540 light Edison dynamos will be installed in the new Tobin apartment house at Thirty-third street and Cottage Grove avenue, Chicago. The Chicago Edison company has the contract.

Among other enterprises contemplated by the Yoakum, Tex., Improvement company is the establishment of an electric light plant. The capital stock of the company is to be increased to $150,000.

The Citizens' Electric Light company, of Braddock, Pa., gave notice to its patrons that a 20 per cent. reduction in rates would go into effect on March 1st. The reason for this unexpected move is believed to be the formation of an opposition company.

An isolated incandescent lighting plant is to be installed in Chapin & Gore's restaurant on Monroe street, Chicago, by the Chicago Edison company. The establishment will be lighted by 360 16 candle power lamps supplied from a dynamo in the basement driven by a Buckeye engine now in service.

The city of Rochester, Minn , is to be equipped with a complete central station plant by the Western Electric company at a cost of about $16,000. The installation will include two arc light dynamos, with a capacity of 90 lamps of 2,000 candle power each, and a 750 light alternator for incandescent lighting.

A bill has been introduced in the Senate of New York giving additional power to the Buffalo & Niagara Falls Electric Light & Power company. It allows the company to obtain by lease, purchase or condemnation, real property in Erie or Niagara counties, and gives the right to lay pipes, conduits or string wires over any highway, railway or canal, by getting consent of commissioners or superintendent of such thoroughfares, and if consent cannot be had, the right of way to be obtained from the Supreme Court.

The National Electric Manufacturing company has recently installed at Menominee, Wis., a lighting plant consisting of one National generator for 1,000 lights and one Western Electric arc light generator for 50 lights and two 13x12 Ideal engines rated at 100 horse power each. The engines were coupled direct to the line shafting, a friction clutch being used. Two Stirling water tube boilers, 100 horse power each, were also installed. Arrangements are being made to use crude oil for fuel.

W. H. Schott has just completed an installation of a municipal arc plant of 150 lights at Muncie, Ind., for the Western Electric company. The plant consists of three 50 light generators, the power being supplied by an Atlas engine of 200 horse power. A special fire and weather proof wire made by the Western Electric company is used. The circuit is twenty miles in length, the poles are all being painted, and have oak cross arms. The plant is one of the best ever built by the Western Electric company, and has been accepted by the Muncie authorities.

North Knoxville, Tenn., is in trouble over its street lights. Some time ago the Knoxville Electric Light and Power company agreed to furnish 1,200 candle power arcs on a partial moonlight schedule, on the basis of a payment of $8.33⅓ each per month. The charge for 2,000 candle lamps to be $10 each per month. This contract expired on March 1st, and a week or so prior to the expiration of the contract the company notified the authorities that it would be compelled to ask an increase to $10 and $12 each per lamp, respectively, on a renewal of the contract. The city council came together and decided not to pay the advanced rate, and resolved to call for proposals for other means of lighting. The council also empowered the mayor to say whether the company's poles and wires should be removed from the streets.

The annual meeting of the Brush Electric company was held at Cleveland March 16th. The following directors for the ensuing year were elected: S. A. Barton, Boston; J. S. Bartlett, Boston; Myron T. Herrick, Cleveland; J. Potter, Cleveland; C. A. Coffin, Boston; William B. Bolton, Cleveland; S M. Hamill, Cleveland. Immediately after the stockholders' meeting the new board of directors met and elected the following officers: S. A. Barton, president; John S. Bartlett, first vice-president; C. A. Coffin, second vice-president; S. M. Hamill, secretary; L B Le Vake, assistant secretary; J. Potter, treasurer; A. H. Hough, assistant treasurer, William B. Bolton, general counsel; J. F. Hughes, auditor; S. H. Short, general electrican; F. A. Scheffler, superintendent; C. W. Phipps, assistant superintendent; S. M. Hamill, general manager; advisory committee, J. Potter, William B. Bolton, S. M. Hamill; manufacturing committee, S. H. Short, F. A. Scheffler, S. M. Hamill.

ELECTRIC RAILWAYS.

The Thomson-Houston company has secured the contract for the construction of the new electric line at Stockton, Cal. The road is to be in operation in July.

The City & Suburban Railway company of Savannah, Ga., has awarded a contract to L. H. McIntire, of New York, for the equipment of its lines with electricity. The Thomson-Houston system will be used, and about eighteen miles of road converted to the electric system.

A third electric railway between St. Paul and Minneapolis may be built this year. The line will be an extension of the Grand avenue line in St. Paul, will cross the Mississippi river on the Marshall avenue bridge, and will probably connect with the Minneapolis line to Minnehaha Falls. The line will be built if the donors of the bonus for the Selby avenue cable line withdraw their objections to the use of electricity on the extension of that line.

It is proposed to use the electric railway in connection with the new mining camp at Creede, Colo. A line connecting Creede with land on the first beach near the mouth of Willow Gulch, a mile or so below Jimtown, is projected. This road will be of value to those who wish to do business or live in the Creede section. The electric line will bring into use thousands of acres of land not utilized now on account of the great distance from the center of operations.

The proposed electric railroad from Rockland to Camden, Me., will carry freight and mail as well as passengers. Closed freight cars will be used, and every accommodation of a steam road will be given. The length of the road from the center of Rockland to the Camden line will be some nine and a half miles. Work will be commenced on the construction as soon as the weather permits, and it is hoped to have the road in operation by June 1st.

The Rochester Railway company recently advanced the wages of its motormen and conductors, and the latter have issued a card in which they say: "The increase of wages lately conceded to us is most highly prized, especially as it was unsolicited. In future, as in the past, we shall make every effort to serve the interests of the company, and care for the comfort, convenience and safety of its patrons. By this means we shall prove our worthiness of kindness and consideration. Where such generosity and justice actuate employers there is no necessity for protective unions."

It is proposed to appoint a joint parliamentary committee to consider the best method of dealing with the electric and cable railway schemes for London brought before Parliament this session. The committee would be instructed to report whether underground railways worked by electricity or cable traction are calculated to afford sufficient accommodation for the present and probable future traffic; whether any of the schemes propose satisfactory lines of route; upon what terms and conditions the subsoil should be appropriated, and whether any of the schemes should be proceeded with during the present session.

It is announced that the Rochester, N. Y., Railway company has decided to complete the equipment of its lines with electric motors and increase the number of cars now operated by electricity. The company last week placed an order for 200 Westinghouse motors. It is also annouced that an order has been given the John Stephenson company, of New York, for small cars to run under the Clinton, Hudson and St. Joseph street bridges of the Central railroad. The rails for the laying of track for the electric cars that are to take the places of the few remaining horse cars have been received and the work has been begun of distributing them along the lines preparatory to laying them as soon as the frost is sufficiently out of the ground. It is expected that within a couple of months all the horse cars will be replaced by electric cars, for the company intends to push the work with all possible speed as soon as the weather will permit.

MISCELLANEOUS.

The bursting of a big fly wheel in the Brush electric light station at Cincinnati on March 14th, caused about $12,000 damage to building and machinery. The wheel weighed 48,000 pounds. Seven men were in the building at the time of the explosion and all of them escaped without injury except Engineer Fred Cottrell, whose face was scratched a trifle by a piece of flying brick.

There is a common notion that our colleges and universities are somewhat out of touch with the work of the business world. However this may have been in the past, the speedy way in which the schools have adapted their instruction to the needs which have arisen in the development of the arts pertaining to electricity shows that they are now quick to meet the demand which the public may make upon them for instruction. Within the last year Harvard college has erected and equipped a new laboratory of electrical engineering intended to train students in practical work. This course is especially designed for those students who are pursuing the four years' course in electrical engineering in the Scientific school. This laboratory with its workshops is an addition to the admirable resources afforded by the electrical laboratories in the Jefferson building. In this structure the students will receive the preliminary training in physics, while the strictly technical instruction is allotted to the new building. The first use of the new laboratory will be made in the summer course of electrical engineering which will be given in July and August of this year. This course will consist of general instruction supplemented by work in designing, constructing and testing electrical apparatus. It will begin July 6th and continue for six weeks. As the school is within three miles of the center of Boston the opportunities for becoming familiar with large electrical plants are very good. Information in regard to these courses can be obtained from C. A. Adams, Jr., 22 Mellen street, Cambridge, Mass.

TRADE NEWS.

The Crown Electric Manufacturing company of Bridgeport, Conn., has a number of novelties under way which will soon be offered to the trade.

General Manager O. S. Lee of the New England Switch company, Bridgeport, Conn., has a large number of orders for future delivery, and reports that the call for their "Standard" switch is very gratifying.

Beginning on May 1st next, the Stearns Manufacturing company of Erie, Pa., will establish a branch office in Chicago, which will be under the management of A. F. Griswold, who has been with the firm for a great many years. The company's Chicago quarters will be in the Rookery building, room 120.

Secretary C. J. Swift, of the Duplex Electric company of Corry, Pa., was a visitor at the New York office of the WESTERN ELECTRICIAN last week. Mr. Swift reports good business in Duplex lamps. He will include in his trip before his return to Corry, Philadelphia, Baltimore, Pittsburg and a number of other cities.

The new Pfister Hotel at Milwaukee, which is to have one of the finest isolated plants in the West, will require 3,000 incandescent lamps. Simplex braided rubber wire will be furnished for this plant by George Cutter, Chicago. Mr. Cutter is also pleased by the decision in favor of Simplex wire for use on the new signaling plant for the Chicago & Northwestern railroad.

Henry V. Parsell, Jr., New York, who is connected with the Otto Gas Engine company of Philadelphia, returned last week from a trip south as far as Florida. Mr. Parsell stated that the Citizens' Gas & Electric company of Jacksonville, Fla., was considering the feasibility of the gas engine as a motive power for running its central station, and would probably make this change within the next six months.

The Premier Electric company of Brooklyn, N. Y., is showing samples of their "Baby," a small motor made on an improved model for fan and toy purposes. This little machine is known as the "Premier No 1." The Premier company reports business as being very brisk, both for this size and "Nos. 2 and 3." Orders are on hand for immediate delivery from Albany, Boston and a number of large western cities.

Geo. W. Walker and R. S. Lozier, not to forget Engraver Bartlett, deserve credit for the handsome and artistically arranged pamphlet on "Central Station Lighting" that they recently prepared for the Edison General Electric company, New York. The little book contains short descriptive articles on the advantages of the Edison incandescent light. Its mission is to interest the layman as well as the electrician, and to present pertinent facts which are of special interest to those who contemplate investment in central station plants.

The Rockford Electric Manufacturing company has established a business office in Chicago, at room 451, "The Rookery," with District Manager F. E. Drake in charge. It is expected that the headquarters of the company will be removed to Chicago at an early day, this being the first step in that direction. The immediate territory to be covered from this office at present comprises Illinois, Wisconsin, Northern Indiana, and Western Michigan. Mr. Drake held an important position with the Standard Electric company until a recent date, and is favorably known to the trade.

Through the courtesy of Superintendent Alex. Churchward of the Riker Electric Motor company, New York, a representative of the WESTERN ELECTRICIAN was recently shown through this factory. The machinery used by he company is of the latest type, enabling it to turn out strictly first-class work. The company's testing room is one of the best equipped in the neighborhood of the metropolis. Mr. Churchward stated that since March 1st the factory has been run 15 hours a day in order to turn out the work it had on hand. As soon as possible, the company will begin to manufacture a lot of 150 motors and dynamos, ranging from 1 to 50 horse power for ready stock. During the last two weeks orders have been received from Boston, New York and a number of large cities in the West. The Riker company will probably make an extension to the factory or erect a large new one.

BUSINESS.

The Falls Rivet & Machine company, Cuyahoga Falls, Ohio, has under way an installation of line shafting, friction clutches, etc., for the Clinton Gas Light & Coke company of Clinton, Ia. This is quite a large plant, and will be used for lighting and street railway power.

The Williams Engine company of Baltimore, Md., is very busy. Orders are coming in, inquiries are numerous, and prospects for trade this spring are better than ever before. The company is making improvements in its engine, and already has orders for several engines. New machinery is being installed especially suited to the work.

Thirteen is said to be an unlucky number. But when one hears of an electrical engineer that has been in business thirteen months on the thirteenth floor of the Auditorium, and is being consulted on the electrical work for thirteen large buildings, one is inclined to believe, with Charles G. Armstrong, that Chicago is no place for the superstitious.

The Disque battery made by the Partrick & Carter company has many points of superiority that have given it a well earned reputation for reliability. Improvements have been lately added which greatly increase the efficiency and cleanliness of this battery. The lead top connection and covered cell are new features that will be welcomed by users of open circuit batteries.

Charles H. Davis, C. E., in his little folder "Facts and Figures Interesting to Electric Railroad Men," announces that he does no contract work and has no connection with any contractor or manufacturer. In retaining him a purchaser of electrical machinery secures the services of an independent and unbiased engineer. Mr. Davis aptly describes his wo k as that of an "electrical architect."

The McGuire Manufacturing company, Chicago, has received an order from the Consolidated Street Railway company, Grand Rapids, Mich., for twenty McGuire "19 B." trucks for March delivery. This order has just been increased to thirty and will soon be completed, making the fifth from this source in as many months. James R. Chapman, who has charge of the operating department of this road is a street railway man of national reputation, and his adoption of this truck is considered a flattering testimonial to its merits.

The Rockford Electric Manufacturing company is placing a new 25 horse power "iron clad" motor in the Chicago *Inter Ocean* press-room, to be used in operating a fast press. This company has at present seven Rockford motors in use, counting the one now being put in place, aggregating 107½ horse power. The *Inter Ocean* managers have given a number of flattering testimonials of the efficiency and reliability of the "iron clad," having had a part of the plant in operation over two years. This is probably the largest plant of the kind in use in Chicago.

The Mather Electric company, Chicago, has secured an order from the Goodrich Steamboat company for one of its latest improved automatic projectors of 35,000 candle power, to be used on the steamer Virginia. The light will be placed under the control of the officer in immediate command on the "bridge," who will be able in an instant to change it from a beam to a diffused light. The lens is to be 23.62 inches in diameter, and is guaranteed to throw a beam 10,000 feet. The apparatus was made by a house in Paris, and is now on its way to Chicago.

The Electrical Engineering & Supply company, St. Paul, has just closed a contract with the Deer Lodge Electric company, of Deer Lodge, Mont., to install a complete central station plant with a capacity of 30 arc and 750 incandescent lights. The National transformer system and a Sperry arc light machine will be used. Power will be furnished by a 125 horse power Ideal engine. F. J. Cram, general agent of the company, has recently taken a number of orders in Montana, the above mentioned being the largest. The plant is to be completed by June 1st.

Through the courtesy of Secretary J. C. English of the Bridgeport Electric Light company of Bridgeport, Conn., a representative of the WESTERN ELECTRICIAN was permitted to inspect the plans and specifications for a new electric light station which this company is about to erect. The station will have a frontage of 220 feet on Congress street, and will extend back to the river. The plant will have a capacity of about 2,500 horse power, and the company will furnish the city arc lights from this station. The specifications call for a plant which will be complete in every detail, and the company expects it to be "the model of Connecticut."

A fair index of the great amount of business in sight in the electric railway line can be found at the office of the Electric Merchandise company, Chicago. As the company has confined its business strictly to electric railway supplies, it is perfectly natural for street railway men to call and examine their standard appliances. The business of the company is constantly increasing and its popularity steadily growing, owing in great part to the prompt and careful attention to orders which are intrusted to it. Owing to largely increased facilities, the company is better fitted than ever to meet the demands of the trade.

Since the Central Electric company, Chicago, took the agency for the tubing of the Interior Conduit & Insulation company, it has been overwhelmed with orders, a number of the largest buildings in Chicago, St. Louis and Kansas City being supplied with the system. The business in this department of the Central Electric company bids fair to make it one of its most prominent departments. The company also reports activity in its pin and bracket department. The factory at Columbia City is in full operation, and the goods are being sent far and near in carload lots. The pin and bracket made by this firm are of approved quality, and have a steady demand.

According to an estimate by the Clark Electric company, 192 Broadway, New York, the total cost of electric light produced by the Clark system from twenty arc lamps, total illumination 40,000 candle power, including the cost of power, carbons, attendance, interest, etc., is sixty cents per hour. In the Clark system regulation is accomplished by counter electro motor force; that is, the dynamo proper is shunt-wound, and another smaller dynamo connected in the shunt circuit acts to increase or diminish the intensity of the field according to the number of lights that are in use. This is accomplished so quickly, it is said, that any number of lights may be turned on or off without a perceptible change in the illumination.

The National Electric Manufacturing company at Eau Claire, Wis., has recently broken ground for an addition to its factory, 50x100 feet, two stories in height. The lower floor is to be used as an erecting shop, while the upper story will be used as a winding room, a draughting room and a laboratory. The National company has just closed a contract with E. P. Allis & Co., Milwaukee, for a Corliss engine, 1890 type, rated at 400 horse power. The fly-wheel weighs 30,000 pounds, and the engine, complete with the condenser, 45 tons. A contract has also been made for a Stirling water tube boiler, 250 horse power. The engine and boiler are to be used for testing purposes and are an addition to the present plant.

ELECTRICAL STOCK MARKET.

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, March 19th, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	96¼	97
Edison Illuminating company of New York	81½	82
" " " Brooklyn	76	80
" " " Boston	105	110
" " " Chicago	130	140
Edison Ore Milling company	15	20
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomson-Houston Electric company	58	58½
" " Preferred	28	28½
Westinghouse Electric company	16¼	16¾
North American Phonograph company	5	6
New York "	2½	5
Automatic Exhibition company	2	3

ELECTRICAL PATENTS.

Issued March 15, 1892.

470,654. Electric Railway. Edward M. Bentley, Boston, Mass.

Claim eight reads:
"The combination, with the line conductor of an electric circuit, of a series of conducting plates permanently connected therewith, and forming a resistance preventing the formation or continuance of an arc between the said line conductor and a neighboring conductor."

470,656. Motor for Electric Cars. Francis O. Blackwell, Boston, Mass.

470,657. Contact Device for Electric Railways. Francis O. Blackwell, Boston, Mass.

470,666. Police and Fire Alarm Signaling Apparatus. Leroy B. Firman, Chicago, Ill.

470,667. Combined Police and Fire Alarm Signal Apparatus. Leroy B. Firman, Chicago, Ill.

470,697. Protector for Electrical Apparatus. Charles H. Morse, Cambridge, Mass.

470,701. Secondary Battery. George F. Parker and Chas. E. Crapo, Rochester, N. Y.

Claim one reads:
"The herein described dome-shaped metallic plate for secondary batteries, provided with tapering recesses for the active material extending through the plate and arranged in the exciting liquid in the horizontal position with its concavity downward, whereby the gases are retained in the concavity and the liquid is excluded therefrom."

470,721. Lightning Arrester. Elihu Thomson, Lynn, Mass.

470,722. Tell-Tale Device for Electric Circuits. Edgar Tregoning, Malden, Mass.

470,736. Lightning Arrester. George M. Bacon, Scranton, Pa.

470,748. Electric Switch. Samuel Deacon, Lynn, Mass.

470,749 Field Magnet for Dynamos. George E Dorman, Chicago, Ill.

This invention consists of a series of short overlapping arc-shaped segments, with inwardly projecting ends in alignment so as to form a circular field-magnet with inwardly projecting pole-pieces.

470,752 Electrical Hose Signaling Apparatus. William Fowler, Colorado Springs, Col.

470 766. Arc Light Hanger. Charles A. Pfluger, Chicago, Ill.

This invention consists of the combination in an arc-light hanger of vertically movable suspending hooks, each provided with a fulcrum and a spring, whereby it is retained or restored to its normal position.

470,768. Printing Telegraph. Edward J. Silkman, Baltimore, Md.

470,772. Circuit Interrupting Device. Alexander Wurtz, Pittsburg, Pa.

470 773. Circuit Interrupting Device. Alexander Wurts, Pittsburg, Pa.

470,774. Apparatus for Protecting Circuits. Alexander Wurts, Pittsburg. Pa.

470,784. Dynamo. William H. Elkins, Cambridge, Mass.

470,785. Dynamo. William H. Elkins, Cambridge, Mass.

470,786. Appointment Signal for Telephones. Silas W. Gray, Fort Dodge, Iowa.

470,790. Electric Switch. Hugh Moore and Oliver O. Jerrard, Mauch Chunk, Pa.

470,792. Galvanic Battery. Francis H. Root, Chicago, Ill.

The second claim reads:
"The combination, with a galvanic cell, of a rubber stopper and rubber coated wires, the coatings of the wires and the rubber stopper being united as one piece."

470,793. Switch for Electric Signaling Apparatus. Leopold Sellner, Vienna, Austria-Hungary.

470,806. Railroad Circuit Closer. Frank E. Kinsman, Plainfield, N. J.

470,810. Employes Time Recorder. William Lucas and Thomas A. Garrett, London, Eng.

470,813. Electric Railway Signal. Adoniram J. Wilson, Port Chester, N. Y.

470,817. Electric Railway Motor. Francis O Blackwell, New York, N. Y.

The twentieth and last claim reads:
"In an electric railway car motor, a bisected field magnet frame sleeved on the car axle, in combination with an armature mounted on said frame parallel to the car axle and having both parts of its journal-bearing carried by a detachable portion of the frame."

470,820. Electric Connector. William H. Garland, Chelsea, Mass.

470,831. Annunciator. Archibald H. Brintmell, Toronto, Canada.

470,844. Electric Wire Support. Francis O. Blackwell, New York, N. Y.

470,865 Transmission of Electrical Energy to a Distance. Marcel Deprez and Jules Carpentier, Paris, France.

This invention consists in generating and maintaining practically uniform currents of high tension at one station, and sending the same over a line of conductors to another station, and generating maintained and practically uniform currents of lower tension at the second station by the inductive influence of the high tension currents.

470,883. Insulation for Electric Wires. Samuel Vanstone, Providence, R. I.

This invention consists of an insulating covering for electric wires formed of abutting longitudinally divided sections of rigid non-conducting material, the abutting ends of which form a socket joint.

470,922. Manufacture of Filaments for Incandescent Lamps. Thomas A. Edison, Menlo Park. N. J.

This invention consists of a method of forming blanks or sheets, consisting in treating separately two or more sheets of paper with hydrofluoric acid to form a cementing material, and then placing such sheets together.

470,923. Railway Signaling. Thomas A. Edison, Llewellyn Park, N. J.

470,924. Electric Conductor. Thomas A Edison, Llewellyn Park, N. J.

This invention consists of the combination of a wire, a fabric covering thereon, and an outer covering mixture of rubber and infusible material.

470,925. Manufacture of Filaments for Incandescent Electric Lamps Thomas A. Edison, Llewellyn Park, N. J.

This invention consists of a filament for forming the carbon incandescing conductor of an electric lamp, consisting of a number of fine filaments welded together by a carbonizable cementing substance. It also consists of the method of manufacturing incandescing conductors for electric lamps, consisting of uniting by a carbonizable cementing substance, a number of carbonizable filaments, and then carbonizing the whole.

470,926. Dynamo Electric Machine or Motor. Thomas A. Edison Llewellyn Park, N. J.

This invention relates to the construction of electric motors and dynamos, and relates more especially to the field magnets and to means for connecting the armature coils to the commutator plates. It consists of a magnet pole-piece comprising several distinct layers of iron or steel united for a part of their length into an integral mass.

470,927. Driving Mechanism for Cars. Thomas A. Edison, Llewellyn Park, N. J.

470 928. Alternating Current Generator. Thomas A. Edison, Llewellyn Park, N. J.

This invention consists in the combination in an electro magnetic machine of a laminated open field magnet with projecting poles, an armature revolving in front of said poles, and a fan for causing circulation of air.

470,929. Magnetic Separator. Thomas A. Edison, Llewellyn Park, N. J.

470,930. Dynamo Electric Machine. Thomas A. Edison, Llewellyn Park, N. J.

470,942. Appliance for Sighting Guns. Ludwig M. von Markhof, Vienna, Austria-Hungary.

470,946. Underground Electric Conduit. James F. Munsie, Jersey City, N J.

This invention consists of the combination in an underground electric conduit system, with a distributing duct accessible or open at its ends, and a service pipe leading transversely from the distributing duct, the service pipe being open or accessible at its end, remote from the main conduit, and a grappling device for withdrawing wires from the distributing duct through the service pipe.

470,994. Contact Maker. Daniel Draper, Hastings on-Hudson, N. Y.

471,053. Electric Actuated Vending Machine. Archie J. Henry, Watertown, N. Y.

471,063. Electric Elevator. Rudolph C Smith, Yonkers, N. Y.

Of the eight claims the fourth is presented:
In an electric elevator apparatus, the combination, with a multiple wire system of electrical distribution, of a shunt motor the field-magnet coils of which are connected to produce a constant field of force, a switch device, and means for connecting the armature circuit to the leading wires of the system to vary the speed of the motor.

471,064. Electric Elevator. Rudolph C. Smith, Yonkers, N. Y.

Claim fifteen reads:
"15. In an electric elevator, the combination, with the motor and car operated thereby, of a switch mounted on the car, a circuit between the switch and field-magnet coils, a solenoid in said circuit, a switch operated thereby and controlling the armature-circuit, and resistance devices on the switch arranged to be included in the field-magnet coils to vary the speed of the motor."
The object of this invention is to provide means whereby the switch may be mounted on the car and travel therewith and be operated without danger of sparking, burning or otherwise interfering with the circuits.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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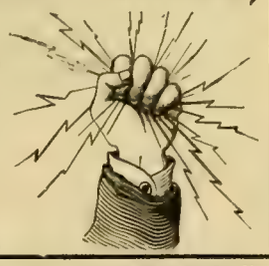

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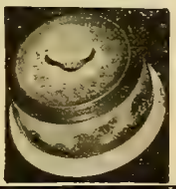

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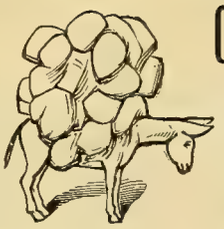

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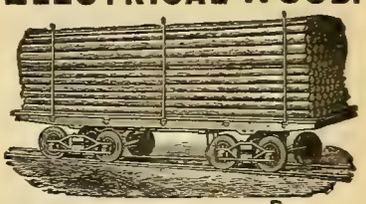

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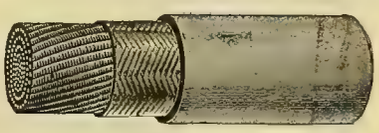

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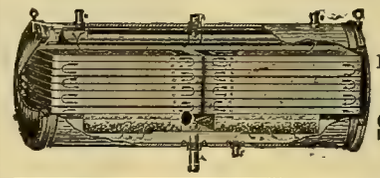

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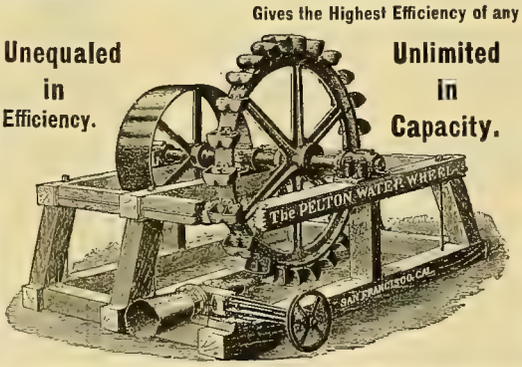

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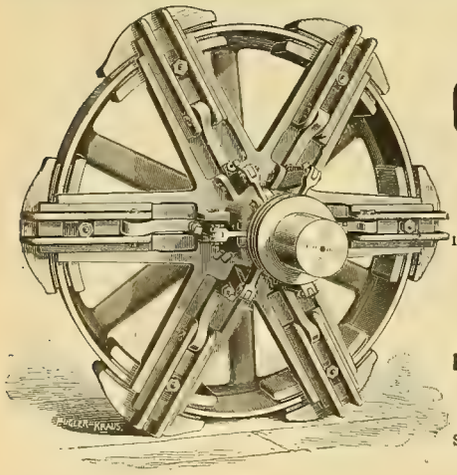

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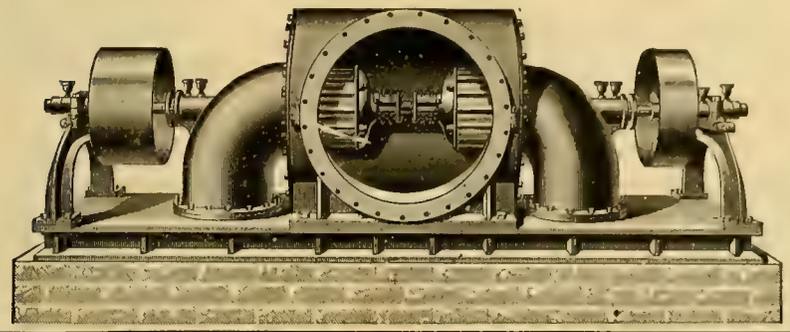

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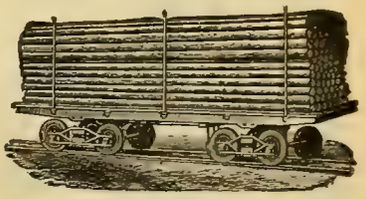

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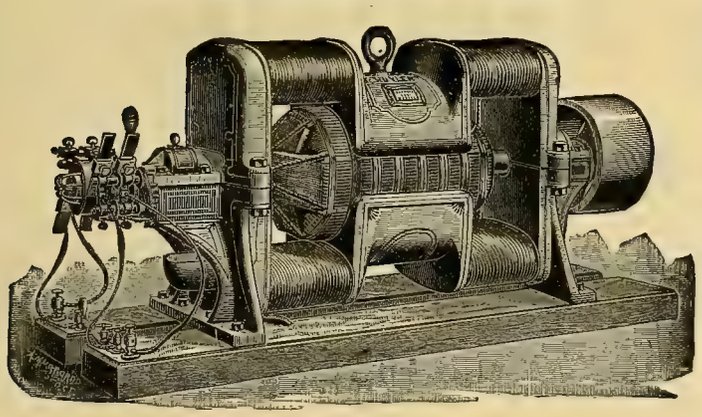

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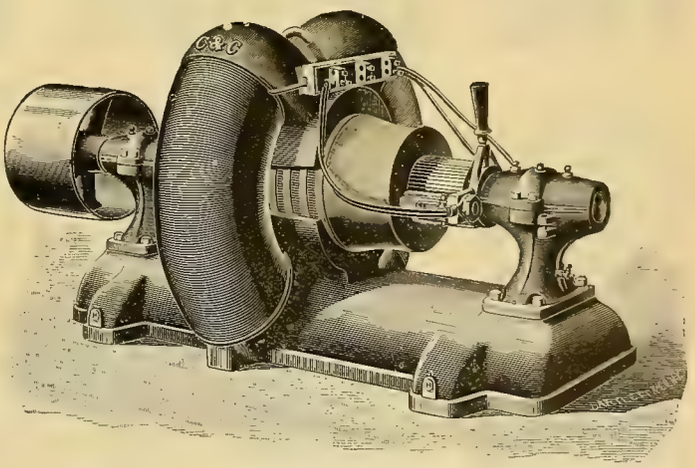

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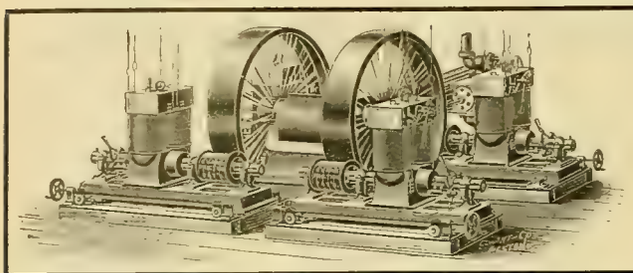

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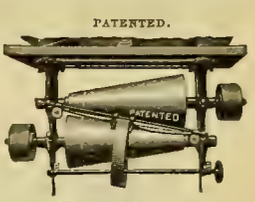

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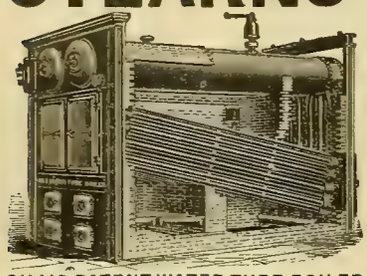

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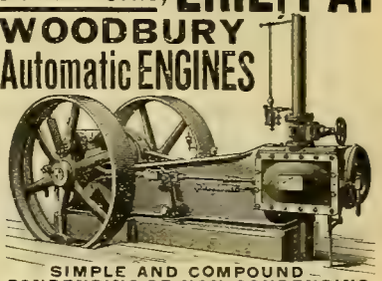

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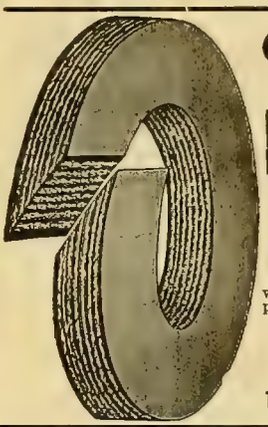

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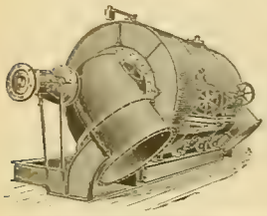

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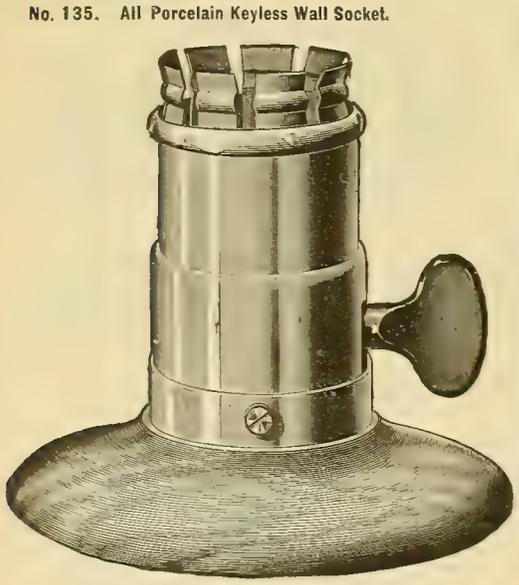

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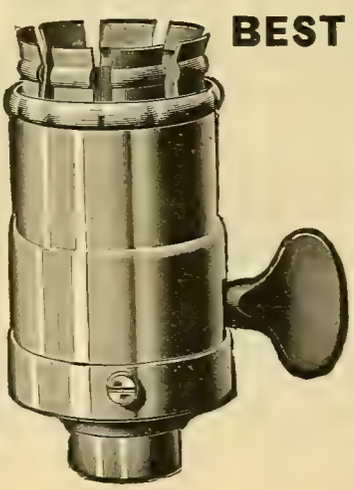

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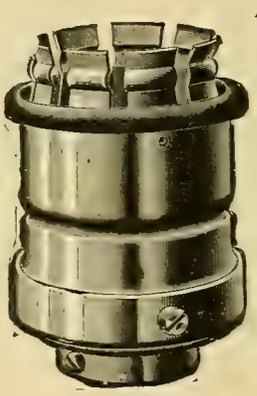

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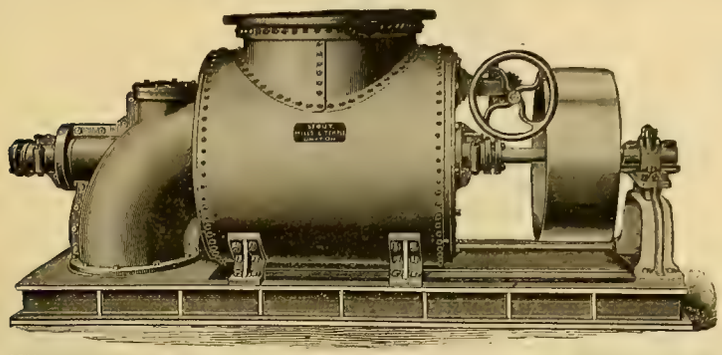

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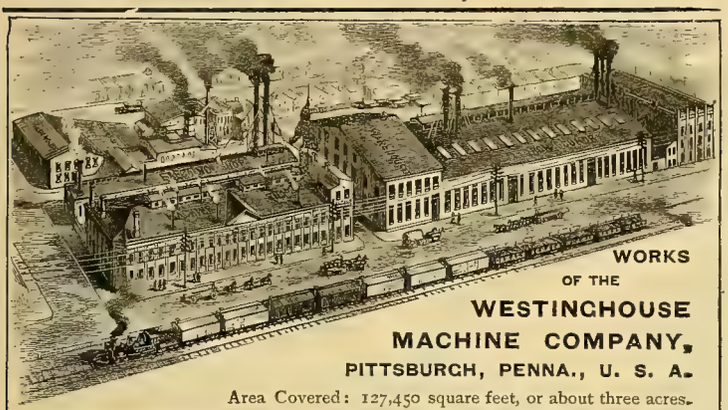

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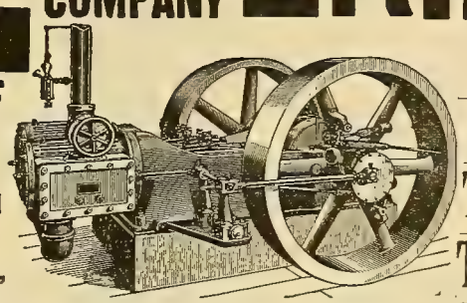

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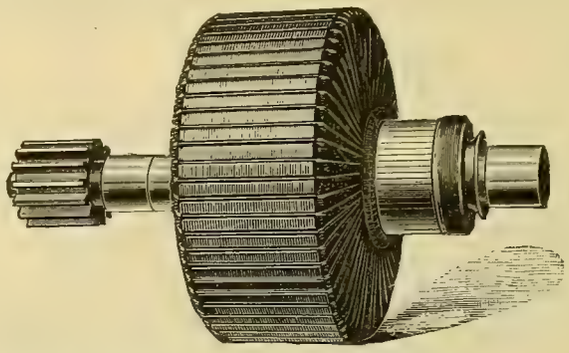

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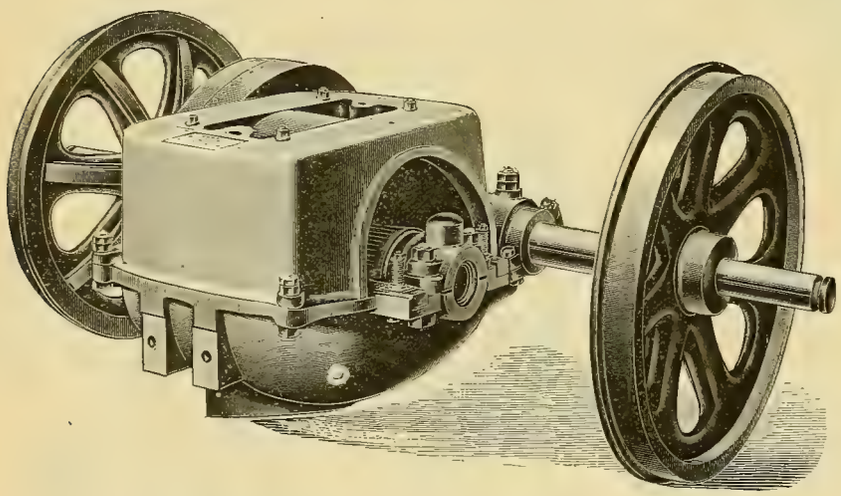

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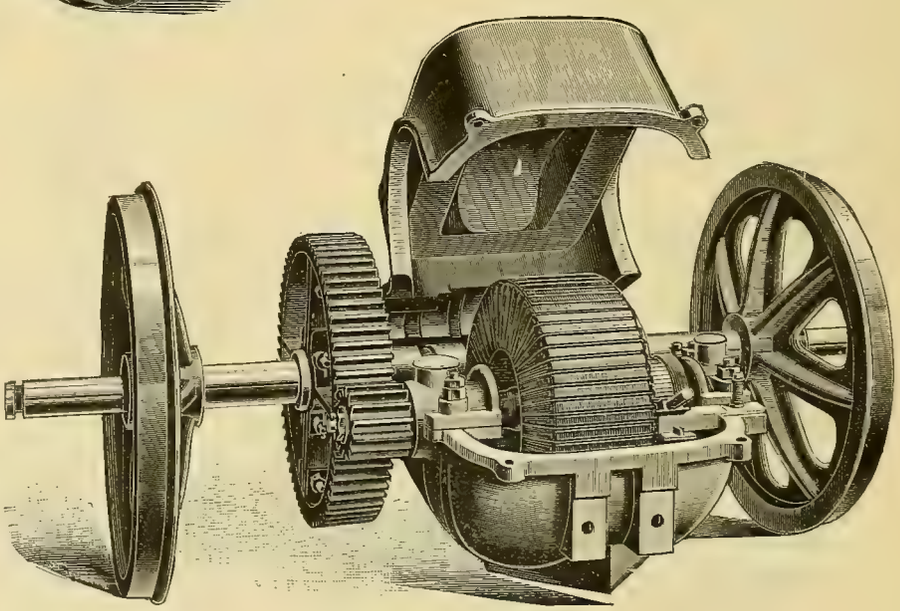

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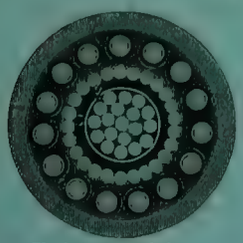
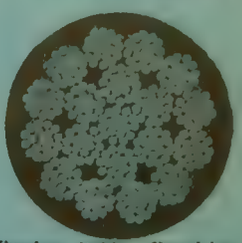
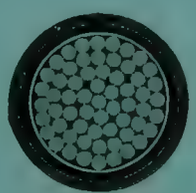

Underground Core.


Feeder Cable, Brooklyn Edison Electric Light Co.

Underground Core, N. J. Central R. R.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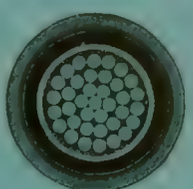
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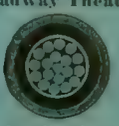
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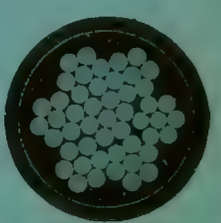
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DEAR SIRS:—In reply to yours of the 29th ult., asking for our experience with your motors under severe conditions, would say that the best performance we had, to my knowledge, was on Sunday, June 7th. A heavy rain had fallen in the morning, and vehicles passing along the highway had tracked considerable mud onto the rail at a point about the **Center of a 50° curve on a 7 per cent. grade.** Motor car No. 4, carrying **64 passengers and hauling trail car with 57 passengers,** stopped by reason of the trolley coming off, exactly at point where wagon track crossed the railroad. Upon trolley being replaced on the wire the motor started **without difficulty.**

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Quite a number of times during the season one motor pulled two loaded trailers; in fact, this was done whenever occasion required.

Hoping the above will be of service to you, I am yours very truly, (Signed) E. A. ROWORTH.

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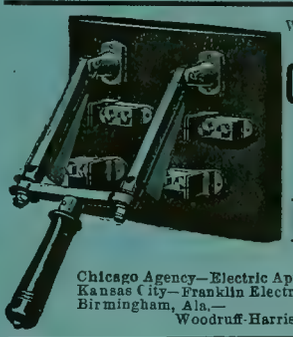

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Rae, Frank B.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
La Roche Electric Works.
Queen & Co.
Union Electric Works.
Western Electric Co.

Engravers.
Braun Illustrating Co.

Electrical Specialties.
Andrae, Julius.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Hussey & Co.
Ries Electric Specialty Co., The.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.

Electrical Intelligence.
Keller & Degenhardt.
Rae, Frank B.

Elevators.
Link Belt Machinery Co.

Engines, Steam.
American Engine Co.
Ball Engine Co.
Ball & Wood Co., The.
Morse & Co., A. M.
Pearson & Co., W. B.
Pond Engineering Co.
Racine Hardware Mfg. Co.
Smith, Thos. G. Jr.
Sioux City Engine Works
Stearns Mfg. Co.
Taylor Engine Co.
Williams Engine Co.

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Chicago Electric Motor Co.
Diehl & Co.
Edison General Electric Co.
Fremont Electric Co. The.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fibre Pipes
The Fibre Pipe Co

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Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Furnace Grate Bars.
Kelly Bros.

Fuse Wire.
Electrical Supply Co.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

Gas Lighting, Electric.
Detroit Electrical Works.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Andrae, Julius.
Central Electric Co.
Columbia Inc. Lamp Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Cons. & Supply Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Western Electric Co.

Globes and Electrical Glassware.
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Brookfield, Wm.
Hemingray Glass Co.
Phoenix Glass Co.

Gum-Elastic Roofing.
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Brookfield, Wm.
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Consolidated Elec. Mfg. Co., The.
Cushing, F. W.
Delaware Hard Fibre Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Hemingray Glass Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
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Munsell & Co., Eugene.
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Western Electric Co.

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Chicago Insulated Wire Co.
Cushing, F. W.
Cutter, Geo.
Day's Kerite Insulation.
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Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
New York Insulated Wire Co.
Roebling's Sons Co., J. A.
Sperry Elec. Mining Machine Co.
Western Electric Co.

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Buckeye Electric Co.
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Cutter, Geo.
Cutter Electrical & Mfg. Co.
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Electrical Eng. & Supply Co.
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Heisler Electric Co.
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Sawyer-Man Electric Co.
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Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.

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Ferracute Machine Co.

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Partrick & Carter Co.

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Munsell & Co., Eugene.
Schoonmaker, A. O.

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Detroit Electrical Works.

Mining Apparatus, Electric.
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Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

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Crocker-Wheeler Electric Co.
Chicago Electric Motor Co.
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Diamond Electric Mfg. Co.
Edison General Electric Co.
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Electrical Eng. & Supply Co.
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Royal Electric Co.
Thomson-Houston Electric Co
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Powell Co., The Wm.

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Gravity Purifier Co.

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Buxton, Geo. B.

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Loud, H. M. & Sons' Lumber Co.
Schindel & Schindel.
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Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Lefmann, Julius.
Loud, H. M. & Sons' Lumber Co.
Milliken Bros.
Schindel & Schindel.
Sterling, W. C.

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Electrician Publishing Co.

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Detroit Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
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(See electric railways.)

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Ries Electric Specialty Co., The.

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Gilman & Co., E. R.
Perry & Noyes.

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Hine Eliminator Co.
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Queen & Co.

Steam Pumps.
Worthington, Henry R.

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Detroit Electrical Works.
Electric Merchandise Co.
Schindel & Schindel.

Tapes, Insulating.
Andrae, Julius.
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Chicago Insulated Wire Co.
Cushing, F. W.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Standard Paint Co.

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Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
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Knapp Electrical Works.
Partrick & Carter Co.
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Detroit Electrical Works.
Western Electric Co.

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Central Electric Co.
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Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
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Short Railway Generators

ARE NO LONGER A NEW TYPE. THEY ARE

STANDARD,

And the record they have made for themselves cannot be surpassed. Inquire in Rochester, Jamestown, Covington, East Liverpool, Muskegon.

The Jamestown Street Railway Company report as follows: JANUARY 6, 1892.

* * * * * * * * * * * * * * * * * * *

On Sunday morning last it commenced snowing very hard, and so continued all day Sunday, Sunday night and Monday. We were obliged to put forth every effort to prevent blockading of the road, which we succeeded in doing.

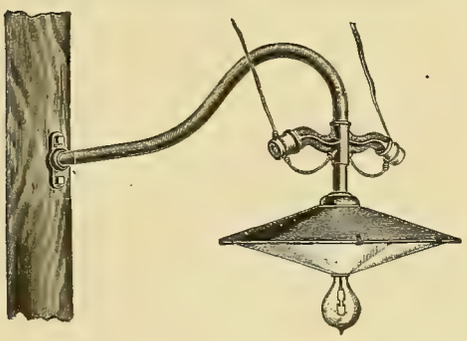
* * * * * * * * * * * * * * * * * * *

On Sunday morning we started your Generator No. 2 at 6:30 a. m., and continued to use the same until Tuesday morning at 3:30 a. m., when we shut it down. This Generator was in continuous service during the entire time, and was not even sanded, nor the brushes touched. It did not use to exceed one-half quart of oil. We consider this remarkable because of the hard work the Generator was doing. * * * * * * * *

Yours very respectfully, GEORGE E. MALLBY, Superintendent.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, OHIO.



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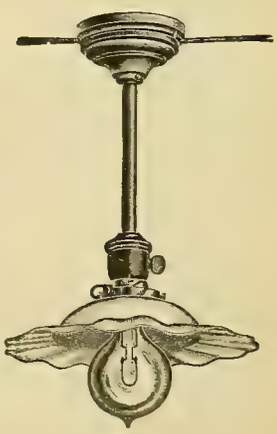
Reduction in Price of Series Socket.

SERIES LAMPS FOR ALTERNATING STREET CIRCUITS.



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FACTS.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES have the indorsement of the best electrical experts and electricians in the world.

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IT IS A FACT that the OKONITE INSULATED WIRES AND CABLES are giving better satisfaction, are more carefully made, and are not only the best, but cheaper in the end, than any other wires on the market.

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116 and 118 Franklin Street, CHICAGO.

"REGENT" Double Core, Rubber Covered WIRES AND CABLES.

SEND FOR SAMPLES AND PRICES.

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ANY BASE, ANY VOLTAGE.

A strictly high-grade lamp, giving FULL CANDLE POWER throughout its life. HIGH EFFICIENCY and LONG LIFE commensurate with its other qualities.

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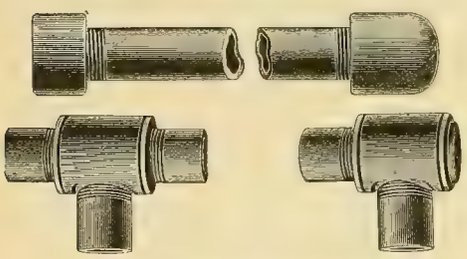
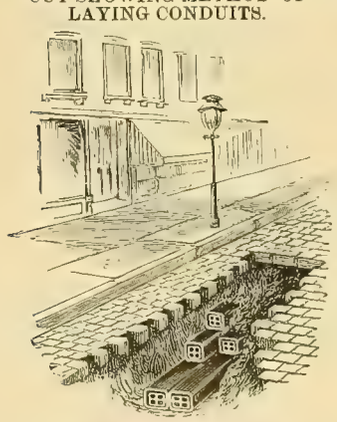
INDURATED FIBRE PIPE.

SCREW OR SOCKET JOINTS.
WATER AND GAS TIGHT.



CUT SHOWING METHOD OF LAYING CONDUITS.



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MULTIPLE DUCT CONDUITS.

The Best Conduit in the World for Underground Wires, and the only one that combines ALL the elements absolutely necessary to a permanent subway system.

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LOW COST,
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HIGH INSULATION,
STRENGTH,
WATER TIGHT JOINTS,
SEAMLESS,
WATER AND ACID PROOF,
INDESTRUCTIBILITY.

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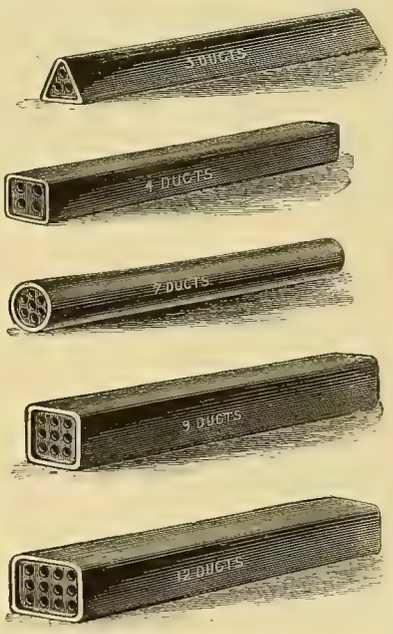

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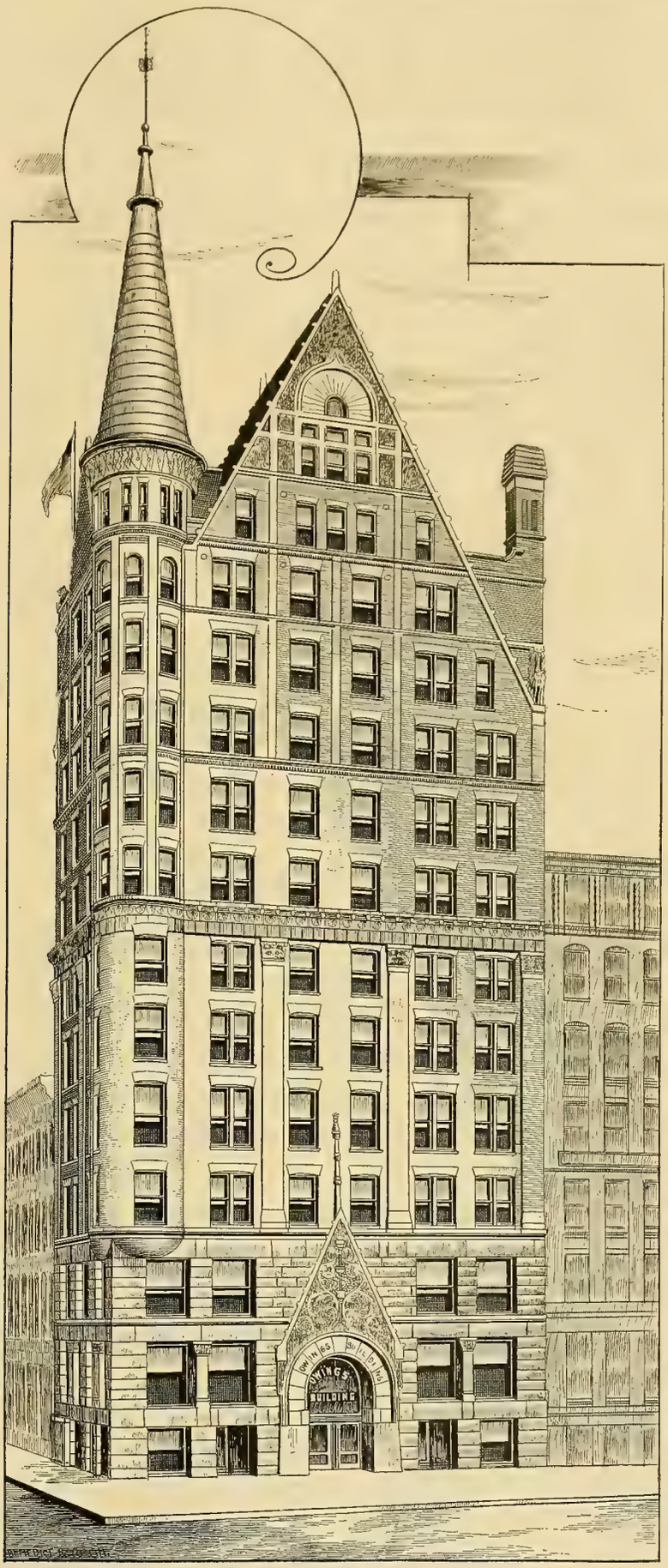

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SAFEST! BEST! CHEAPEST!

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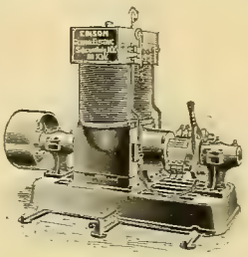

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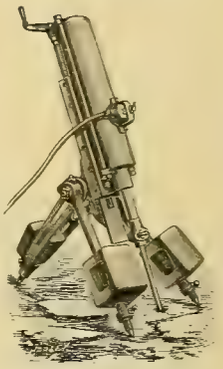
BY EXPERTS NAMED THE IDEAL DRILL.



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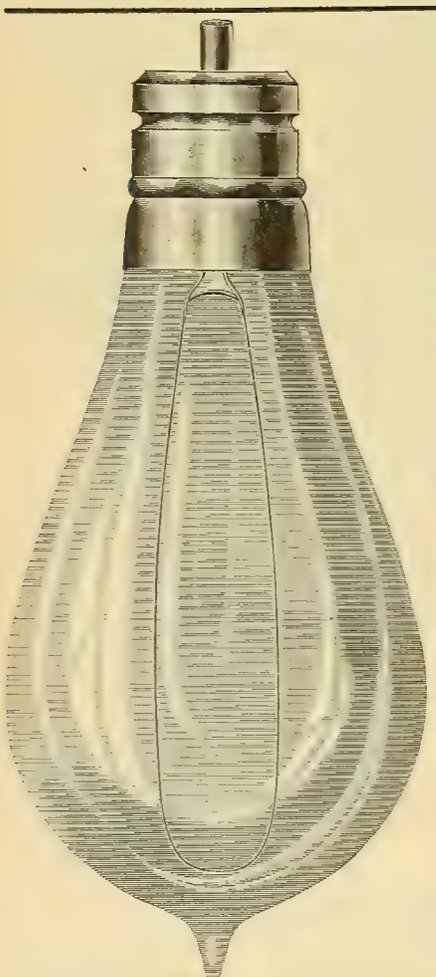

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FULL RATED CANDLE POWER.

Users pronounce them the best in the market. Try them and be convinced of their superior quality.
All Candle Powers. Bases to fit all standard Sockets.

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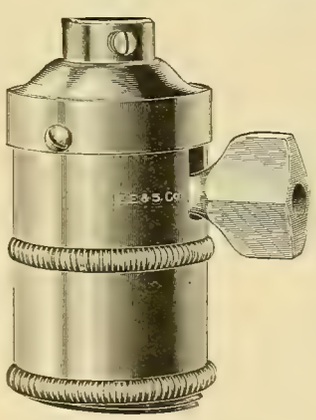

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In small lots.....25 cents each net.
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And all the supply stores of the
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If you contract for longer than one year, you throw away opportunities to save money. In dealing with us you need not be afraid that prices will be advanced. We will protect our customers from the TRUST.

OUR CARBONS ARE NOTED FOR THEIR

Long Life, High Efficiency, Low Resistance.

Write us for samples and quotations before you contract for supply.

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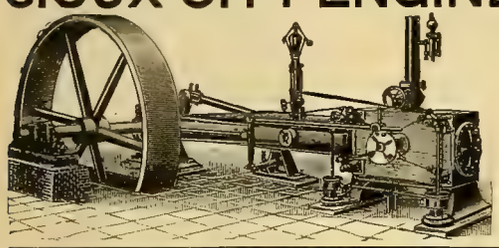

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Simple, Compound, Condensing,

Complete Plants Furnished.

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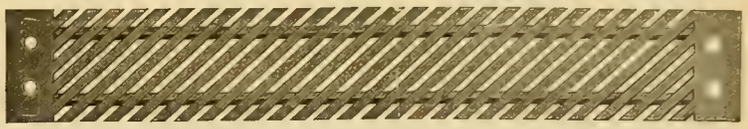

That doesn't require a **BLOWER** to secure a draught.

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KELLY GRATE,

And for DURABILITY, PERFECT FUEL COMBUSTION and SUPERIOR STEAMING QUALITIES, IT HAS NO EQUAL. It will burn ANY KIND of HARD or SOFT COAL equally well. They are especially adapted for hard, continuous service required by ELECTRIC LIGHTING PLANTS. We warrant them NOT to WARP, and to OUTWEAR TWO COMMON GRATES. When your plant requires grates again DON'T be content with one that is "good enough," but use the same number of DOLLARS and secure the BEST—that is, THE KELLY GRATE. Invest a stamp in writing us for descriptive circular. We will return it, and tell you about our SHAKER GRATE, the only one of its kind made in the United States or any other place.

GIVE US A CHANCE TO BE OF USE TO YOU.

KELLY BROS., - GOSHEN, IND.

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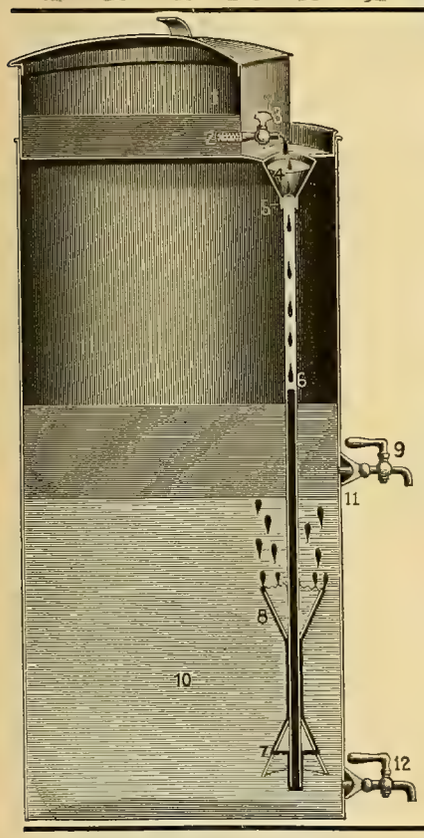

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GRAVITY PURIFIER.

From 75% to 90% Saved in your Oil Bills by using the Gravity Purifier.

TESTIMONIAL:

FORT WAYNE, IND., April 22, 1891.

GRAVITY PURIFIER CO., Decatur, Ind.

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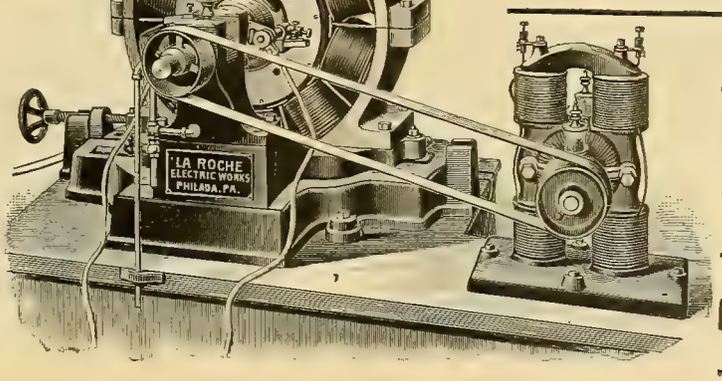
116 and 118 N. 6th St., Philadelphia, Penn.



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Direct System.

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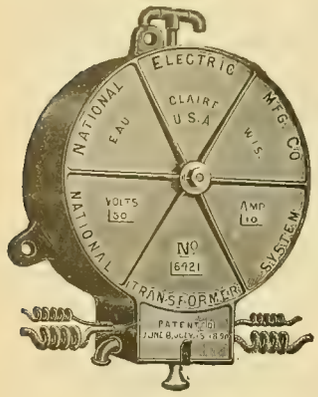

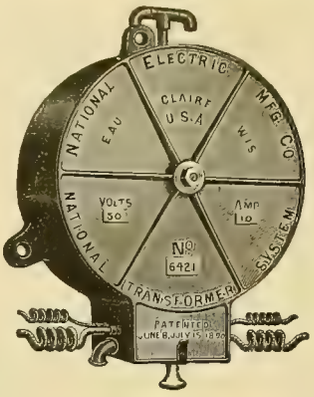

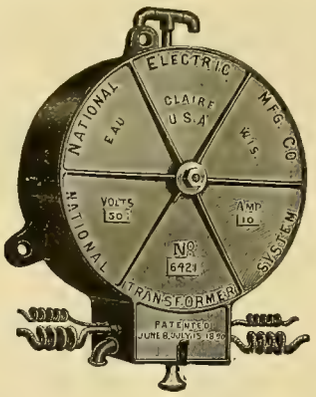

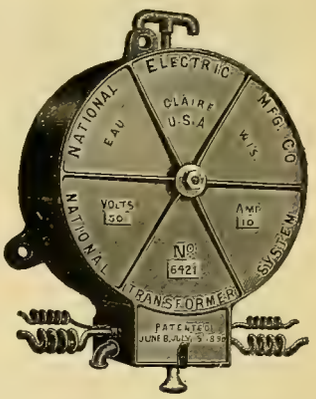

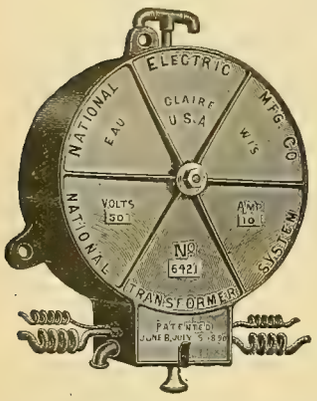

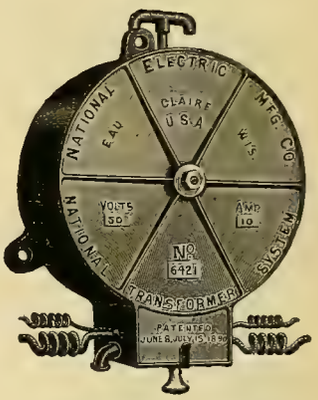

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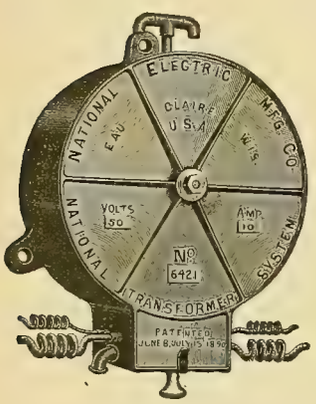

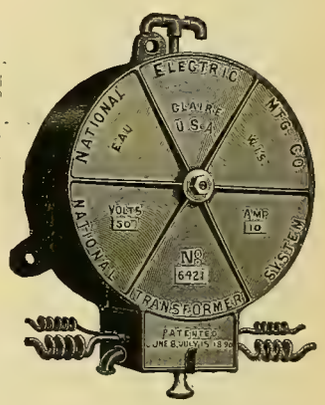

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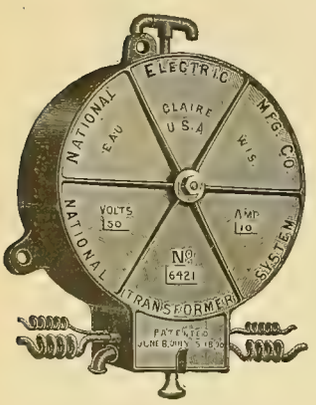

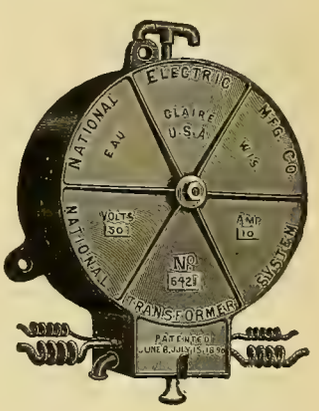

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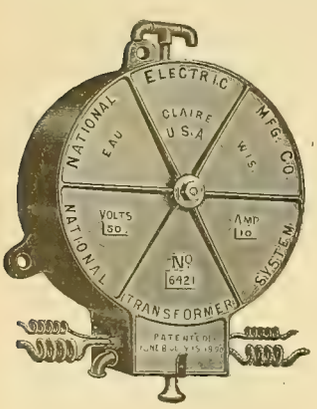

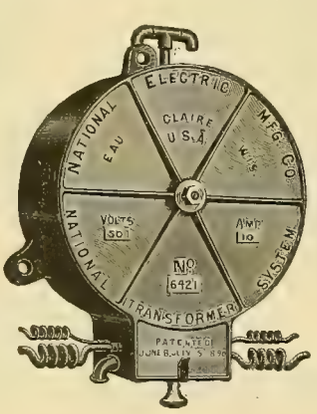

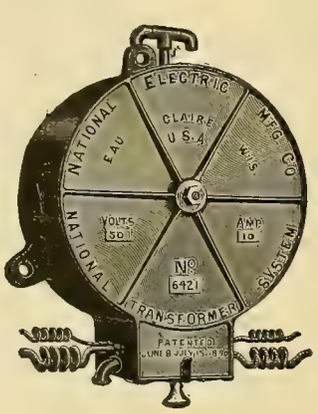

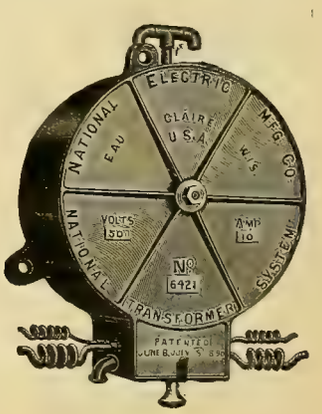

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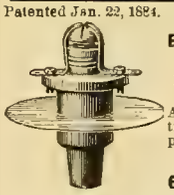

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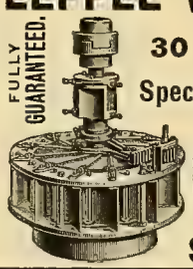

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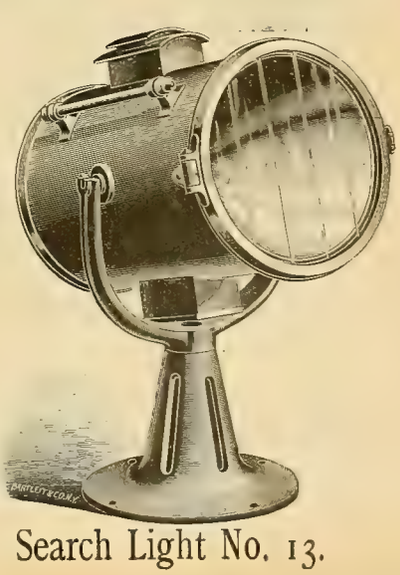

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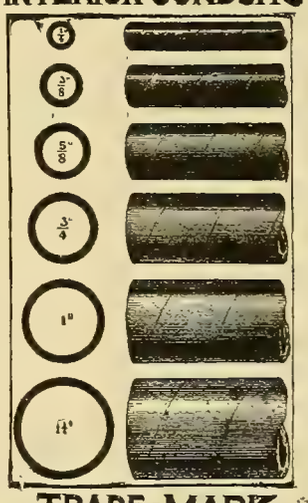

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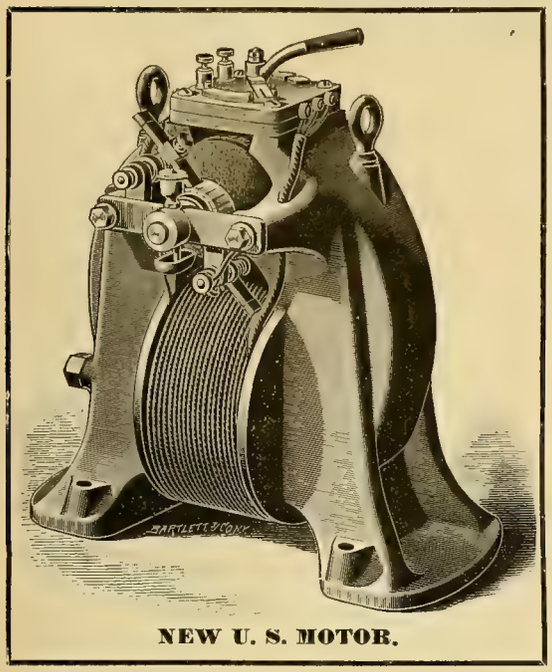

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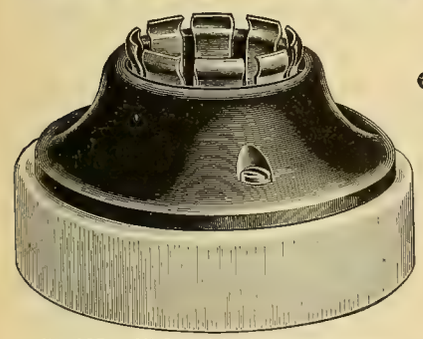

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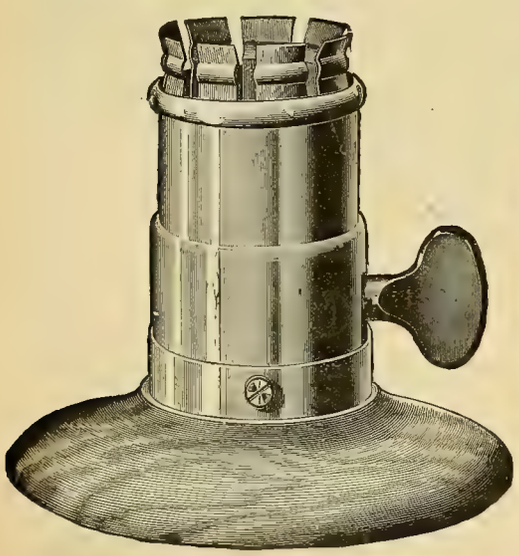

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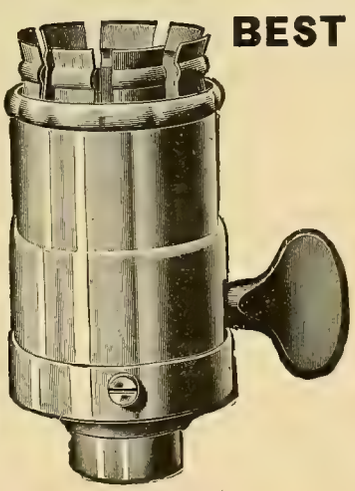

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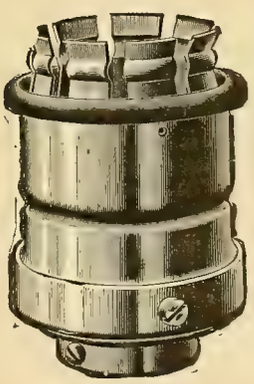

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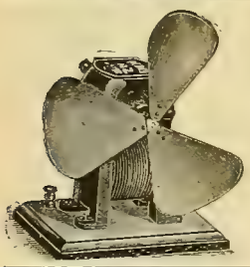

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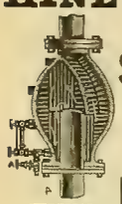

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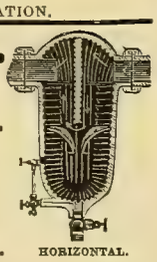

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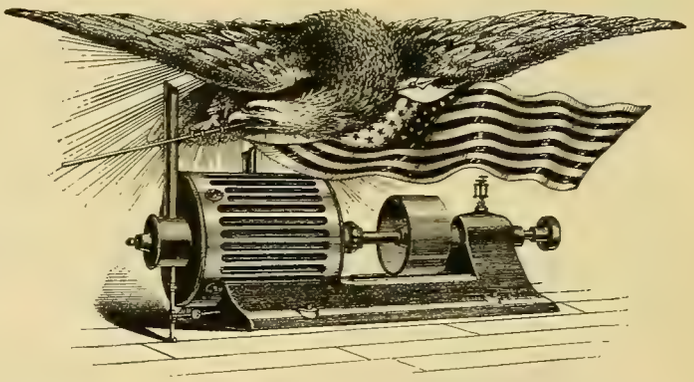

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Vol. X. CHICAGO, APRIL 2, 1892. No. 14

Electricity at the World's Fair.

Interesting electrical features of the present stage of construction work at the World's Fair grounds are shown in the illustrations presented on this and the succeeding page. Figs. 1 and 2 give an excellent idea of the work done on the electrical subways which are to contain the conductors for power and light. The former shows a view taken from a point just north of machinery hall looking north. It shows the big double conduit leading from the generating station in the machinery building as it appears in process of construction. Directly ahead is the electricity building, while a corner of the administration building is shown at the left. The latter will undoubtedly be the most handsome and imposing of all the buildings when completed. The picture shows the appearance of the staff covering. In Fig. 2 is given an interior view of the long stretch of single conduit extending north and south along the western side of the great manufactures building. The top had not been boarded over at the time the photograph was taken, and the lights and shadows on the side of the subway are plainly marked. About 3,000 feet of subway have so far been laid. An article on the "Electrical Subways for the World's Fair," with map and diagrams, was published in the WESTERN ELECTRICIAN of November 28, 1891. In view of the advanced stage of the work it is permissible to reproduce the following paragraph:

"The greater portion of the conduit will be exactly eight feet and four inches square. The outer material will be two-inch tarred plank laid on stringers one foot apart. These stringers will be eight inches wide and they will support the inner skin of the conduit, which will be an inch thickness of cement plaster laid on metal lathing. The larger tunnels will be six feet six inches wide inside, and the smaller size four feet three inches. All will be six feet six inches high in the clear, so that a man may walk through without difficulty. In the larger conduits there will be a passageway in the center, with a row of cross-arms on either side, while in the smaller ones there will be but one row of cross-arms, with a side passageway. Manholes will be provided at convenient distances. The cross-arms will be supported on iron castings especially designed for the purpose, which will be placed twenty feet apart, and bolted to the stringers. Glass insulators of a size sufficient to accommodate the largest cables will be used on the cross-arms. All wires must be covered with water-proof insulation. The conduits will be laid, on an average, eighteen inches below the surface of the ground, and will at all times be above the level of the lake. The interior will have the appearance of a concrete tunnel, and there will be ample room for all the wires necessary.

Fig. 3 is a reproduction of a photograph taken on the floor of the electricity building last week. It shows the springing point of the great iron arches that support the roof. The iron work of the building is now practically completed. The frame work for all the towers up to the main entrance line is now finished. About one-third of the gallery floor has been laid and the roof boarding completed over all the gallery trusses. Within a few days the staff men will be at work covering up the exterior frame work of the building with their white composition. For a month they have been at work in a temporary factory on the flooring of the great building, under the direction of Peter Taparelli, an intelligent Italian. A large stock of moulded material has already been accumulated, and the work will be finished in two or three months.

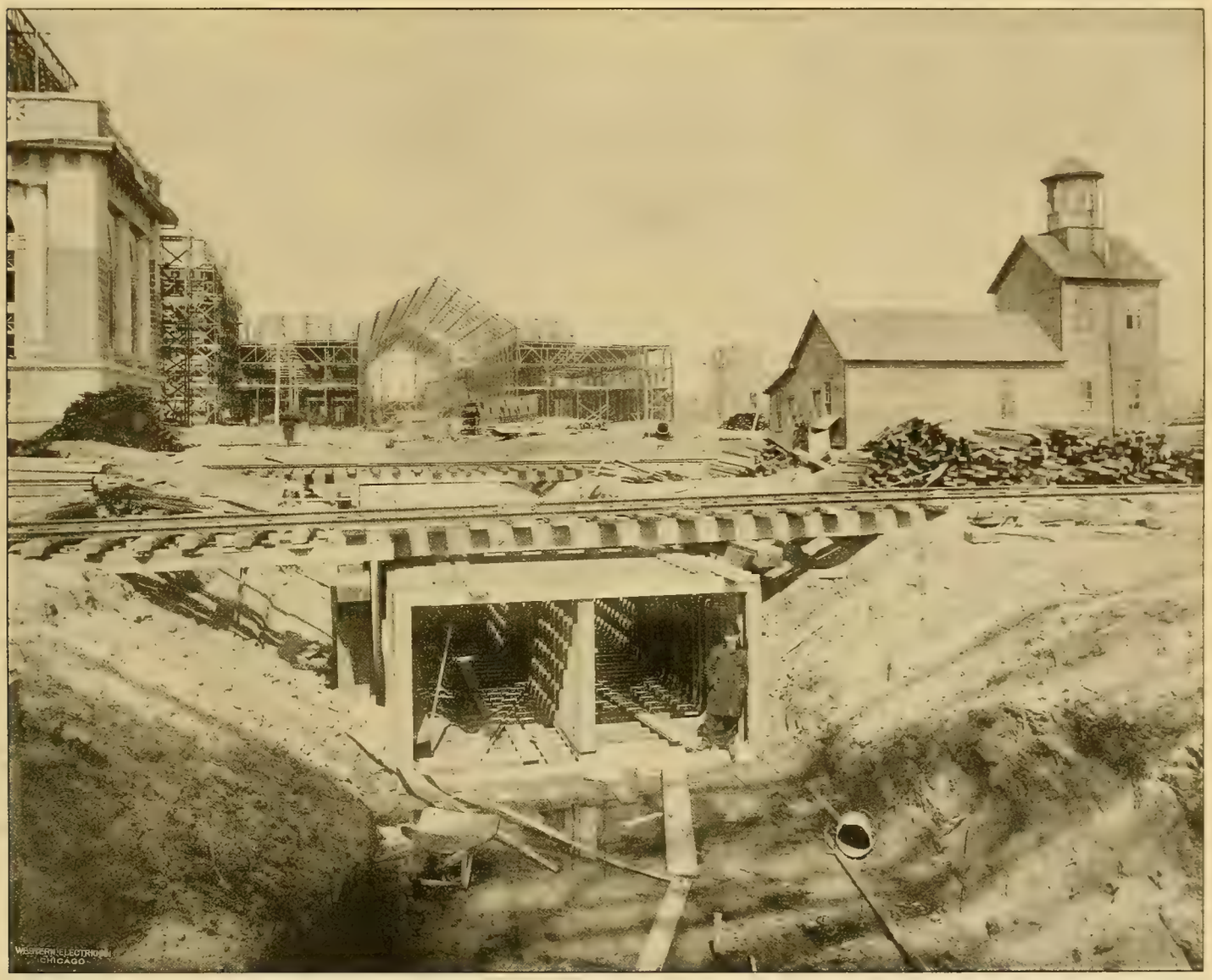


FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.

The trouble over the bids for the arc lights at the World's Fair has been settled by a compromise. Captain Eugene Griffin, vice-president of the Thomson-Houston Electric company, appeared before the committee on grounds and buildings on March 23d. Captain Griffin said that there was no intention to "squeeze" the fair, and that the Thomson-Houston company was willing to be perfectly fair, if its bid had been made under any misapprehension of the conditions. The speaker made a good impression on the committee, and Col. R. C. Clowry, Director H. B Stone and Frederick Sargent, electrical engineer of the construction department, were appointed to confer with Captain Griffin and endeavor to reach an

amicable understanding. This conference was held on Friday of last week at the Chicago club, and lasted from 9:30 A. M. until 2:30 P. M. The situation was talked over in a friendly aspect in all its various phases, with the result that Capt. Griffin finally agreed to furnish 2,500 lights at the rate of $20 each, promising, in addition, to supply 1,000 more at the same rate if called upon to do so. On their part the World's Fair representatives agreed that the

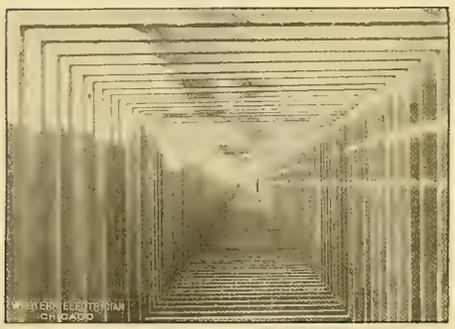


FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

company should not be required to furnish any superintendence or help of any kind in the operation of the plant during the fair. At the same time it was agreed that the Standard Electric company of Chicago should be given 1,000 lights and the Western Electric company 500 lights on the same basis. The former company had previously offered to supply a large portion of the lights needed at a lower rate than that of the Thomson-Houston bid—said to be $22 per lamp. Thus, 5,000 of the 6,000 lamps are provided for. There is still some talk of seeking the remainder from foreign sources, and April 6th has been fixed as the date of Mr. Sargent's departure for Europe. At this writing the matter is still unsettled, however. The arrangement gives general satisfaction and all concerned appear to be glad that an agreement has been reached.

The committee on grounds and buildings has rejected all the bids for generators for motor service save that of the Eddy Electric Manufacturing company, which offered to supply 300 kilowatts for the transportation building free of cost. It adopted a recommendation that this company be offered the privilege of furnishing from 1,000 to

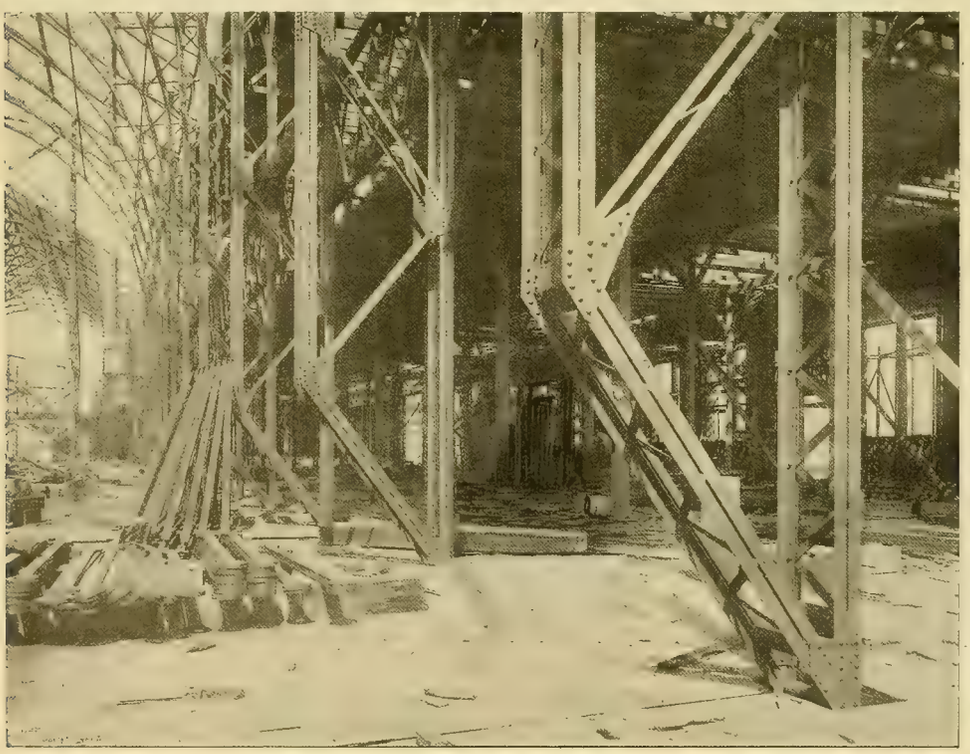


FIG. 3. ELECTRICITY AT THE WORLD'S FAIR.

1,500 horse power capacity at the rate of $2.50 per horse power. In the event of the company agreeing to furnish 1,500 horse power capacity on the terms mentioned, all other firms wishing to supply generators for the World's Fair plant must do so free of cost. In case, however, the Eddy company chooses to supply but 1,000 horse power the Mather company will be given an opportunity to furnish the capacity mentioned in its bid (600 kilowatts) at the rate of $2.50 per horse power. "We only care to buy 1,500 horse power out of the necessary 3,300," a construction department official is represented as saying. "We shall get the remainder in the way of exhibits."

It will interest all engaged in electrical pursuits to know that Director H. B. Stone, president of the Chicago Telephone company, is mentioned as a possible candidate for president of the local board, to succeed W. T. Baker.

B. E. Sunny, western manager of the Thomson-Houston company, will retire from the directory at the next election. In view of the present and prospective relations of the World's Fair and his company, he does not deem it proper to remain on the board.

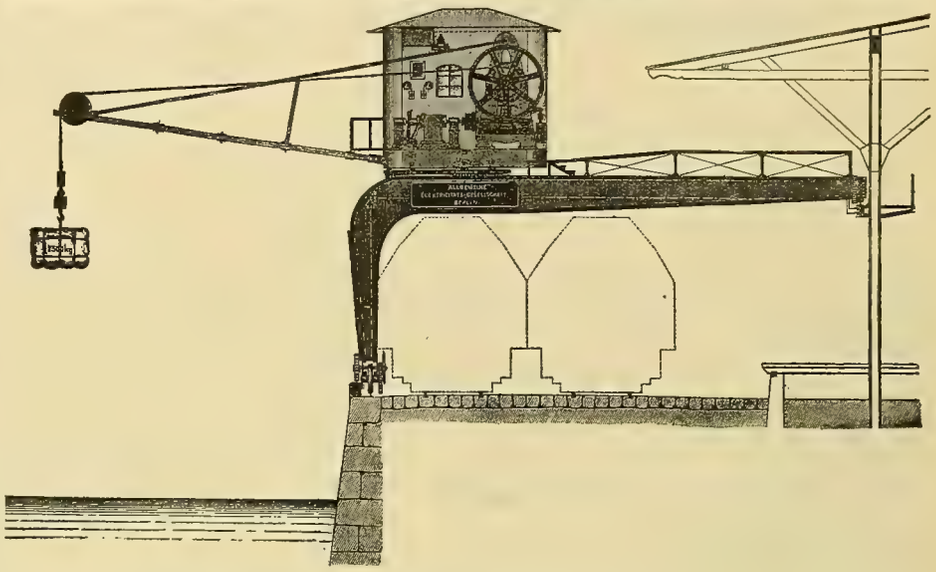
Upon the recommendation of Chief of Construction Burnham, the committee on grounds and buildings has agreed to let the contract for furnishing boilers of 10,000 horse power capacity to the following companies for the amounts indicated:

Heine Boiler company of St. Louis, 2 500 horse power, $20,000; Campbell & Zell company of Baltimore, Md., 2,500 horse power, $20,000; Mills Boiler company of London, England, 2,000 horse power, $16,000; Stearns Manufacturing company of Erie, Pa., 1,000 horse power, $8,000; National Water-Tube Boiler company of New Brunswick, N. J., 1,000 horse power, $7,300; Abendroth & Root of New York, 1,000 horse power, $8,000. Total horse power, 10,000, $79,300.

The contractors, for these prices, provide for the erection of boilers capable of sustaining a pressure of 125 pounds per square inch. The boilers are to be furnished with all fittings, attachments and appurtenances, walled in ready for connection with mains and water supply, the contractor to build smoke stacks and flues, and operate the boilers during the period of their use and remove them at the close of the fair. The exposition furnishes fuel and water only.

German Electric Wharf Crane.

Cranes operated by electricity are being substituted to some extent for the hydraulic cranes that have long been used on the wharves of the great seaports of Germany. The accompanying illustration represents a new type built for use in the city of Hamburg by the Allgemeine Elektricitaets Gesellschaft of Berlin. This crane was designed for use in the loading and unloading of vessels, and has a



GERMAN ELECTRIC WHARF CRANE.

capacity of 5,000 pounds. It has been in constant use since November, and in spite of exposure to the severe winter weather has worked so well as to demonstrate the fact that the field for electric machines of this character is one of great promise and signal importance.

The crane rests on a movable iron support, which is high and wide enough to allow the passage of freight cars on two tracks beneath it, and is provided with a movable truck to facilitate the loading of the freight from the vessel into the cars. The mechanical data of the crane are as follows: Capacity, 2,500 kilograms; height to which load may be raised, 13¾ meters; extreme reach from center of crane, 10¾ meters; speed of raising or lowering, 1 meter per second; speed of travel with full load, 2 meters per second.

In the construction of the machine ordinary chains were discarded wherever possible. and wire rope was substituted. The use of spur or bevel gears was also avoided, to the end that the motion be as uniform as possible. The conductors are brought to the outside of the truck, whence the current is communicated to the motor by sliding contacts on small copper rails, thence through cables run down through the interior of the vertical standard. About this hollow standard turns the hoisting and revolving mechanism, which is fastened to a turn-table and is inclosed on all sides in an iron casing, provided in places with panes of glass. The hoisting and revolving mechanisms are completely separated from each other; each has its own motor, and each is controlled by a separate switch. The revolution is accomplished by worm gearing, which actuates the driving wheels (not gears), and which bear on the turn-table and rotate it. This is a bold departure from the usual rack and pinion.

To prevent an accident from a too sudden starting or stopping of the machinery, a flexible coupling is inserted between the armature shaft and the worm gear. As a result of the series winding, the operator has it in his power to modify at will the speed of the motors. The 40 horse power motor for the hoisting apparatus, is a shunt wound machine, provided also with the flexible coupling The reversion of the direction of rotation of the armature is accomplished by commutating the current in the starting box in the armature circuit. By an ingenious contrivance a brake is connected mechanically with the starting switch so that in throwing it over to reverse the motor the brake is on full when the switch lever is at the point of zero, and is eased off as the lever progresses and admits the commutated current. The crane has shown a saving in efficiency over water and steam cranes of as much as 20 per cent.

To insure against an accident in the event of the circuit becoming broken while the crane is loaded, a brake is provided for the drum, but whose shoe is kept from bearing on the drum axle by a strong electro-magnet. As soon as the circuit is broken the shoe is released, and, by a simple mechanical contrivance, embraces a pulley on the drum axle, and the machinery is brought to rest. It has been shown that the power required to drive the electric motors is almost proportional to the load, which is not the case with steam cranes. The steam apparatus used on the best crane does not take all the expansive force of the steam, while the electric machines have the additional advantage of curtailing the consumption of current by taking advantage of the counter electromotive force generated by the operation of lowering the crane's load. Further, the important loss of energy in steam pipes is avoided by the employment of electric motors, which by ordinarily careful insulation are rendered independent of the weather. The cut and description are from the *Elektrotechnische Zeitschrift*.

American Institute of Electrical Engineers.

The annual meeting of the American Institute of Electrical Engineers for the election of officers, the reception of yearly reports, and the transaction of business, will be held at the headquarters of the Institute in New York city on Tuesday, May 17th, and will be followed by a dinner in the evening.

The general meeting for the reading and discussion of papers will be held at Chicago on Monday and Tuesday, June 6th and 7th. The programme of papers is now in preparation.

Love Underground Conduit Electric Railway.

Several tests of the recently completed underground conduit for the Love electric railway system have been made in Chicago within the last two weeks. The track is laid in the form of a loop on Racine, Fullerton and Webster avenues and Halsted street, and is said to be 8,000 feet long. A recent trip was made in six minutes, a summer car being temporarily fitted up with a trolley and motor. Arrangements are now completed for regular trips in connection with the North Side cable service.

The wires of the fire alarm telegraph system of Boston are to be placed underground. The fire commissioners will make a beginning in Tremont street. A cable will be run from the city hall across the Probate Court building and down to Tremont street, where it will enter the conduit and connect with the fire alarm wires. All the fire signal boxes now in buildings will be placed upon lamp-posts on the sidewalk and connected with the wires, which will pass up through the hollow post. A red lantern at the top of the lamp posts will show the box number in white figures. As soon as this work is completed other sections of the city will be treated in a similar manner.

Electric Lighting in Des Moines, Ia.

The city of Des Moines, Ia., is particularly fortunate in its electric light and railway service. In a recent issue the electric railway plant was described in detail. The electric lighting and power plant is equally good. The work was begun by the Des Moines Water Power company early in 1891. This concern secured the water power on the Des Moines river, but did not make much progress in developing its plant until the formation of the Des Moines Water Power & Electric company, which was in reality a reorganization of the old company.

The plant at present consists of one 2,000-light, two 1,200-light and two 750-light generators of the Slattery alternating type, five 80-light Wood arc and one 40-light Western Electric arc machines with two 40,000-watt C. & C. generators for a power circuit. The water power has been largely improved until it now supplies several hundred horse power in excess of the amount required. The company has in place several Leffel wheels aggregating 700 horse power and expects soon to make a still further addition to the capacity, nearly doubling it. As a safeguard against an accident of any kind a steam plant of 500 horse power is kept constantly in readiness with fires banked. This plant consists of one 250 horse power Ideal and one 250 horse power Ball engine. A contract has recently been signed with the city for the supplying of 200 arc lights for street use. The company is operating 250 commercial lamps. The demand for incandescent lights has been very active, over 4 000 being in actual use, many of which are under a lamp hour contract. But little attention has as yet been given to the transmission of power, but about 75 horse power has been called for, requiring motors of from ⅛ to 15 horse power each. No money has been spared in making the plant a model one, and with the popular management the installation will undoubtedly be doubled within the next year.

The capital stock of the company is $450,000 and the following officers have been elected: President, Fred D. Goode; secretary and manager, C. K. Mead; treasurer, Lowry W. Goode. The active management of the affairs of the company has been placed in the hands of Mr. Mead, and to his popularity and business qualifications is due a large share of the success already attained.

The illustrations give an idea of the extent of the plant. In Fig. 1 is shown a part of the dynamo room of the power station. The switch-board is shown in Fig. 2, and in Fig. 3 there is an excellent view of the river on which the station is located and from which the power is secured.

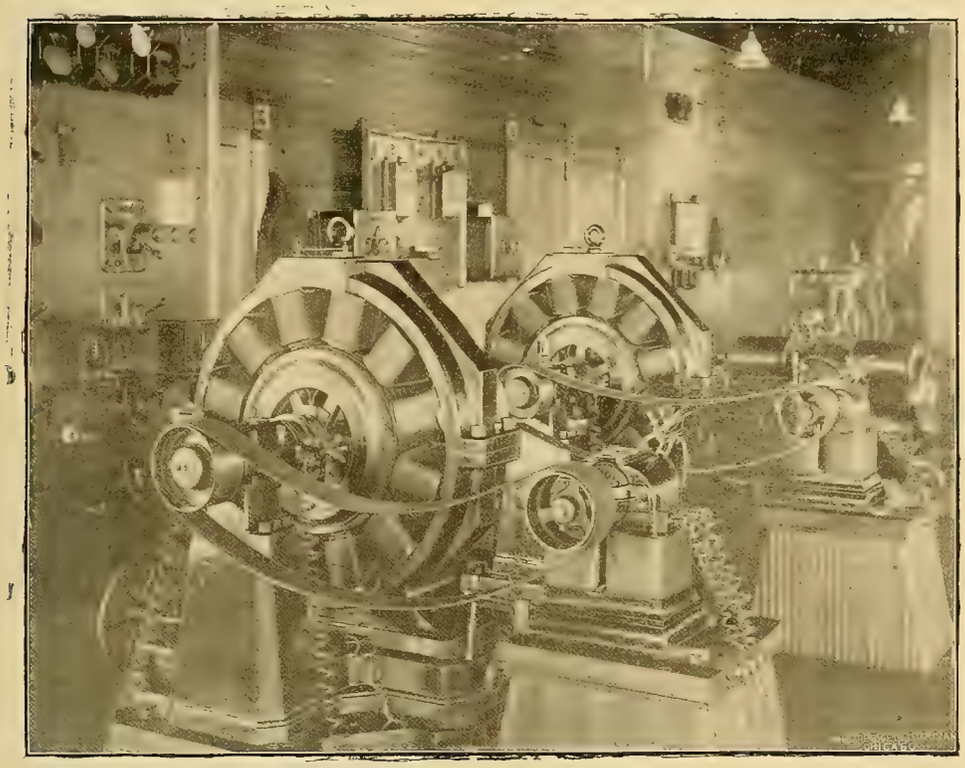


FIG. 1. ELECTRIC LIGHTING IN DES MOINES, IOWA.

An experimental train consisting of new American buffet and drawing room cars, was run over the English Southeastern line to Dover, and, according to an English exchange, the cars, which are very commodious, are luxuriously fitted and have all the latest improvements, including the electric light. It is understood that they will be run in connection with the continental service.

Dynamic Induction at High Potentials and Frequencies.

BY ELIHU THOMSON.

It is the purpose of the present writing to supplement the experiments which were described by me a short time since, in which condense discharges at comparatively high potentials were used to induce by dynamic induction similar discharges in parallel circuits or coils.

FIG. 3. ELECTRIC LIGHTING IN DES MOINES, IOWA.

The application of the principle to the production of an efficient lightning protector or device affording a selective path for high frequency discharges has already been pointed out. So also the effects of the use of a varying numbers of turns in the coils under induction have been shown—effects which have enabled me up to the present to obtain sparks of over thirty-one inches in length in free air between ball-terminals about one inch in diameter and in an apparently continuous stream of not less than 250 per second. These sparks are bluish white, like Leyden jar discharges, and are accompanied by a loud rattle or roar. These effects and their bearing on insulation will be further adverted to.

The following experiment is an exceedingly instructive one as showing the means I used for obtaining a balance of electromotive forces or selective path.

Two coils of heavy wire are wound, each having about 12 or 15 turns, more or less. The coils are separated by a glass cylinder, one coil being in the interior of the cylinder and the other being wound outside thereof. Connections are made as in Fig 1. The turns of the coils should be kept apart or well insulated from one another. An incandescent lamp L is put in circuit with one of the coils, as the outer one, by putting one terminal of the lamp in connection with one end of the inner coil and the other lamp terminal to one end of the outer coil. The wires a b permit condenser discharges to be passed through the inner coil; a branch wire C is taken from b and its free end can be connected to any part of the outer coil so as to include more or less of the turns of the outer coil in a branch with the lamp around the inner one. With say 12 turns in the inner coil, and a possible change of the turns of the outer coil from none to 15 or 16, and passing condenser discharges over an air gap at J with an air blast playing on the spark to prevent continuous arcs when the condenser charges are furnished by the high potential secondary of an alternating current transformer, the lamp at L would be lighted to a greater or less brilliancy, according to the turns of the outer coil in use. In applying the movable wire to the outer coil at a certain point, there is found to be no current passing in the lamp, and on passing this

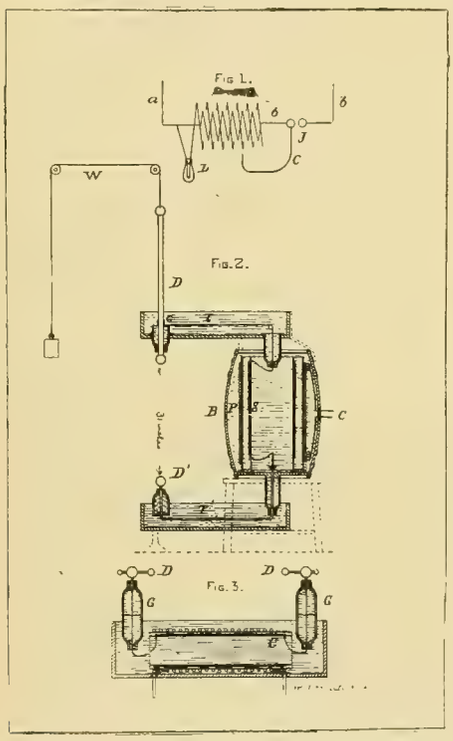
FIG. 2. ELECTRIC LIGHTING IN DES MOINES, IOWA.

wire either way from this point, so as to include more or less of the outer turns, the lamp is lighted with a gradually increased brilliancy as the neutral point is more and more departed from. Of course a current indicator, provided it responds to currents of excessive frequency, may be substituted for the lamp. This experiment shows in the clearest manner the fact that a selective path for the discharges of high potentials is obtained in adjusting the relative number of turns in the outer and inner coils.

I have in a previous communication stated in what way this combination of inductive coils has been applied as a lightning arrester or protective apparatus for dynamos, motors, transformers, etc. Varying the spark length at *f* or the condenser capacity does not, so far as has yet been determined, disturb the relations found. It is of course necessary that the two coils be well insulated from each other, and this can easily be done by immersion in oil or separating them by glass, hard rubber, or the like.

I will now describe certain forms of apparatus which are adapted for obtaining at will very high potential discharges. In fact, I have been able easily to obtain from about 1,600 feet of wire sparks of over thirty-one inches between the discharge balls. So far as can be estimated from available data, these sparks are due to potentials of not less than half a million volts.

In Fig. 2 *B* is a barrel of lubricating oil, an oil of high insulating qualities, being in fact a liquid paraffine. The top of *B* is open, and in it are immersed the primary and secondary coils, *P* and *S* each wound on a paper cylinder.



FIGS. 1–3. DYNAMIC INDUCTION AT HIGH POTENTIALS AND FREQUENCIES.

The cylinder on which *S* is wound is about three inches smaller in diameter than the other, and has an external diameter of about thirteen inches. It is covered with two layers of silk, and upon this is wound 500 turns of number 26 cotton covered wire in one layer, with a silk thread between the turns. This layer covers about twenty inches of the length of the cylinder. The terminals of this fine coil are carried out respectively through the lower head and up through the oil above, as will be described.

The primary *P* consists of fifteen turns of a conductor composed of five rather heavy wires laid alongside, and the connections are made by carrying the terminals outside at *C*, keeping them about two inches apart. The wire leaving *S* downward goes to a rod which rests in a cup in the center of the bottom head of the barrel. This cup has a rod extending down through a glass cylinder filled with oil which dips in a horizontal trough of oil *T*, through the center of which is carried a prolongation of this rod to conduct the discharges to the lower discharge terminal *D'*.

The upper end of *S* is treated in a similar way, passing up through a cork in a glass vessel, such as an inverted bottle with the bottom perforated, then horizontally in the trough *T* of oil to the sleeve *G*, through which a hollow brass bar *D*, with rounded ends, may be slid up or down. For this purpose, a string and pulley, with counter weight *W*, may be provided. The bar *D* should be, say, an inch in diameter, to avoid brush discharges from its sides, and in fact its upper end should be covered with a bottle of oil or have a large polished ball; otherwise large brush discharges will pass into the air from it. By means of a condenser and spark gap with a blast of air blowing across the gap, the apparatus may be used to obtain the high potential and high frequency sparks. The charging of the condenser is from the secondary of a high potential induction coil, giving about 15,000 to 20,000 volts, the primary of which coil is fed from alternating current mains. The condenser used in the experiments consisted of sixteen Leyden jars of about a gallon each, which was all there was at command. This will be replaced by a special condenser adapted for such work. The discharges from the apparatus are, as stated, over thirty-one inches long, and this distance is the maximum that can be given to the space between the terminals as the apparatus is constructed.

The power of the discharge is exemplified by the ease with which glass plates are punctured. Heavy pine or even oak boards are perforated and set on fire. The discharges scorch a black line where they pass over a surface of wood, and soften glass where they locate themselves in passing over a sheet. A stick of wood placed between the terminals and joining them is splintered and torn by the discharge, and is found covered with a fur of fine splinters. Glass vessels are shattered in the line of the discharges, and inflammable matter is set on fire.

Perhaps the most beautiful effect is obtained by the insertion of a plate of glass between the electrodes when separated about twenty-four inches. If the glass be thick enough to resist perforation, the discharges spread all over it and pass around the edges, producing an almost indescribably beautiful effect, especially in a feebly lighted room, which allows all the minor ramifications of spark to be seen.

The induction in the fine secondary of the apparatus is about 1,500 to 2,000 volts for each turn, which would give 750,000 to 1,000,000 volts total for the 500 turns. But on account of condenser actions absorbing a part of the discharge, it is probable that the effective electromotive force between terminals may not much exceed 500,000. We have no ready means of measurement of such pressures.

A very simple and inexpensive form of apparatus for obtaining these high potential discharges is shown in Fig. 3.

It consists of a wooden trough, the joints of which are capable of holding oil; its parts may be nailed or screwed together in the ordinary way, with shellac or white lead.

The primary coil of ten turns lies against the sides of this trough, and the secondary layer may be an ordinary wire heavily insulated with cotton and wound on a cylinder of paper *C* or cardboard covered with dry muslin or silk. If the turns are not over six inches in diameter, the cotton insulation between turns will suffice if rather thick, say 1-100 of an inch or over.

The secondary terminals are taken out at the center of the ends of the cylinder as shown, and led up through a glass vessel *G*, which may be conveniently made of two bottles with the bottoms removed and cemeted together, or a specially blown glass vessel may be used instead. Its object is to hold oil and cover the secondary terminals to a height sufficient to remove them far enough to prevent discharges passing over the surface of the oil in the trough, which is used to cover the coils, as indicated. The discharge terminals *D D* pass up and outward from the bottles and the sparks are obtained between them. The simplicity of construction is evident. A trough four feet long will hold a coil capable of giving a spark discharge three feet long. By coupling up two such troughs in tension this effect may doubtless be doubled if required.

It is important, of course, that all connections, leads from the condenser to the primary coil, etc., be as short and as free from self-induction as possible, or the rate of oscillations on which the high inductions depend will be lessened and the effects be weakened to some extent. The potential given by a secondary coil of a certain number of turns depends, of course, on the rapidity of magnetic change and the extent of such change or maximum densities of field attained. The greater the number of turns in the primary the greater will be the field strength if the same current flows in every case. But increasing the number of primary turns shows the oscillation rate and diminishes the maximum current value, and so diminishes the magnetic density. There is evidently to be selected, therefore, for each condenser, that number of turns which will give the highest product of the rate of change and the extent of change or maximum field.

As a striking illustration of the slowing effect of numerous turns of wire on the periodicity or rate of change, it may be mentioned that if, instead of passing the condenser discharges through a coarse coil of few turns, using the spark gap and charging transformer as before, they be passed through a well insulated coil of many turns of comparatively fine wire, the discharge rate may easily be brought down low enough to cause the spark to whistle along with the sound of the alternating discharges of 125 periodicity used in the charging transformer. The introduction of a well made iron wire core greatly lowers the tone obtained. It is conceivable that an approximation to music might be obtained from spark discharges sent through coils of such varied inductance as to cause the rates of oscillation to follow those of the musical scale.

In the conduct of the experiments on high inductions, which have been described, one cannot fail to be impressed

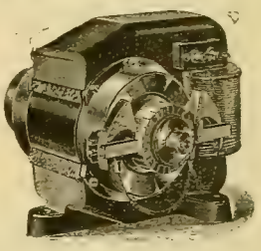


FIG. 1. ENGLISH MOTOR WITH ROLLER BEARINGS.

with the capabilities of oil as an insulator. The perforation of two inches of oil between rounded terminals of say ½ inch diameter would seem to demand a potential capable of causing a leap of five feet in air. It appears to be true that edges or points under oil or embedded in any insulating medium are effective in inducing puncture for the same reason as they are effective in discharging through air. They act as electric wedges and concentrate the dielectric strains upon those parts of the insulating medium directly in front of such points or edges. Hence, the most perfect insulation to resist puncture in oil or air demands smooth surfaces of as large diameter as possible. This is, of course, a different matter from insulation resistance or power of resisting leakage.

Siemens & Halske Company.

The headquarters of the new Siemens & Halske Electric company of America, will be on the twelfth floor of the new Monadnock building, Jackson and Dearborn streets, Chicago. A suite of twelve offices has been leased, but a portion of the space will be devoted to the Wells-French company. Dr. Berliner, who is to be chief electrical engineer of the American Siemens & Halske company, is expected in Chicago some time in April. The plans for the factory are being prepared in Germany.

English Motor with Roller Bearings.

Austin & Myers, an English firm, have brought out a series of motors which present several features of interest. Referring to the cuts, Fig. 1 shows the motor complete, and Fig. 2 shows the same machine taken to pieces. It will be seen that the armature runs on roller bearings, the rollers being really rings. Another point worthy of attention is the brush mechanism. The brushes are fed in without lead or trail, by a peculiar cam controlled by a

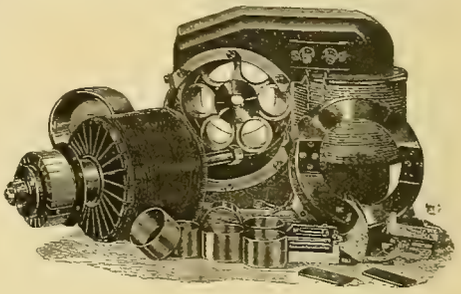


FIG. 2. ENGLISH MOTOR WITH ROLLER BEARINGS.

spring. The motor is specially designed to work with little attention, the roller bearings being adopted so that no harm is done if they are not oiled for some time. The brushes are arranged so as to require no attention. This type of machine is made in several sizes, from a miniature one weighing only 9 pounds, which will rest on the palm of the hand, up to 5 horse power. The cuts are reproduced from London *Industries*.

The *Scientific American* suggests that if torpedo boats can be successfully operated from the shore by means of electricity, the same power could be utilized for the propulsion of life-boats. "The electrical boat," it says, "can be launched and propelled with impunity for long distances in the roughest seas, in which the ordinary life-boat could not live for a moment. There is no reason why an electrical life-boat might not be made one of the most useful and valuable appliances of all life-saving stations on our coasts, and on well-appointed ships or steam vessels."

Analysis of Movements by Photography and the Incandescent Lamp.

One of the most curious uses to which the electric light has been put is its employment as an aid in the photographic analysis of movements. A Frenchman, M Marey, has made considerable progress with the method, utilizing instantaneous photographic plates, and his assistant, M. Demeny, has given some interesting experiments before

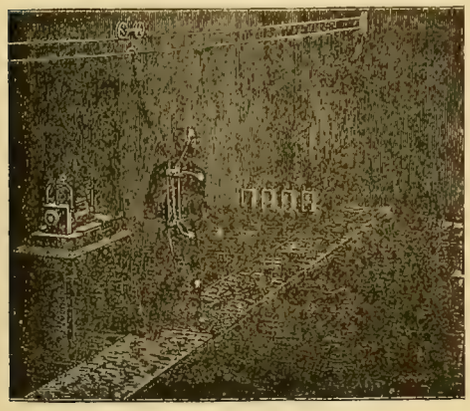


FIG. 1. ANALYSIS OF MOVEMENTS BY PHOTOGRAPHY AND THE INCANDESCENT LAMP.

the Conservatory of the Arts and Trades in Paris, showing the practical application of the method.

M. Marey applied the idea in two different ways. That the analysis of motions may be complete and perfect, it is necessary that the successive images of a rapid movement be taken at very short intervals of time, and even then it often happens that the different images become confused. In order to prevent such errors M. Marey conceived the idea of placing upon the limbs of his subject shiny lace, or silver buttons, and then making him file along in front of a camera over a black path sheltered by screens. The subject was dressed in black, the result being the appearance on the plate of a series of white bands. The operation succeeded admirably at night, by the aid of the electric light.

This experiment gave M. Soret, a physician of Geneva, the idea of making a more direct use of the electric light by placing an incandescent lamp at each of the joints of of the subject, and MM. Quenu and Demeny carried out the idea at the Beaujon hospital, obtaining interesting results in an analysis of the abnormal walk.

The cuts presented herewith make it an easy matter to understand the method.

The subject in the experiment carries five incandescent lamps, fed by accumulators, with which he has to remain in constant communication during his walk. As is indicated in Fig. 1 the subject, already wired and fitted with lamps in the manner described, is placed by means of a trolley in

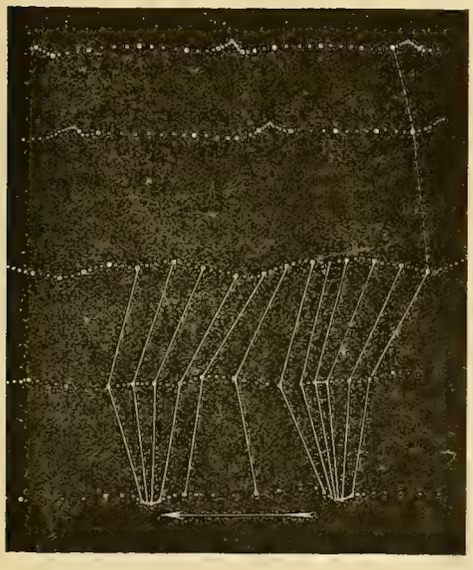


FIG. 2. ANALYSIS OF MOVEMENTS BY PHOTOGRAPHY AND THE INCANDESCENT LAMP.

connection with two overhead wires leading to the accumulators.

An idea as to what sort of record is made on the sensitized plate may be obtained from Fig. 2. In this cut the arrow shows the direction in which the subject is moving and the five horizontal dotted lines indicate respectively the movements of the head, shoulder, hip, knee and foot of the man carrying the lamps. The cuts were reproduced from *Electricité*.

Lightning Arresters, and the Discovery of Non-arcing Metals.[1]

By Alexander J. Wurts.

Part II.

For direct current use I have devised something quite similar, the principle of which will be understood by reference to Fig. 7. Referring to the figure, A is a generator, one pole of which is grounded at G, the other being connected to the trolley line L; E is a circuit controlling device consisting of fixed commutator like metal pieces e^1, e^2, e^3, opposite pieces being electrically connected; F^1, F^2, are brushes insulated from each other and revolving at a high speed in a direction indicated by the arrow; F^1 is connected to earth, and F^2 to the line; e^1, e^2, e^3, are connected respectively to three condensers, C^1, C^2, C^3, the latter being grounded as indicated at d. The action is as follows: With the brushes in their present positions, the line is connected through F^2 and e^3 to condenser C^2. This condenser is therefore being charged while condenser C^1 is being discharged to earth through e^1 F^1. When F^2 passes to e^1, condenser C^1 will be connected to the line, and become charged while condenser C^3 will be discharging through e^2 and F^1. Thus by the continued rotation of these two brushes, it will be seen that the trolley line is being constantly discharged into a fresh condenser.

This arrester has also not been tested in actual practice, but if my hopes are fulfilled it will accomplish for direct current circuits what the neutral point arrester is intended to accomplish for alternating circuits, the idea being in either case to take off the charge bit by bit, but at such rapidly recurring intervals that the line will be kept practically free from charge, or, at least prevent the charge from obtaining sufficient intensity to damage any portion of the system. Personally I am much interested in these two arresters, which practically afford direct connection to earth without dynamo leakage, and would like to dwell on them more in detail, but time will not permit.

Referring once more to my experiments with charged wires, I would say that they were nearly all repetitions of experiments quite familiar to all of you. Let me, however, call your attention to one of them, which, I am confident, is not old in detail. Referring to Fig. 8, L is a Leyden jar, l is a bare line wire, a portion of which is coiled and immersed in a tank K of water. This tank is well grounded. Line l is continued through induction coil C, and then grounded as shown; b is a gap discharge circuit. Now, with the spark at A there was a small spark at b; with a gap at d there was a sparking at d and b, spark d being larger than b. With a gap at e sparks were obtained simultaneously at d, b and e. Induction coil C was either a primary or a secondary of a 40-light converter. When C was primary, spark e was very small. When C was secondary, e was larger, but still small when compared with d and b. From these experiments I learned two lessons, both of them old, but in books they did not impress me as they did in practice. The first lesson was, that I must not expect one or two discharge circuits to discharge the many miles of wire that we have in our lighting and power circuits. The second was that a "kicking coil," no matter how great its impedance, would still take a portion of the discharge. My final conclusions, then, were that, in order to afford the best possible protection for electric plants, the wires must fairly bristle with discharge points properly located in discharge circuits. With this idea in mind, a cheap and effective pole arrester seemed to be the proper thing to look for. My experiments from this time on led me to a discovery so remarkable, and so contrary to all previous ideas, that I am going to read you a description of them.

In designing the arresters already described, I had followed closely the rut of previous practice, which had always been to provide with each discharge circuit, a circuit interrupting device. Upon reflection, however, it was evident that one circuit interrupter placed in the main circuit would interrupt the arc on any discharge circuit. For a moment the problem of a simple pole arrester seemed solved, but on second thought the difficulties and inconveniences inseparable from any automatic main circuit interrupter appeared to be insurmountable, and the idea was no sooner conceived than it was abandoned. And yet, poor as it was for practical purposes, it proved a good stepping-stone, and led to the following plan, viz.: To provide the line with ordinary discharge circuits, that is, with the well-known saw-tooth protectors, made of carbon, so that they would not easily burn away; and then, in the station, between the generator and the first discharge circuit, provide an automatic device, which, upon the passage of an abnormal current from the generator, would instantly short circuit the dynamo and as quickly open again, the intention being that, should a short circuit occur out on the line through any of the discharge circuits, a short circuit at the dynamo would so reduce the pressure on the line as to render it impossible for an arc to maintain itself. Then, any such arc, having been extinguished, the short circuit at the generator could be interrupted, and the service would continue as before. This idea meeting with general approval, steps were at once taken to put it to a test in the following manner: To a 1,000 volt alternator there was connected a circuit consisting of about 100 yards of line wire, and in this circuit there was placed a pair of carbon dischargers having saw-tooth edges and a $\frac{1}{16}$ inch air-gap, also a switch. In shunt with this circuit—that is, directly across the terminals of the generator, there was connected a simple device (it will not be necessary to explain its construction) which, upon the passage of an abnormal current in the circuit containing the dischargers, would instantly short circuit the generator and as quickly open again. All the connections being made the air gap was bridged with a bit of tinfoil to start the arc, and the switch thrown. The actions that followed in an inconceivably short space of time were these. The tinfoil burst with a snap, an arc was formed, the automatic short circuiting device operated, the arc was extinguished and the short circuiting device opened. So far, this was exactly what was anticipated, but no sooner had the short circuiting device opened, and the electromotive force returned to the line and the dischargers, than the dynamo pressure forced an arc across the air gap once more, and the whole operation was repeated. This repeti-

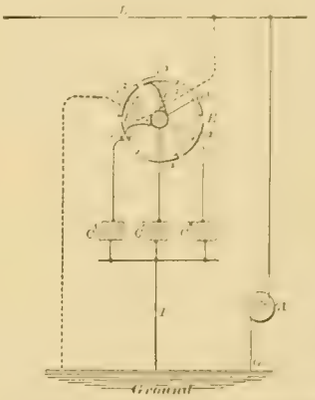


FIG. 7. LIGHTNING ARRESTERS, AND THE DISCOVERY OF NON-ARCING METALS.

tion was found to be due to the fact that when the arc was first established between the carbon saw-tooth plates, the carbons were heated to a white heat, which, not having time to dissipate itself before the pressure returned, the dynamo current found a sufficiently easy path over the heated air gap to re-establish an arc. However, the test being otherwise satisfactory, success seemed assured, for all that was necessary now was to use solid metal dischargers that would readily conduct the heat away, and the trouble above cited would no doubt be avoided. So the test was repeated, using the same apparatus as before, except the dischargers, which now consisted of three solid, round brass rods, 1 inch in diameter, and 1¼ inches long, placed side by side with their axes parallel to each other, and having air gaps of $\frac{1}{16}$ inch. That is, the line was connected to the two outside bars, leaving the middle one idle to be connected to ground, as would be the case in a double pole lightning arrester. The air gaps were bridged as before with tinfoil to start the arc, and the switch thrown. The test was successful in the highest degree—too successful, in fact, not to arouse suspicion. So I thought I would repeat the experiment, and see how the dischargers would behave without the short circuiting device. The result was an overwhelming surprise, for at the dischargers there was merely an insignificant spark scarcely larger than a pea. The experiment was tried again and again, with the same result. Any electrician would have predicted a brilliant display of fireworks. The most plausible theory advanced to explain this action was that the electric motor driving the dynamo being small, its speed was probably reduced to such an extent by the overload suddenly thrown upon it, that the electric pressure was at once reduced below that which would be necessary to maintain an arc across the air gaps. On second thought, this theory would have seemed improbable, but at the time it was accepted without a question. In a few days a test was again made, this time a small engine being used for motive power, and the same results were obtained as before. On the afternoon of the same day both engine and generator were changed, with like results. In the meantime a little reflection seemed to indicate that perhaps this strange action was not, after all, due to the slowing down of the motor, but to the possible cooling effect of the metal dischargers on the arc. With this idea in mind, I had constructed a set of three dischargers similar to the first, but much larger, 2½ inches diameter by 3 inches long, thinking that if a little metal

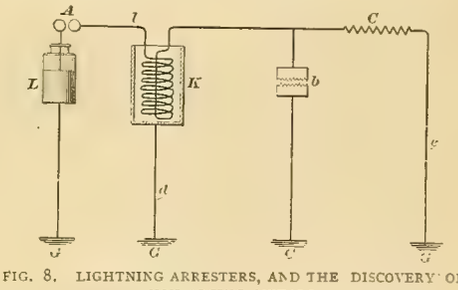


FIG. 8. LIGHTNING ARRESTERS, AND THE DISCOVERY OF NON-ARCING METALS.

was good, more would be better, and that perhaps with a large generator the mass of metal would have to be greatly increased to produce the results already obtained. This large discharger was connected to a 3,000 light, 1000 volt alternator; the air spaces were bridged as before; and the scene which followed beggars description. The large metal bars were melted like beeswax in a great ball of fire. My disappointment was keen, for I thought I was on the verge of making a discovery, and that in the previous cases the comparatively feeble engine had not been the cause of the action. Thinking, however, there could be no harm in melting up the smaller discharger, I connected it in where

[*Continued on page* 207.]

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A CONTEMPORARY makes what we consider to be a valuable suggestion as to the utilization of electric power in the life-saving service. The idea advanced is that lifeboats be provided which could be propelled from the shore by electric power. In this way a boat of the staunchest construction could be handled by means of a cable from the shore, just as the electric torpedo is controlled.

THE building of electric cranes is not confined to America by any means, as shown by the German wharf crane described in an article presented in this issue. This machine differs from the traveling cranes, to which electricity has mainly been applied in the United States, in that it is designed for outdoor service, and in fact it has already satisfactorily sustained the test of several months' every-day service in winter weather. There is no doubt that similar cranes could be introduced on American docks to advantage.

IT is a matter for general congratulation that the finance committee of the common council of Chicago has recommended an appropriation sufficient to provide for the electric lighting of two of the important thoroughfares leading in the direction of the World's Fair. It would be a lasting disgrace to Chicago if the date set for the opening of the exposition should find the South Side boulevards leading to Jackson Park lighted by dingy gas lamps, and it is gratifying to note that it is not likely that Chicagoans will be called upon to meet this reproach.

THE agitation of the New Yorkers to obtain lower telephone rates still continues, but the proceedings are nearly a repetition of the old, old story, and it now looks as though money would, as usual, win the day. The Subscribers' association, which has the matter in hand, is wrestling with politicians in Albany, and the opponents of the reform bill have already succeeded in delaying its consideration for a short time. We do not hesitate, though, to venture the prophecy that unless the Subscribers' association has a large fund of filthy lucre at its disposal—which, in all probability, it has not—the monopolists will find a way, mysterious, perhaps, but nevertheless efficient, to prevent the much desired reduction in the price of the now very necessary instrument.

IN its work of establishing an Institute of Technology in connection with the University of Chicago, the Chicago Electric club is receiving encouragement from many quarters, not the least important being the action of the Western Society of Civil Engineers and Architects, which appointed a committee at a recent meeting to co-operate with the committee of the Chicago Electric club. It is now believed that the new institute will be ready to receive students when the other branches of the university are opened. Much work has yet to be done, however, but the advocates of the proposed school are enthusiastic and energetic, and they are bound to make the project successful. W. L. B. Jenney, the architect, is chairman of the joint committee, and several meetings have been held for the purpose of furthering the project.

A CHICAGO daily paper is apprehensive lest the dispute over the arc lighting at the World's Fair grounds "interfere with the completeness of the general electrical exhibit." In deploring such a possibility the editor remarks: "No World's Fair exhibit can compare in utilitarian interest to mankind with the electrical exhibit. A large portion of the intelligent public has come to believe that electricity is the force that will rule all spheres of human activity in the future. They are intensely interested in every new use to which the subtle agent has been put." This is undoubtedly true, to a great extent, and it gives us pleasure to assure the journal in question that its fears are entirely unfounded. The matter in dispute has been satisfactorily settled, and even were it not so the electrical interests are too intelligent and far sighted to allow the fact to interfere with their exhibit, for which the preparations are already well advanced. The electrical display at the exposition will be at once brilliant, instructive and popular.

ATTENTION is frequently directed to the progress that has been made in the application of electricity by the fact that the right to use electric power is often an important feature in contracts. An illustration of this was presented in the New York papers recently in speaking of the negotiations for the purchase of the South Orange horse car lines. The Philadelphia street railway syndicate, in which Widener, Elkins and Matthews are interested, desired to purchase the road but would not close the deal unless it was shown that a franchise for operating the lines by electricity could be obtained at once.

Now, however, a number of local capitalists, who have been opposed to the Philadelphia syndicate, have offered the same sum, $1,500,000, and have undertaken to introduce electricity. A few years ago such a consideration would not be dreamed of—and, moreover, a few years ago the Philadelphia syndicate was pooh-poohing the use of electricity as a method of propulsion.

IN common with all other well-wishers of the World's Fair the body of citizens constituting the electrical interests of the country will rejoice that the trouble arising from the bids for the arc lighting of the exposition has been dissipated. The result was reached by concessions on both sides, but it is only fair to state that the authorities of the exposition, and particularly the construction department, emerge from the contest in much better shape than was deemed probable a week or ten days ago. They have secured the very material reduction of from $38.50 to $20 per lamp, although sacrificing the condition by which contractors were required to furnish a superintendent and dynamo man for each type of machine. These men will be employed by the exposition company, on the recommendation, undoubtedly of the contractors. The details of the arrangement are given on another page. It is gratifying to observe that an era of good feeling has succeeded that of unbridled accusation and that the World's Fair authorities have discovered that the men composing the electrical companies are not such terrible fellows after all.

PROF. ELIHU THOMSON still continues his interesting investigations of the phenomena of induction at high potentials and frequencies. In this issue another paper describing some of his most recent experiments is presented. Prof. Thomson bids fair to become a most enthusiastic advocate of oil insulation. He states that in all these experiments on high inductions he has been impressed with the excellent properties of oil when used as an insulator. "The perforation of two inches of oil between rounded terminals of say one-half inch diameter," writes Prof. Thomson, "would seem to demand a potential capable of causing a leap of five feet in air." But he points out that to obtain perfect insulation to resist puncture in oil or air, there must be provided surfaces smooth and of as large diameter as possible.

Prof. Thomson also brings out another interesting point. After touching upon the slowing effect in his experiments of numerous turns of wire on the periodicity of the oscillatory condenser discharges, he explains how they may be passed through a fine wire coil of many turns, and the discharge rate brought down low enough (besides being susceptible of variation and control) to cause the spark to "whistle along" with the sound of alternating discharges of a periodicity of 125. With the very practical thought of turning this peculiar acoustic effect to some useful end, Prof Thomson conceives the idea that an approximation to music might be obtained "from spark discharges sent through coils of such varied inductance as to cause the rates of oscillation to follow those of the musical scale."

Who can tell but that like gas, air, and, in many cases, steam engines, the calliope will yet yield its place among novelties to an electrical musical instrument for which Prof. Thomson has as yet found no name?

AFTER much discussion and many delays the prospect for some practical work in providing a rapid transit system for New York city has considerably brightened, and at present it looks as if much of the opposition would be withdrawn. It is quite probable, however, that many changes will be made by the commissioners in the plans as already published, and it is not at all improbable that the original idea will be abandoned and the work undertaken by the New York Central. Dispatches from Albany say that the route will be changed from Madison avenue to Park avenue, the New York Central having consented to the construction of a road above the tunnel, and open cut In this case the plan is for both roads to use the new Harlem river bridge. The dispatch says that the Rapid Transit commissioners also contemplate running an elevated road between blocks on the east side. This change is explained by the opposition of Madison avenue property owners, which it was feared would greatly delay the work, if not ultimately defeat the project. The New York Central has signified its approval of the course pursued, it is claimed, and will work in conjunction with the commissioners. It is explained that at the beginning of the commissioners' work it was feared that if the Park avenue route was selected it would inevitably lead to a conflict with the New York Central, and this the commissioners desired to avoid as much as the charge of giving the franchise to the Vanderbilts. They seem at present, if reports be true, to have overcome this fear.

It is now assumed in New York that the Rapid Transit commission has practically decided to give up the idea of selecting a route independent from all existing railroads and of auctioning off the charter. The commission claims it has spent months on the matter, and it has exhausted every feasible project in endeavoring to furnish the city a convenient and cheap system of rapid transit. It will therefore fall back upon section 32 of the Rapid Transit act, which provides that in such an event the commission, as a substitute, may grant to any existing railroad companies permission to extend their lines by branches, sidings or in any way they may see fit. It is understood that the commission will grant this right to the New York Central, and that that company is prepared to go ahead and furnish the city all the facilities for prompt and convenient service.

The plans of the Central have not been made known but it is quite probable an elevated structure will be adopted as President Depew has expressed a favorable opinion of plans of this nature which have already been submitted.

[*Continued from page* 205.]

the larger one had been, bridged the air space, and threw in the switch. Imagine my astonishment on hearing an insignificant snap like the crack of a toy pistol, and seeing an arc as before no larger than a pea. I then pushed a nickel down into one of the air gaps to short circuit it, and leave only one air gap for the arc, and tested again, with the same results. Two questions now presented themselves, viz : what were the differences between the large and the small dischargers other than size, and why did the small discharger behave in this altogether unlooked for manner? The answer to the first question was readily found by tracing the two dischargers back to their source and there learning that the larger one of the two was made of cast brass, containing certain proportions of tin and copper, and the smaller one was made of hard drawn brass, containing certain proportions of zinc and copper. These facts at once established two differences between the dischargers other than mere size: One was, their physical structure, and the other their composition. Which of these two differences caused the difference in their actions? A discharger composed of cast brass containing the same proportions of zinc and copper as the hard drawn brass discharger was made and tested, and found to work perfectly. It was thus determined that the physical structure of the metal had no influence in suppressing the arc. The important difference between the two dischargers then lay probably in their composition, and I was now rapidly becoming convinced that in brass, consisting of certain proportions of copper and zinc, there must exist certain properties which do not permit of an arc being maintained between two dischargers, even with the high pressure of 1,000 volts. It also occurred to me that possibly the shape of the dischargers had something to do with the results obtained. So the next step taken was to have a number of dischargers made up in different shapes and sizes, such a spheres, ovals, solid half cylinders, tubes and cubes. All worked well with the exception of the cubes. The cubes were placed so their faces were separated by $\frac{1}{16}$ of an inch. Now when the tinfoil was placed over their edges, the action was favorable, but if the tinfoil were pushed down between the faces, the arc would hold on indefinitely, and yet without any demonstration whatever, thus, even when the arc did hold on, showing a very different action from the other metals. The size of the dischargers did not seem to affect the results so long as there was sufficient metal to prevent actual melting—¼ inch brass rod melted on the third trial. It was next decided to make dischargers of other metals, and thus learn whether there were any other substances that would give these results, and if so, perhaps some light would be thrown on the real cause of the action. The metals first tested were hard steel, hard-drawn copper, phosphor-bronze, aluminum-bronze and aluminum, all of which failed utterly. The next metal tested was zinc, and with this most successful results were obtained. Perhaps you will now think the experimenter very slow to put two and two together, but who is there who is at all familiar with the properties of zinc that would have suggested this metal as one likely to resist an electric arc and 1,000 volts in this manner? With such results before me, I was ready to try anything. The next metals were tin and nickel. Both of these failed. Tin made the most brilliant display of all the metals. The next tried was antimony, and it worked perfectly. The theory now advanced to explain the phenomena was that with the metals that do not allow the arc to be maintained, there is formed at the instant the arc is started, an oxide of the metal, which, becoming instantly volatilized in the intense heat of the arc, chokes up the air gap with vapors of high resistance, and so presents an effective barrier to the further passage of the current. With metals that do maintain the arc, instead of the vapor of the oxide of the metal, there is formed a pure vapor of the metal itself; and this offers comparatively no resistance to the passage of the current. When tests similar to the above were made on a 500 volt direct current generator, every one of the metals failed. The arc, however, was small and quiet with the special metals, thus even with the direct current showing a very peculiar action. Another curious phenomenon connected with zinc and antimony is this: The smaller the air-gap the less tendency there is to maintain arc when using an alternating current at 1,000 volts pressure. In fact, when the air gap is two inches long the arc, when once started, will be maintained, while at $\frac{1}{8}$ inch or ¼ inch the arc will not give up without a struggle, and at $\frac{1}{32}$ inch there is only a small spark caused by the fusing of the tinfoil, and the circuit is instantly interrupted.

The next step taken was to try higher pressure. A short circuit on a 2,000-volt generator, through the double air gap discharger, failed to be interrupted; five and six air spaces also failed. Six air spaces of $\frac{1}{32}$ inch each, interrupted the short circuit instantly, but six air spaces, which would make three on each side of the circuit for the lightning charge to jump through, were strongly objected to as offering too great a resistance. A test was then made to determine the pressure needed to strike an arc across three air gaps, and was found to be 3,500 volts, measured with a Cardew on an alternating current generator. The experimenter then procured a lightning arrester well known in the market, and one which is known to take the lightning discharge successfully, and tested it for the striking electromotive force, which was found to be between 8,000 and 9,000 volts. In order, however, to avoid any prejudice that a series of air gaps might arouse, the following plan was hit upon: Pairs of non-arcing dischargers were mounted upon thermostatic supports in such a manner that the pairs would normally rest in contact with each other, and so that any current traversing the system would be forced to pass through the thermostats and dischargers in series. The theremostats were so arranged as to cause the two dischargers in each pair to open a way from each other upon the passage of the current. If then, a single and permanent air gap were connected in series with this system, that is, an air gap just sufficient to prevent the normal pressure of the line from striking any arc, and if an arc were started across it, the sudden rush of current through the thermostats would instantly introduce a number of air-gaps in the circuit corresponding to the number of pairs of thermostatic dischargers, and thus automatically open the short circuit. This device was tested and found to work admirably. Of course after the circuit has been interrupted, the thermostatic dischargers at once return to their normal positions. In fact, this action is so rapid that if a series of these dischargers be connected in a short circuit without a permanent air gap, the circuit will be automatically opened and closed every two or three seconds. In order to appreciate the very remarkable action of this thermostatic device it must be well borne in mind that a very small air gap is all that is necessary for the interruption of the circuit.

Thus far, although I had tested a number of metals, my selection had been quite at random, so by this time I was desirous of making a more thorough and systematic investigations of this new property. The chemical properties of zinc and antimony were carefully compared without any new light. The various groups of metals were examined, and then it occurred to me that, of all the metals tested, not one of them belonged to the two groups in which zinc and antimony are found according to Mendelejeff's grouping. The metals of the zinc group are, zinc, cadmium, mercury and magnesium. and of the antimony group are,—antimony, bismuth, phosphorus, and arsenic. I first tested cadmium, and found it non-arcing. Then magnesium,—more, however, from a sense of duty than because I had hopes of anything but negative results. Fortunately I made this test on much lower electro motive forces, and found it non-arcing at 100 volts over two air gaps of $\frac{1}{32}$ in. each. On 250 volts the magnesium caught fire, which was, of course, anticipated. I then wanted to try mercury, but for the moment, not seeing how to make such a test with a liquid, I was diverted to the antimony group, and upon testing bismuth found it to be non-arcing. Phosphorus and arsenic were not tested. A final attack was now made upon the zinc group by testing mercury in the form of a copper amalgam. This test was the most successful one of all, for after a number of short-circuits on a 1,000-volt alternator, I found the surface of

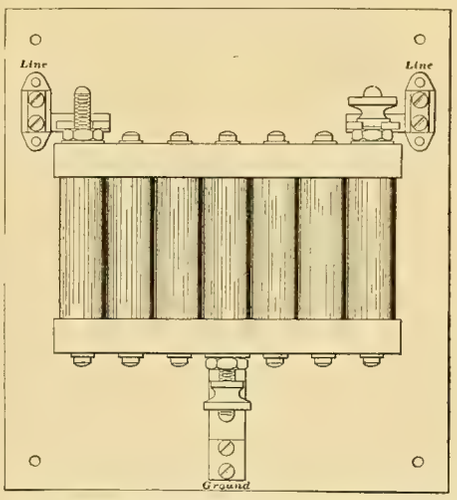


FIG. 9. LIGHTNING ARRESTERS, AND THE DISCOVERY OF NON-ARCING METALS.

my dischargers had not been disturbed in the slightest degree. It will thus be seen that all available metals in these two groups are non-arcing. In searching for the non-arcing metals each test was made with two air-gaps and the electro-motive force at the time of the short circuit was, with the exception of the test on magnesium, 1 000 volts.

Figure 9 represents a double pole lightning arrester made of non-arcing metal, and in connection with this paper will be readily understood without further explanation.

Electric Lighting in Chicago.

At a meeting of the finance committee of the city council held on Friday of last week it was decided to accept the proposition of the South Park commissioners to build an electric light plant costing $100,000 and put up 175 lamps on Grand boulevard, Fifty-first street boulevard, and Michigan avenue south of Thirty-fifth street, if the city would pay the operating expenses. These were fixed at $155 a lamp a year on figures given, it was said, by City Electrician Barrett, but Prof. Barrett told the committee that he thought $120 a lamp would be enough, and the committee voted to appropriate $20,000 for the purpose. None of the South Park commissioners were present, but it is believed they will not object to the alteration in in the figures. The committee determined also to light Michigan avenue and Prairie avenue from Thirty-fifth street north, so that there will be two thoroughfares well lighted by electricity from the center of the city out to Jackson Park.

Single or Double Motor Car Equipment.

Following is a stenographic report of the discussion at the Chicago Electric Club, March 21st, on the subject of electric car equipment:

ELMER A. SPERRY: I have been deeply interested in the consideration of a single motor car equipment. It has seemed to me better to employ a single motor, where possible, and thereby dispense with the complication involved in using two. There is certainly no trouble in obtaining power enough in one motor, but inasmuch as it has been suggested by someone that the car equipments have been designed in some instances by the so called electrician rather than the mechanical engineer, the mechanical difficulties encountered in transmitting the power after it has been generated and distributing it to the traction wheels of the car, have stood in the way of employing one motor rather than two. I have undertaken to put this principle into pracical form For instance, I have employed a single motor for two wheels upon cars; also for four wheels, six wheels and eight wheels; and these not on models but upon full-sized car equipments. Some eight wheel car equipments which I have been engaged upon have weighed as high as twelve tons. and have been employed on very heavy grades. On equipments of this class I have installed motors as high as 125 horse power, in those cases running eight wheels. These equipments have been used on tracks with heavy grades and in severe service and the heavier motors have been used on extremely sharp curves. Where employed as locomotives they have been attached to very heavy trains and have succeeded in not only doing the work for which they were designed, but in most instances a great deal more.

The points that I will consider in connection with this matter may be stated briefly as follows: The single motor equipment is simpler, less expensive, of lighter weight and has higher efficiency.

As to simplicity, it is of course conceded that one motor is simpler than two and when the motor is geared to the tractive elements of the combination by single reduction gearing, there are less journals and less parts.

It will readily be understood that with a given potential a larger motor has less windings and proportionally less weight for a greater capacity.

That the equipment is lighter in weight I have had ample opportunity to observe. I have seen single and double equipments operated side by side, and have investigated the single reduction and double reduction equipments, both where one motor and where two motors are employed and know that the saving where single motors are employed is between 1,800 and 2,200 pounds. This factor is one of importance, inasmuch as it has to deal with the wear and tear upon the road bed and the total amount of power required by the equipment, especially the total amount of dead weight to be pulled about for a certain carrying capacity in live loads. For instance, take an extreme case, like the Pike's Peak railroad. There they have an equipment which weighs about 37 tons. The total capacity of that equipment in live load is somewhere between three and four tons. In electric street car service, especially where the roads are comparatively level, the paying weight can be greatly increased as compared with the total weight of equipment. This can be accomplished to the greatest extent where a single light motor is employed. Let us consider in this connection the distribution of this weight, where a single motor equipment is used and also where there are two motors, each hung upon the axle. Where two motors are employed it is customary to hang them directly upon the axle, and the consequence is that in some instances they spring the axle. The axles are much more readily crystallized when carrying this weight and, as is well known, the road bed suffers materially. This last feature of the question has seemed to dawn upon the street railway people all over the country almost within the last six months, and efforts are being made to overcome this objection.

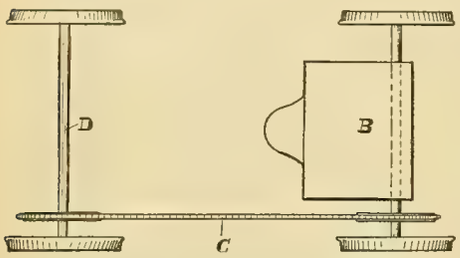
The higher efficiency of the motor is analogous in every way to that of the dynamo. You can readily understand that a large dynamo can be made of higher efficiency than a smaller one, and it is equally true that all the arguments generally used in connection with the difference in the size of dynamos, are equally applicable in every way to the motor.

There are two or three ways of mounting the motor in the single motor equipment so that all the wheels may become drivers. The only way in which traction is secured is through adhesion, and from experiments which I have made I have found that the more wheel contacts we have the more opportunity there is for adhesion.

Now there are two methods in which a single motor may be employed. Let us consider the motor in Fig. 1. In this case it is mounted directly upon the axle and its end may be supported in any of the usual ways, elastic or otherwise. In that case the power from a single motor may be transmitted by gearing or by a sprocket chain *C* to the other axle, letting the dotted line indicate the sprocket chain. That method was one of the first used by Mr. Van Depoele. This form of transmission was used at a very early date by Mr. Van Depoele where he placed the motor on the front platform of the car and then transmitted back through countershafting, first using gearing and then transmitting to one axle by a chain. In numerous instances in Ohio chains were used between two axles so as to transmit the power to all the axles to get the benefit of all the adhesion. This idea of using a sprocket chain, while it was one of the first, has never proven successful from the fact that wherever in engineering a sprocket chain is used it requires that the centers shall be adjustable. The distance between the axles in all cases should be capable of adjustment. Of course it is possible in some instances to use a sprocket chain with an idler when so used, but it must be a "face wheel" in almost every case. As to the car, our wheels are small as compared to the distance. The idler brings the chains too close

making the possible adjustment very small. The idea of making both or one of the axles adjustable with reference to the other at first was not thought to be good engineering. The proof of this, of course, would be in equiping a car in this manner and watching the operation. I have done this and can report after some months of use that there seems to be no trouble at all in allowing one axle of a truck to be adjustable. The main difficulty encountered at first was the fact that sometimes one end would be adjusted farther than the other. I found that a very simple expedient to remedy this was to provide a small scale attached to the stationary part of the truck, with a little pointer fastened to the movable pedestal box, and whenever it was adjusted the pointer would move along the scale, indicating when the two sides

Fig. 1



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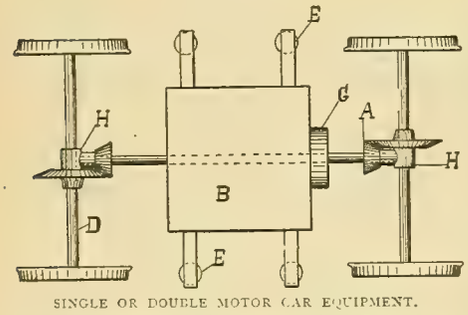
were alike, so that the two axles would not be at an angle. The other system may be diagrammatically illustrated in Fig. 2. Suppose *B* to be a motor, a bevel pinion shaft connected therewith, and a bevel gear to be attached to each axle as shown. The bevel gear on one axle should be in the opposite position to that on the other, so that all the wheels will move in the same direction. It has been thought by some that the use of bevel gearing is objectionable. It has been thought that a bevel gear will not run on pitch line. I have found it in actual test to have different requirements than spur gear. I find that when the pinion in any bevel gear combination is held so that its lines can be maintained in an extremely rigid manner, and that these lines are made to meet exactly at the point of coincidence of the pitch lines and cones, there is no friction in the bevel gear, even though it be a rough casting, and although the teeth of the gear may be in the same condition as when taken from the sand. But allow either of these lines not to coincide with the points, as I have stated, friction is at once found to exist, and to a very measurable degree Each tooth in Fig. 3 is in the line of radius, and all its elements are in the line of the cone. For instance, the epicycloidal curve or involute curve, whichever is employed, is in the line of the cone. But just as soon as they are allowed to come out of line—I have drawn Fig. 3 so as to show the effect—the teeth bear on the top at one end and underneath at the other end, and tend to wedge together, force themselves apart and bind when the axis is at an angle as indicated at II. This shows the necessity of holding the alignment of the pinion shaft with reference, to the gear absolutely.

Another serious question is encountered in designing the equipment. A railway truck is one mass of loose joints. It must be thus constructed to make short radius curves. For instance, each axle must have a lateral play with reference to the truck. It also must have a slight capacity for varying as to parallelism of axles, and at the same time each support at the journal bearings must have a capacity to rise perpendicularly individually, without reference to the other. In going over obstructions a wheel will rise over it and fall to the track again, and when the following wheel comes up, it will rise, while the other three wheels will maintain their position on the track face; and to design gearing which will uniformly and simultaneously rotate these axles and yet permit of all these motions is

Fig. 2



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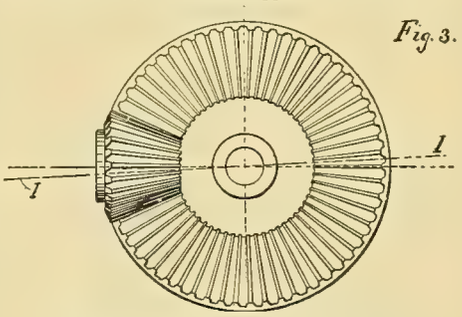
one of the most difficult problems that I have met. It cannot be done by mounting this axle, the pinion shaft, on projections of a truck frame It will be readily seen that the alignment cannot be maintained, because the truck frame rises and falls with reference to the axles with different loads and condition of track. I have been enabled to obtain the best results, very perfect results indeed, by mounting it directly on the axle, and allowing the pinion shaft to have no other support than the axle. For instance, building the armature with its shaft hollow, so that the pinion shaft may pass entirely through it without touching it, and allowing thereby an additional advantage, viz., the vibration which is transmitted from the axle to the pinion shaft, to take place freely without being transmitted back to the motor. This involves a peculiar transmitting device between the motor and the axle, one which will allow of the eccentric relations of the two shafts, not an easy thing to design; so that it will at all times perform its functions, and at the same time not allow, as I say, the vibration, the hammering blows and concussion in this axle to run back into the motor.

There is one other matter with reference to this gearing to which I wish to call your attention. You will readily see that if either of the axles have an end-wise motion with reference to itself, and a lateral motion with reference to the truck, independent of the other axle, and the end of the pinion shaft is retained upon that axle and located with reference to the axle in a constant position, the mesh of the teeth will differ. This difficulty has been so thoroughly overcome, however, that even a cast pinion and gear will run noiselessly when speeded up from thirteen to fifteen miles. It will run coming down grades much faster than that, with almost no noise whatever, with a 30 inch wheel. That means that the gear at 11 miles will run about 120 revolutions, giving it quite a high velocity. The gears have been laid out so that even on an irregular track, taking turn-outs, etc., there is no apparent noise from them. So much for the transmission.

Now as to the economy of current. There is one other factor in the absorption of current by the two motor car equipment than that referred to in direct absorption for the power given. We have here a curve Fig. 7, which was planned by C. A. Pratt, in which the ordinates show the amount of extra current consumption by either one of two motors per car equipment owing to the fact that they are coupled together and are compelled to revolve in unison. It is certain that there is a want of uniformity of absorption of power in the case of two motors. One of the best contemporary authorities on this matter writes as follows: "It is found in practice that if electric motors as ordinarily constructed and connected in circuit are belted to the same shaft, or are otherwise applied to the same work, so that they must revolve together, the results are unsatisfactory, because of the fact that the load will be unequally or disproportionately divided. This is occasioned by the fact that it is very difficult, in fact almost impossible, to construct electric motors so that they will, with the same rate of rotation, and when supplied with current at the

Fig. 3.



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same potential, have precisely the same counter electromotive force. Therefore, if two motors are connected as ordinarily to the same supplying mains, and operated so that they must revolve together, that motor whose armature produces the lowest counter electromotive force will take a larger current than the other motor. The effect of this increased flow of current is to greatly exaggerate or enhance the difference existing between the motors, because the magnetic field of the motor is disturbed by the increased flow, and its counter electromotive force is thereby still further reduced. This motor, requiring a higher speed to produce a counter electromotive force, equal to that of the second motor, takes the bulk of the work and tends to drive the second motor as a generator, and the load is divided unequally between the motors. It is practically impossible to make motors, running under the conditions mentioned, self-controlled by adjustments affecting only their own circuits."

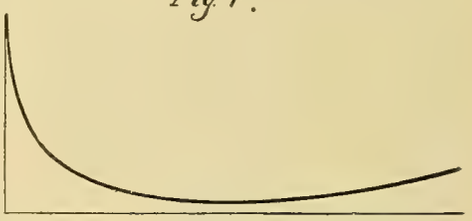
The line marked 100 shows the height of the ordinates of a 15 horse power motor absorbing 10 amperes when the motor measures two and a half ohms, which is a high efficiency motor for the capacity. The height of the ordinates that intersect this curve at various points shows the amount of power absorbed or the amount of heat put into the motor, which is added to this amount of heat indicated by the line already mentioned when these motors are run together, and when they vary 2, 4, 8 to 10 per cent., so that the height of the ordinate intersecting the curve should be added to the height of the ordinates marked 100.

For purposes of dynamos and motors, cast iron cannot be depended on to within 5 per cent.; therefore, two motors with cast iron fields built for the same armature speed, when working on the same potential, may easily differ 10 per cent. in speed. There will be a further difference in speed, due to unavoidable difference in winding, but this ought not to exceed .1 per cent., and may be neglected. Suppose two motors were built to run at 500 revolutions, one may make 475, and the other 525; now, if the armatures of these machines are forced to revolve together, either the slower will pull down the speed of the faster, or the faster will increase the speed of the slower, or the speed of both will be affected. Consider the case in which the slower armature reduces the speed of the faster one; the result will be that the counter electromotive force of the faster will be reduced, and a greater current will flow through it. This will increase its torque to such an extent that the slower motor will be unable to hold it down; its speed will increase, raising that of the slower motor beyond its normal. This will raise its counter electromotive force, and a smaller current will flow. All of the work will then fall on the fast machine, with the result that its speed will decrease, and then the cycle will be repeated.

Suppose the resistance of each motor were 2 5 ohms, and under normal conditions each takes 10 amperes. The drop of potential in each will then be 25 volts, leaving 475 volts for the armature to produce as a counter electromotive force. Now, suppose both were designed to make 500 revolutions, but, in practice, one made 475, and the other 525 when running independently; then, clearly, if the faster one is forced to run 475 revolutions per minute, it will produce an electromotive force of but 430 volts, which leaves 70 volts, and this will produce a current of 28 amperes through the 2.5 ohms of motor resistance. On the other hand, if the slow motor is forced to make 525 revolutions, proportion would indicate a counter electromotive force of 525 volts, but, as this is impossible, it will simply run idle while the other motor does the work.

In the curve the ordinates represent the relative amounts of heat lost for various percentage differences in the two

Fig 4.



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motors over and above the heat normally lost in the motors.

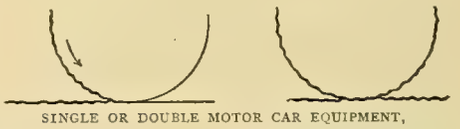
The line marked 100 represents the normal heat loss. The curve shows an additional heat loss due to the difference of the motors equal to the normal loss when the machines differ by a little over 5½ per cent.

It is a fact in practice, and it has been one of great interest to me, that, upon several occasions, a street railway superintendent has actually removed one of the motors from a double-motor equipment, and has reduced the destruction of armatures in the neighborhood of 70 per cent. I know of an instance, not many miles from this city, where the superintendent has made a success in this particular instance. His line has four grades, and in conversation with him he stated that he had removed in every instance one motor from the equipment, and the burning of his armature, was reduced to 30 per cent. since this change had been made.

The next point is economy in repairs. This needs but a passing comment. There are certainly less parts to wear. and if we can, in a single large motor, run at lower speeds, the repairs will certainly be less in number and less in quantity. But, taken in connection with the fact that when a single motor is used for car equipment it is possible to mount that motor in an entirely different manner, and in a manner that is calculated to meet the special requirements as, compared with the case where two motors are in operation, it is possible to still further reduce the wear and tear. In the case of single motor equipment the motor may be elastically supported, and may be removed entirely from the hammering concussion of the axle. The insulation, which is a large component of every motor, and which consists of cotton thread, something which cannot, by any possibility, stand the sledge-hammer action, in this manner may be protected from the concussion and jar which is constantly going on in the axle.

The point which I wish especially to bring out is that where we have a single motor we are enabled to get a great deal more traction. The office of the motor on the car truck is traction; it is placed there for the sole purpose of pulling the car along, and this result is accomplished through the adhesion of the wheels on the rails. I have been much interested in the increased traction when four wheels, six wheels and eight wheels have been coupled to the same motor, and, experimenting along this line, I have had an opportunity that, perhaps, has not presented itself to every one to ascertain what this is. In conversation, not many days since, with one of the best authorities in railroad locomotive engineering, I brought up the matter, and obtained from him a statement something as follows: He said that it is a well-known fact that where two locomotives are used to pull a train, the results are not satisfac-

Fig. 6 Fig. 5.



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tory. For instance, where two four wheeled locomotives are used in the place of one eight wheeled locomotive, and where the same total weight is on the drivers, the engine with the eight drivers will pull much more than the two engines with four drivers, each with one-half the total weight on the drivers, leaving out of account the boilers and running. The only instance in which this will fail to be a better arrangement is where more speed is required. Where great speed is required, two locomotives have an advantage over one in that the four cylinders have larger total port areas than the two cylinders in an eight-wheeler, and the wire-drawing is less. This is merely an incidental factor, entirely foreign to the matter of traction. The single locomotive has this advantage over the double locomotive: All the wheels are coupled together, and compelled absolutely to revolve simultaneously, especially with reference to their peripheral velocities. One can readily see if any wheel does get down to an actual contact with the rail, it finds itself going at exactly the right velocity to help along, rather than to

slip, as would be the case if the peripheral velocity of the drivers were different from the others.

I find different statements with reference to traction. It seems that the idea of adhesion and friction is something like the old idea of static and kinetic electricity; that they are entirely separate and distinct phenomena. I find in some works the statement that adhesion should not be confounded with friction. Now, this little clipping that I hold in my hand seems to come to the point slightly, but still it is not complete. It says: "The friction of quiescence—that is, the resistance to the commencement of motion—is greater than the resistance to its continuance; but, after motion is commenced, this cohesion or whatever it is' —evidently not knowing what it is —"that constitutes the peculiar initial resistance is destroyed, so that it is only the constant and regular friction of motion that is of much consequence in practice." This is all very well for friction, but how about adhesion?

The fact is that adhesion and friction are doubtless the same thing, only, as in the case of static and kinetic electricity, it is a matter of degree. Now the friction not only varies with the pressure, irrespective of the surfaces, but also varies with the velocity. At zero velocity friction is very high. As the friction of quiescence disappears, the curve of friction doubtless comes down and goes along almost parallel, and at high speed it is supposed by some to rise again, as shown in Fig. 4. Now if this is not so I think it would be very difficult to explain one phenomenon which in Chicago we have excellent opportunity to observe. It is a fact that the friction brake used on all the South Side cable lines is operated by what is known as the momentum brake system, the invention of Thomas L. Johnson of Cleveland. There a double friction phenomenon exists in this way—one controls the other. On one of the axles is a loose friction disk, which is held up by a lever under the control of the gripman, against a rotating disk fastened solidly upon the axle, and to the first disk is fastened the brake chain which applies the brake shoe to the periphery of the wheels. Now in this case we have the reverse of the old way of trying the experiment, by taking the resistance of the friction of quiescence and having it come down as motion is given. It is often said that it is a poor rule that does not work both ways. In this brake system if the friction did go up it would be very apparent, much more so than in the ordinary application of brakes. Now what is the fact? When the brake is applied, the velocity is very great as compared with the loose stationary disk, therefore we should expect to find the friction low, and we know that the initial reduction of the velocity of the car is not great. But as the train is brought to a standstill the curve of velocity drops off more and more quickly and at last drops off very suddenly and if one is standing hanging on the strap, as is usually the case, the body is swayed farther and farther, until at last when rest is attained by the car there is a sudden lurch ahead, showing that the resistance undoubtedly comes up as we should expect it to do if our curves are correct. When we speak of journal friction, the value of the frictional quality is low as compared with adhesion, or the frictional phenomenon connected with adhesion. In the matter of adhesion on an ordinary 16 foot street car we have about 13,000 pounds per square inch applied, whereas in an ordinary journal we have only from 900 to 1,600 pounds per square inch, which is the highest journal pressure in practice. But where we have such a severe application, where only a minute part of the surface is available, and where the wheel would tend to dig itself into or abraid the rail where the velocity differs, the phenomenon that we know as adhesion takes place. We are enabled to know one point on that curve. For instance, we know that friction between chilled cast iron and ordinary soft steel rails is as high as 24 per cent., even after a slight motion is attained. Furthermore, that by the application of sillicates or sharp sand it can be raised as high as 42 per cent., even after slipping has set in. The idea of adhesion is undoubtedly one of molecular gear. Suppose a wheel surface to be greatly magnified. In this case we find that the surface is always more or less rough, and when we reduce it to a molecular surface it must certainly be rough, as shown in Fig. 5. In this case we have what may be termed a molecular gear, or gear and rack, and as they roll it might be said that the teeth mesh. This is known as the friction of quiescence; we obtain the enormous pull that we observe in the high point of the curve. Now then, why does the curve come down so rapidly? It seems to me that it may be readily explained by saying that the critical moment is when the slip first starts to take place; these gear teeth are then stripped off, and we have left what approximates a surface. We can almost illustrate it by an irregular line, with the straight suface to the rear, where the gear teeth have been stripped, as in Fig. 6.

In my judgment this goes to show that we must arrange our truck and our car equipment so that the first or initial slip will be prevented. It is a fact that has been observed that where a train is running double header, just as soon as the drivers of one locomotive commence to slip on a heavy grade the drivers on the other will immediately commence to slip, although they have no mechanical connection whatever. The tractive power, which was very high, and which was exerting itself upon the load tremendously, just as soon as the slip occurred was reduced and all the load was thrown on the other drivers, which were not equal to the increased duties. In the case of an eight-wheeler the advantage exists in the fact that they are all coupled together and all must rotate in unison. When one driver tends to slip, it is held back to its place by its rigid attachment to all the other seven that do not happen to slip at the same instant. At the next instant it perhaps binds itself down in rigid, direct contact, has its gear teeth all meshed, and does not offer to slip, and may tend to hold back some other driver from slipping at the next instant. The adhesion is thus of high value, so that their tractive power is very much greater than it is where they are allowed to slip, in which case the tractive power comes down to merely a fraction of its possible value and to a point generally denominated friction.

Single motor car equipment admits of construction rendering available the high tractive power secured by coupling the drivers. I find further that gearing for such connections is far superior to side rod connection from the fact that lost motion in joints of the reciprocating parts tends to start the slip, bringing about a great reduction in tractive capacity.

W. L. R. Emmet: I will base my arguments first on mechanical reasons which I think exist for making the single motor rather impracticable in street railway work, and secondly on the fact that two motors can be put upon a car in certain ways which will avoid most of the troubles that Mr. Sperry has enumerated.

Of course, as Mr. Sperry says, you have got two axles that are entirely independent of each other, and their relative motions are necessarily very complex. In fact there is no law that will cover it. We have got to go up and down a short distance between centers through the different variations, producing very complex motions; and in order to get a truck that will run with regularity it is necessary to give a sufficient relative motion which shall be rather beyond the range of anything that can be compensated for in ordinary gearing or in ordinary methods of mechanical coupling. The two ways in which we can do this are by joints or by springs. These relative motions are taking place and it is necessary to have some

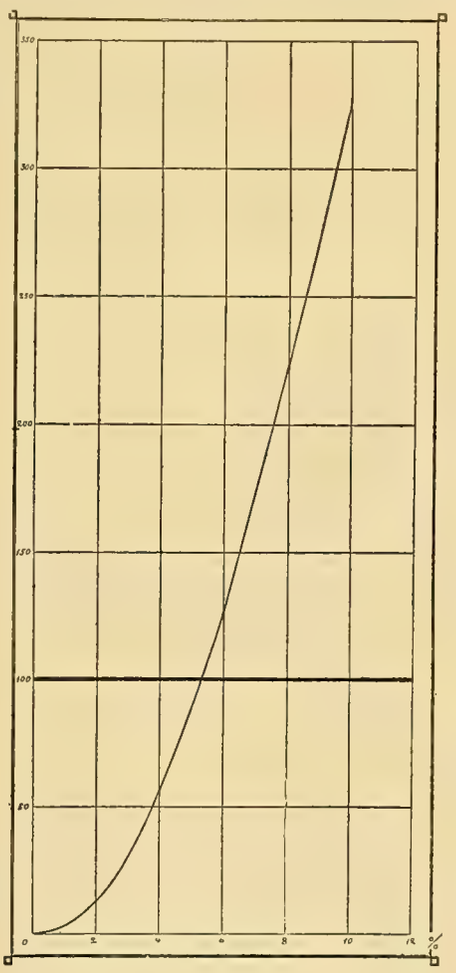


FIG. 7. SINGLE OR DOUBLE MOTOR CAR EQUIPMENT.

mechanical device. If the pinion is mounted on a separate carriage, as Mr. Sperry has indicated, it would be all right as far as the pinion is concerned, but you have got to have some intermediate device between it and the armature, and that device has to have more than one quality. It has got to be a more or less complicated device, and it is a sort of device that is not suited to street railway work.

Now I think in looking at this mechanical problem that it would be a very great mistake for us to assume because things have been done in locomotive practice successfully we want to adopt the same means in street railway practice. An electric motor is an infinitely simpler device than a locomotive. If we adopt electrical locomotives we want to make them just as simple as possible, and I say that this is very nearly accomplished mechanically with the double equipment.

Any arrangement for coupling a motor, that is on two separate axles, implies a great deal of mechanism, whereas the double equipment is extremely simple mechanically, and I think the essential expense to the street railway company in running two motors lies in the renewals of gearings and in the renewals of bearings. I will say in a general way that a bevel gear will run as well as any other gear if you keep it right, but the difficulty is to maintain a proper intersection of those axes. This much more difficult than it is to maintain the parallelism of two axes with other forms of gear. Another thing, the variation of the parallelism will not make the same difference that a slight difference with this will make.

Mr. Sperry has read an extract from a paper on this subject, and the curve is traced there describing the loss of two motors, running together on the same car, due to irregularities. He has not, however, brought out all the important points, showing why trouble exists in the present form of car equipment, and from the curve there traced, as I understand his description of it, and what he read the real causes of the trouble between motors are not dealt with at all.

Now we will say there are two motors on a car. The current from a certain field may find several paths, so that the fields in which these armatures are running may be made entirely different, the field strain may be varied, and the consequence is these armatures are affected indiscriminately by parallel currents, and of course the discrepancy existing in the current taken by the two motors may sometimes be more than it would be if it was due to the different conditions of the motors, assuming that the motors were independent and parallel.

In running two motors on a car in series this selective action of course cannot take place. Each armature takes the current that goes through its own field, and the armatures can never be overloaded through a weak field. It is only where the field becomes short circuited that the armature may be burned out. With two motors in series this is impossible. By running the motors in series the wire is much as it would be on a single motor of the same power. It makes the armature a great deal simpler, the field a great deal stronger, with less liability to trouble. With two motors the voltage is divided by two. Instead of having 500 volts to deal with on a commutator you have 250. Of course two motors are somewhat heavier than a single motor would be, but their whole weight does not bear on the axle, and you will have all these electrical advantages. At the same time you have absolute mechanical independence and you have a simple system.

Now this matter of the friction of wheels on the rail that Mr. Sperry spoke of, is a very interesting one, and I think his argument about the number of wheels on a track all being bound together is very true; but the trouble is, if those wheels are bound together independent of each other the strain involved in keeping those wheels down to the same motion is very great. There are gains in traction, but there are very great losses in efficiency, where the question of slipping is not taken into consideration at all, but the mechanical wear and tear is tremendous.

Now, in locomotives the matter of keeping up a system of connecting rods and all the parts of the locomotive has to be thoroughly well done. They have got to be set so that their relative lengths are just right. The motors involved are very rapid—rapid reciprocating motors—the parts are small, and the hammering, the wear and tear is not so perceptible on these small parts as it is on larger parts. I believe that the mechanical disadvantages of running one motor far outweigh the electrical advantages which a single motor has over two motors while running in series. As I suggested, the simplicity of the series arrangement approximates it very closely, and here is absolutely no confusion between the motors. There is no loss in efficiency, and there is the fact that you have not got all your eggs in one basket, and in case of trouble, if the armature is grounded it does not burn out everything. If one armature is disabled the other will take care of the car, and take care of it for some time, until the trouble is discovered and the damaged part taken out; whereas when the motor is open, as in the case of any trouble like short circuiting or grounding the armature, it is very violent, and it will probably destroy the field and destroy the brushes and do a great deal of damage.

F. L. Perry: I would like to ask Mr Sperry what his experience has been with the side rod method of coupling. Has he made any experiments with side rods to connect a single motor to four drivers, after the locomotive style, for example?

Mr. Sperry: That is a question of a great deal of interest to me. Mr. Emmett has called our attention to the fact that if the wheels are not of the same size internal strains are generated. I have experimented with ordinary commercial wheels, where eight wheels have been coupled and compelled to revolve simultaneously, and know exactly how many pounds per ton it takes to overcome the internal strain. There is no appreciable difference between that arrangement and where the wheels are entirely separate; that is, each axle entirely separate from the other. The internal strains, which it seemed to me at first would be something considerable, do not exist.

Now, in regard to the use of side rods as in locomotive practice, if you take, for instance, a case where a motor is coupled by gearing to two axles, and then take the same motor and couple by side rods to two axles, we find that in the case where the side rods are used, the traction is very much below the case where the gearing is employed. This must be due to the fact that no reciprocating mechanism can be employed without some lost motion in the parts, and that lost motion starts what I might call a shearing of the molecular teeth referred to in my diagram. This may be proven in a practical way as follows: I have experimented with one of our mining locomotives. The tables given by Porter in this work on light locomotives, which is probably the best work in the English language on that subject, say that a locomotive with a weight on the drivers that we have in this particular equipment should be stalled on a certain grade with a certain load. The tables are computed for different grades and the weights enumerated which should stall locomotives on those various grades. Now, we have quite a number of grades where this locomotive is in service, so we made a test and found which the locomotive will pull 100 per cent. more on the grade than the figure given in the table as the weight that would stall the locomotive. There is no more weight, and the conditions of rail contact do not differ, but the absolute harmony of rotation, harmony of peripheral velocity in gearing is constant, while, when communicated from wheel to wheel through side rods there is a jerky motion which gives the initial slip.

MR. PERRY: I understand you to say then that you consider the gearing to be more efficient?

MR. SPERRY: Very much more so.

MR. PERRY: My reason for asking your experience was that we all know that locomotive builders, being men of experience in matters of traction, connect their locomotive drivers with side rods. One of the most progressive electrical companies too, has lately turned out its largest electric locomotive, and in this machine the side rod method of coupling is employed. I think the rod is built without any straps, and with a bushed rod, something similar

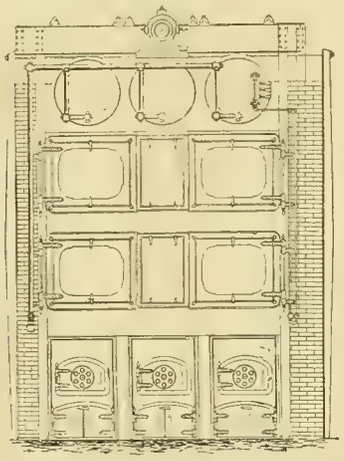
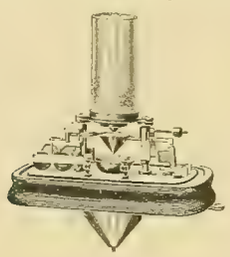


FIG. 1. BOILER TESTS AT ROCHESTER, N. Y.

to the rod used on some of the Pennsylvania railroad passenger engines. Reference has been made to the possibility of trouble from the necessity of adjusting side rods. When the rods are bushed as on the Pennsylvania railroad the chances are that the motor man would have but little chance of interfering with them. It struck me that there was a tendency at the present time to use side rods as connections from a single motor, especially on large locomotives—in other words, that the tendency was to admit that perhaps the use of the side rod on a heavy and comparatively slow speed electric locomotive was not such bad practice after all.

M. J. SULLIVAN: I would like to ask a few questions. It did not seem to me that you made a distinc-



A. T. SMITH'S MAIN LINE CUT-OFF.

tion between places where you had heavy or light traction. In other words, your discussion was general and did not apply to cities where they had to use heavy four wheeled trucks. Did your arguments apply in general to all cases alike?

MR. SPERRY: I should say they did.

MR. SULLIVAN: Then you made the statement that you had eight wheels connected from a single motor, but I did not understand clearly how that was accomplished.

MR. SPERRY: Supported in the center of the car is a single motor of 50 or 60 horse power. The power is transmitted from that motor to the wheels by a system of gearing which compels all the eight wheels to revolve simultaneously. We have two cars of that kind in operation, and each is over thirty four feet over all. These cars have operated on all sorts of grades, and all sorts of curves,

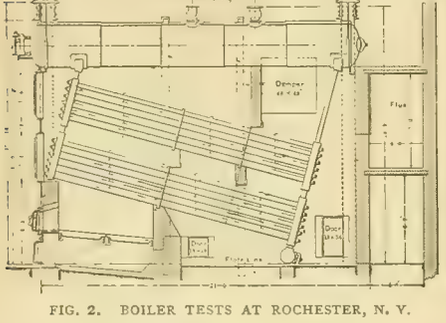


FIG. 2. BOILER TESTS AT ROCHESTER, N. Y.

with and without trailers. They have seen hard service so so we do not consider that they are an experiment.

The survey for the Rockland, Thomaston and Camden Electric railroad has been completed. The road will extend from Rockland, Me., through Rockport, to the north side of Camden village, nine and one-half miles, and will be in operation by June 1st. It will carry freight and mail as well as passengers.

A. T. Smith's Main Line Cut-off.

In the accompanying cut is illustrated a main line cut-off which is especially designed to be connected with open circuit batteries or other apparatus, for the purpose of preventing a closed circuit for more than 5 to 30 seconds. The device consists of a pair of magnets, a glass reservoir for sand or its equivalent, an armature and valve lever, a conical shaped cup with a balance lever and an adjustable weighted lever, a receptacle and a resetter. This instrument is constructed on the principle of a scale, is mounted on a neat base, 8½x6 inches, and is covered by a glass shade, 8 inches in height. The most important claims for this device are, that it can be set to any desired time of cut-off, and it cannot fail to operate; that it can be made to open or close at the proper time to which it is set, and it works with the weakest current. This little cut-out is manufactured by A. T. Smith, New York.

Boiler Tests at Rochester, N. Y.

Owing to a controversy over the relative efficiency of the Babcock & Wilcox boiler and the Heine boiler, both companies agreed to a comparative test at the power station of the Rochester, N. Y., Railway company in February last. Dr. Charles E. Emery conducted the experiment for the Babcock & Wilcox company and Prof. M. E. Cooley for the Heine company. The report of the results of this test are appended in the accompanying table, which bears the signature of Dr. Emery and Prof. Cooley.

Some of the minor features of the tabulated report need a little explanation.

The value of a horse power used in rating the Babcock & Wilcox boiler is that fixed by a committee of the American Society of Mechanical Engineers and which was used previously in reports of the boiler trials at the Centennial exhibition, such value being thirty pounds of water evaporated into dry steam at a pressure of seventy pounds from feed water at a temperature of 100 degrees. On this basis 33,307 British thermal units of heat are derived from the fuel and imparted to the steam for each horse power. This rating has by common consent come to be called the association rating. The Heine boiler, on the contrary, is still rated on an older basis, viz., the evaporation of thirty pounds of water at a pressure of seventy pounds from a temperature of 212 degrees, which corresponds to only 29 932 British thermal units per horse power. The older horse power used for the Heine boilers is, therefore, only 89.9 per cent. of that furnished by the Babcock & Wilcox boilers, and it follows that in driving engines or in doing a given quantity of work of any kind the Heine boilers are, on account of their rating, only required to do 89.9 per cent. of the work performed by the Babcock & Wilcox boilers by the association rating. In lines 28 and 29 the maximum horse power obtained is calculated respectively for the two ratings, from which it will be seen that the Heine boiler, when, by its own method of rating, developing 666⅔ horse power, would, by the association rating used by the Babcock & Wilcox company, only be doing 598 95 horse power, while the Babcock & Wilcox boilers when developing, according to association rating, 731.78 horse power, would, according to the Heine method of rating, be developing 814.37 horse power.

In his report Dr. Emery makes the following general statements on the value of heating surfaces:

In any boiler the surface to which the fire or products of combustion is first exposed is most efficient because the heat is transferred at a maximum difference of temperature. As the gases pass toward the chimney their temperature diminishes and the potential efficiency of each square foot of surface diminishes. All such surface, however, produces economy so long as it still further reduces the temperature of the products of combustion, whereby less heat is wasted in the chimney and more imparted to the water in the boiler. Reducing the heating surface for a given power merely means throwing away more heat in the stack, in case the combustion be perfect, and throwing away combustible gas and unutilized hot air in case the combustion be imperfect. In the latter case, evidently, the uptake temperature may be low even with reduced heating surface unless the gas be accidentally lighted. The heating surface of the bottom of a kettle set on a stove is very efficient, but it does not prevent much of the heat of the fire from going up the chimney. A kettle inclosed in a furnace is familiar on the farm. The bottom of the kettle is as efficient as that on the stove, but there is in addition heating surface on the sides which acts to reduce the temperature of the products of combustion, so that with this arrangement a given amount of water can be boiled with less fuel. The heating surface of steam boilers has been progressively increased in the same way, but to a greater extent. At first boilers were shaped like a kettle or were cylindrical in form and the heat was applied on the bottom and sides only. Finally flues were introduced through the cylinders and the heating surface materially increased, with a large saving in fuel. This type of boiler gives large power for a given weight and being accessible for cleaning will always be a favorite where these conditions are important and fuel so cheap that economy is of secondary consideration. Such a boiler is, however, greatly inferior to the higher types of boilers now available, in which much larger proportions of heating surface to power developed are employed and particularly to the Babcock & Wilcox boiler, which is in addition constructed in such a manner as to promote perfect combustion and secure the highest protection against dangerous explosions. Boilers built with reduced heating surface may obtain the higher heating surface efficiency shown by the old flue boilers, but necessarily at the same enormous sacrifice of economy.

The cuts show a front view, Fig. 1, and also a detailed view, Fig. 2, showing the principal features of the Babcock & Wilcox boiler.

RESULTS OF TEST OF BOILERS AT ROCHESTER RAILWAY CO., N. Y.

		One Babcock & Wilcox.	Two Heine Safety.
1	No. and kind of boiler		
2	Diameter and length of shell	8 of 36 ins. diam. and 22 ft. 6 ins. long.	1 of 48 ins. × 19 ft. 7 ins. each boiler
3	Number, diameter and length of tubes	216 4 in diam. 18 ft. long.	87 3½ ins. × 16 ft. each boiler.
4	Square feet of heating surface	*784	2900
5	Square feet of grate surface	75.8	74 2
6	Rated Capacity	416 0 H. P.	200.0 H. P. each
7	Kind of fuel used	Reynoldsville, Pa., run of mine—bituminous.	
8	Duration of test—hours	10.02	10.00
9	Total amount of fuel used—dry	33819 00	33015.00
10	Pounds of fuel per hour	3375.15	3301 50
11	Total amount of ash, including fires hau'ed out	2279.00	4167.00
12	Percentage of ash	6 74	12 62
13	Average steam pressure	126.68	127.18
14	" Draft pressure	1.016	1.111
15	" Barometer	29.88	29.97
16	" Temperature of feed	171.50	168.25
17	" Temperature of air	35.86	33 73
18	" Temperature of room	59.35	49 20
19	" Temperature of stack	Pyrometer doubtful.	Pyrometer doubtful.
20	Total amount of water evaporated into dry steam, Actual conditions	223654 00	189332 00
21	Pounds of water evaporated under actual conditions, per hour	23218.96	18938 20
22	" of water evaporated per lb. of coal. Actual conditions	6.879	5.736
23	" of water evaporated per lb. of coal, from and at 212°	7.475	6.255
24	" of water evaporated per lb. of combustible from and at 212°	8.015	7.158
25	" of water evaporated, per sq ft. heating surface per hour from and at 212° F	5.270	7.120
26	" of coal per sq. ft. grate, per hour	44.53	44.49
27	" of coal per horse power	731.78	598 95
28	Horse power actually developed, {70 lbs. and 100°	814.37	668 50
29	{70 lbs and 212°	75.8	66.8
30	Percentage over rated capacity	70 lbs. and 212°	70 lbs. and 212°
31	Square feet of heating surface per horse power	70 lbs. and 100° 6.53	70 lbs. and 212° 4 35
32	Percentage of moisture in steam	1.088	No 3, 0.755 } av. 0.6195 No 4. 0.484 }

ROCHESTER, N. Y. February 25, 1892.

Chas. E. Emery Expert appointed by the B. & W. Co.
M. E. Cooley Expert appointed by the H. B. Co.

Chicago Electric Club.

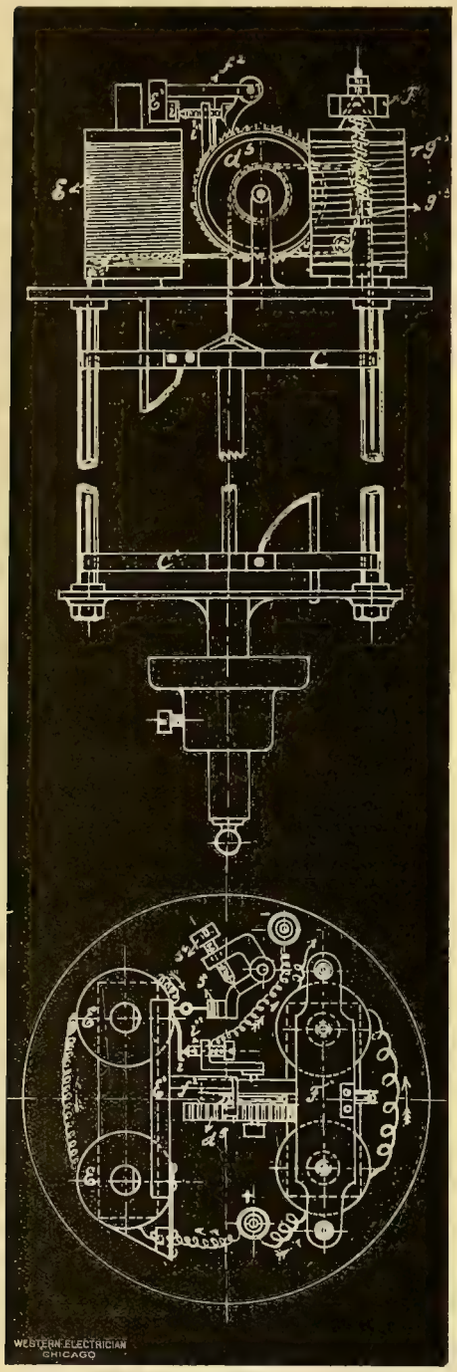
At its last meeting on Monday evening, March 28th, the Chicago Electric club listened to a talk on "The Gearless Motor" by Prof. Sidney H. Short, and a paper on "The Single Reduction Motor," by G. K. Wheeler. Prof. Short delivered, without notes, a remarkably instructive address. It was regretted, though, that Mr. Wheeler was unable to be present to read in person his paper. After the two principals had delivered themselves, there was a general discussion, participated in by Messrs. Armstrong, Jackson, Cutter, Emmett, Grier, Elliott and others. Alex. Kempt presided at the meeting.

An electrical firing mechanism for Gatling guns was recently tested by United States naval officers. The electrical apparatus was attached to the barrel of the gun so as to move with it, while it was so disposed of as not to interfere with the elevation or depression of the gun. By the use of the electrical apparatus the gun is fired automatically at a rate of speed, for a piece of ten barrels, of 1,500 discharges per minute and upward.

Riedel's Arc Lamp.

In this lamp, which was designed by Josef Riedel, electrician of the Germania Electric company, Boston, the arc is formed and maintained at a fixed point by means of movable carbon holders. The advantages claimed are that the lamp is of a comparatively small size, being not longer than two feet, so that it can be used in rooms and stores with low ceilings. The shortness of the lamp is obtained by enlarging the cross-section of the upper carbon and suspending the carbon-holders from cords, so that the long carbon pencils of the ordinary arc lamps and the long racks for the upper carbon holders are dispensed with and a flat top given to the lamp.

The construction of the Riedel lamp will be understood after an explanation of its operation. When used in an



RIEDEL'S ARC LAMP.

incandescent circuit the current is first passed through a resistance coil, so that a current of the required strength is supplied to the electro-magnets as required by the arc to be formed. The tension of the spiral springs g^2 is then adjusted by the nuts g^3, so that the current is strong enough to attract the armature F' and form the arc by the lowering of the lower carbon pencil.

To produce the feed of the carbons, which is regulated by the shunt electromagnet E, the set-screw i' is so adjusted that it forms contact with the spring i of the armature E', so that the shunt current is interrupted whenever the armature E is attracted. By the set-screw s^4 the flat spring s^2 is so adjusted that it retracts the armature F immediately, so that the shunt-circuit is closed again. By this the armature E' is vibrated and the ratchet-wheel d_1, operated by the pawl f^2, so that the carbons are fed toward each other. When the carbon-feeding mechanism is properly adjusted, a uniform size of arc is obtained, and the irregular burning and flickering of the light prevented.

Electrical Interests Affected by Canadian Storms.

A violent snowstorm visitited Ottawa, Ont., on the evening of March 10th. It is estimated that eighteen inches of soft snow fell. The entire Rideau street route of the Bell Telephone company of Canada, which serves the eastern section of the city, was completely wrecked. Thirty-nine poles in succession, ranging from sixty to forty-five feet in height, tumbled. The larger poles carried 150 wires on ten pin arms. The span wires of the Ottawa Electric Railway company, being attached to these poles, the whole system on this street consisting of double trolley wires, went down with the telephone poles. The railway company cut off the affected portion and ran the balance, consisting of two-thirds of the system, as usual. Temporary repairs were immediately undertaken and the whole system was running the following day. The telephone company expects to have its lines working in a few days. On the Elgin and Maria streets routes twelve large poles, carrying 100 wires, came down with a crash at ten o'clock the following morning. This was not all. On the company's southwestern route 100 wires came down for a distance of one-eighth of a mile. The herculean task of untangling the wreck was under the personal supervision of General Manager L B. McFarlane of the Bell Telephone company, eastern department, Montreal.

The railway companies two sweepers were out all night and successfully battled with the storm. At 4 A M. the company was requested by the superintendent of the city fire alarm, to shut down owing to troubles with the fire alarm wires. This request was complied with, and at 6 A. M., the trouble having been removed, the sweepers resumed their work and enabled cars to run on schedule time. This storm was the same that visited Utica and Syracuse, N. Y., on that date.

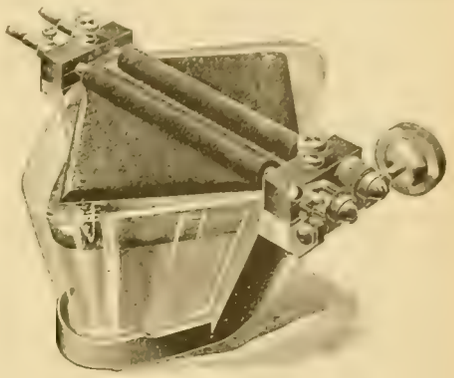
Application is being made to the Parliament of Canada by the Ottawa City Passenger Railway company for permission to use electric instead of animal power. The road has been inexistence as a horse road for twenty-five years. Last year a controlling interest in the company was purchased by Messrs. Ahearn & Soper, who are also the principal stock-holders of the Ottawa electric street railway, and are Canadian representatives of the Westinghouse Electric & Manufacturing company.

An Astronomer's Complaint.

Prof. Swift, the noted astronomer of the Warner Observatory at Rochester, voices a new complaint against electric street lights in writing to the *Scientific American*. He says that the electric light in cities makes it impossible to discover new nebulæ or faint comets, and that the sky illumination fogs the plates in photographic work. Speaking of a remedy, he says: "The invention desired is one that will maintain the light at one level, and that near the bottom of the globe, during the entire night. Could this be done and the upper half of the globe be painted white, it would benefit the street not only, but would also prevent nine-tenths of the light from ascending skyward. The inventive genius who shall accomplish this feat will go down to posterity with honor, while astronomers and photographers of celestial scenery will, in particular, have cause to bless his name."

The New Bailey Current Controller.

Briefly described, this instrument, as shown in the accompanying cut, consists of two triangular-shaped carbon plates, each carrying a bit of sponge at one of its angles, and so mounted over a small glass cup of water that, by means of a worm gear, operated by a hand-wheel, the sponge tips are gradually moved down into the water and toward each other until the plates touch at their lower points. By turning a thumb-screw, the left-hand plate may be unlocked from the gear, and moved as far into the water as desired, and then the other plate gradually turned down toward it. This last method gives a still more gradual increase of current. Each shaft passes through a hole extending through the longest edge of the plate, and is moulded into the plate with pure tin, the tin completely filling the space between the shaft and the carbon. An electrical connection is thus secured, which has an abundance of conductivity, and one which is non-corrodible. Each plate is $3\frac{1}{2}'' \times 3\frac{1}{2}'' \times 4''$; the whole apparatus is, over all, $7''$ long, $7''$ wide, $4\frac{1}{2}''$ high, and weighs two pounds. This current controller, or rheostat, will give a current at the outset of the feeblest character, and will increase the current without fluctuation, and, finally, will give the full strength of the battery without shock. It is claimed to be the only instrument in which the electrodes move toward each other. At the start they are fully six inches apart, and at the finish they are in hard contact. There is no cover over the plates, and when out of water they are separated fully [illegible] of an inch apart, there is no danger of escape of current by means of water adhering between them, or by moisture of condensation. In the construction, no wax or cement is used. Although simple



NEW BAILEY CURRENT CONTROLLER.

in appearance, this improved controller is the result of five years' experiments and six years' experience with the old style Bailey controller.

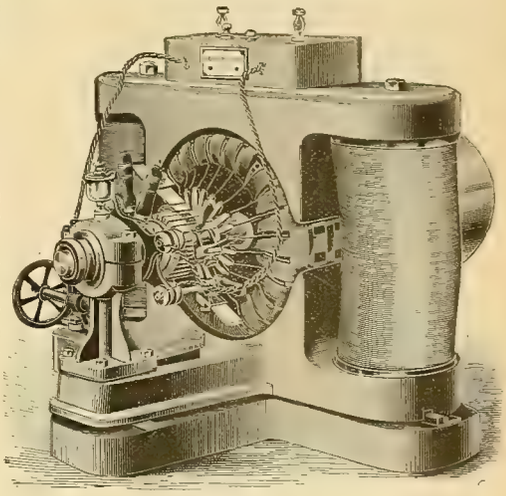
The device is handled by the Law Telephone company, New York.

The New Duplex Arc Generator.

The arc generator built by the Duplex Electric company, limited, of Corry, Pa., possesses many of the general characteristics of the incandescent generator manufactured by this company, as will be seen by the illustration, which is of a 1,350 volt dynamo. This dynamo is simple in construction, and is said to be a cool-running, highly efficient series machine. It has an armature of the closed-coil type, with sixteen to twenty-four coils, according to size, made so that any coil may be removed without interfering with the rest. The armature is of the Gramme ring type, is constructed with special reference to perfect ventilation, and to prevent short circuiting. The commutator is of hardened copper, thoroughly insulated with mica, in fact, mica and wood are the principal insulators used throughout the generators. The armature shaft is of Bessemer steel, and runs in carefully fitted phosphor-bronze bushed boxes, swiveled to insure alignment.

These machines are made with oil cups, or self-oiling bearings, to suit the purchaser. There are no rheostats or resistance coils with either the dynamo or on the incandescent generator manufactured by this company, the regulation being accompiished on the arc dynamo by changing the position of the brushes on the commutator. When so ordered, the dynamo is fitted with a simply constructed automatic regulator, which is sensitive to the slightest change of load, and acts quickly and quietly by changing the position of the brushes

The electrician of the Duplex company has had years of experience with nearly all other makes of apparatus, as well



THE NEW DUPLEX ARC GENERATOR.

as in designing several different dynamos. It is said that this machine is one of his most perfect designs, and overcomes many objectionable points common to dynamos for arc lighting. Every generator is thoroughly tested to its fullest load before leaving the factory. The machines are made in any size, from 5 to 80 lights after the 1,200 and 2,000 candle power type.

New Edison Stage Regulator.

The Edison General Electric company has brought out a new stage regulator switch by means of which graduations of light are obtained fine enough to satisfy even the most fastidious of stage managers. This switch, mounted on a slate base, consists of fifty clips arranged in a circle in four divided quadrants with a four-armed contact passing over them, and engaging in a clip every quarter width of the clip. Contact over the entire fifty clips is made by a movement of the switch handle through an angle of 45° only, instead of through 120°, as in the usual forms of stage

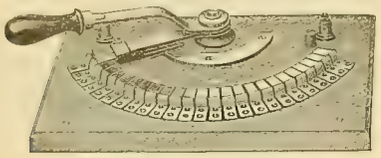


FIG. 1. NEW EDISON STAGE REGULATOR.

regulators. By this arrangement speed of the operation is considerably increased. These switches are either directly mounted on the sides or the top of the fire-proof stage regulators, or are mounted separately upon a switchboard and connected with the regulators by means of regular fire-proof cables made up of the strands of the connecting wires. They can also be arranged in a special frame in such a manner that the handles can be worked separately; or they can be connected together and all be operated as one unit. In the cuts is shown the original type of stage-regulator switch Fig. 1, with the semicircular row of clips, and for purposes of comparison, the improved switch Fig. 2 with the circle of clips divided into four quadrants.

Telegraphy and Telephony in Combination.

It was noonday in a busy down town office, says the Boston *Herald*, and a reporter was awaiting the return of the manager, when the pretty stenographer went to the telephone, and, after the usual parley with Central called: "Hello, Charlie. Are you busy just now?"

Apparently Charlie was not, for she continued: "Oh, yes. I had a lovely time, but don't you think——"

Here there came a strange pause and with a pencil she tapped idly on a light piece of board which she had taken from her desk and was holding before the transmitter.

"A case of 'wait a minute,'" thought the eavesdropper, sympathetically; but the pretty girl spoke again, with a laugh: "I don't believe it, for I heard——"

Then she began tapping on the board again. Then the reporter caught on. She was telegraphing. So when she returned to her desk he remarked: "I notice you have an original method of telephoning."

"Oh, did you see that? Well, I'll tell you about it, but you must not give it away. You see I can't use the telephone here without every one in the room hearing what I say, and they do say that those girls in the central office listen to the conversations over the wire, and, as Charley

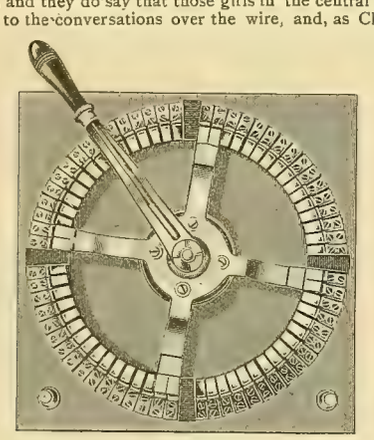


FIG. 2. NEW EDISON STAGE REGULATOR.

and I are both telegraphers, we invented this method of conversation by telephone. Isn't it a great scheme? Not one in the office understands it."

An Elmira dispatch states that a syndicate composed of the mayor of Elmira and a number of leading bankers and other prominent capitalists of that city, has just obtained control of the Elmira Water Works, the Elmira Electric Light Works, the Electric Street Railway system of thirty-three miles, and the Inter-State Fair association, which will be put under one management as the Elmira Municipal Improvement company. The price paid for the five plants is $2,800,000. D. C. Robinson, mayor of Elmira; General Woodward, president of the Third National Bank, New York; Jackson Richardson, president of the Elmira National Bank; Hon. Smith M. Weed of Plattsburgh, N. Y., and D. Graham, president of the Montreal & Chicago Shipping company, it is stated, are in the syndicate.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 26.—The two most talked about topics in New York electrical circles at present, are, of course, the telephone agitation and the senate bill to incorporate "The General Electrical company."

On Wednesday the Telephone Subscriber's association had a hearing before the assembly committee on Gas, Electricity and Water. There were two bills—one introduced by Mr. Rice of Ulster, and one by Mr. Cahill of Kings—both designed to accomplish the reform in telephone rentals, and another bill, the old Blumenthal measure of last year, which provides for the appointment of a commission to fix rates, and which was introduced by Mr. Malone of Brooklyn. On the following day Mr. McMahon handed in the telephone bill reported favorably the day before by the committee on general laws, and Senator Aspinall promptly moved that it have its third reading. But Senator Roosch, who had been instructed, most likely, to be in readiness for some such action, objected. As a single objection prevents the advancement of a bill out of its regular order, President Sheehan ordered the bill to the committee of the Whole. The bill will probably have a hearing on Wednesday next, when the telephone companies will present their arguments against it.

On Thursday Senator Cantor's bill incorporating the General Electric company, was the special order before the New York state senate.

Under the provisions of the bill Joseph P. Ord, S. Endicott Peabody, Frank S. Hastings, James Jackson, S. Dana Green and Eugene Griffin, their associates and successors and assigns, are constituted a body corporate under the name of the General Electric company, and as such are authorized, among other things, to manufacture, buy, sell, lease and use machinery and articles of every kind in any way connected with electricity for purposes of light, heat, power, locomotion, telephony, telegraphy, metallurgy, or for any other use or purpose; to carry on a general manufacturing business; to receive shares of the capital stock, bonds or other securities of any other corporation; to acquire real and personal estate, and to invest the funds of the company in stock, bonds or securities of any other corporation.

The rights, powers and privileges granted to the corporation are not to be controlled, limited or restricted, further reads the bill, by any existing statute or law of this state; but so far as such statute or statutes or law are inconsistent with the provisions of the act they are to be altered and amended to conform to it. Except as above provided and except upon subjects relating to which special provision is made in this act, the said corporation shall be subject to and governed by the general provisions of the law of this state applicable thereto.

The franchise tax of the corporation is to be one-twentieth of one per cent. of its capital stock.

The Brooklyn City & Newton Railroad company has secured the approval of the State railroad commissioner of the proposed change of motive power to the single trolley electric system on its Franklin avenue route.

Plainfield, N. J., will have the overhead electric system. Monday night the common council granted a franchise to the Plainfield Street Railway company, allowing it to construct and operate the electric system over a part of the route which had been mapped out. If the council be satisfied with the workings of the motors over this route, the line will be completed through all parts of the city. If the trolley be unsatisfactory, the rest of the line will be made a horse car route. The company binds itself to adopt any better electric system than the trolley as soon as one is perfected.

On Monday night the village trustees of New Brighton Staten Island, voted to grant the increased price demanded by Erastus Wiman for electric lights. The increase will begin when Mr. Wiman shall have built and equipped a new electric light and power station within the limits of the village at a cost of $100.000. This action will, it is expected, result in the construction of a number of electric surface railways.

W. F. O.

Toledo, O.

TOLEDO, March 26.—The Toledo Electric Street Railway company has almost recovered from the recent disastrous fire and is running cars on nearly all of its lines again. The new cars are a great improvement over the old ones, being two feet longer and having extra springs and larger trucks, which prevents the cars from lurching. The new barn is nearly ready for occupancy, and is an exact counterpart of the one burned.

The Consolidated Street Railway company is also beginning active operations for the transformation of its horse lines to electric roads. Wires are being strung on Broadway as far as Knapp street and will be connected to the Summit street line. Preliminary work on the proposed Belt road, which will be formed by connecting Adams and Monroe street lines via Central avenue, is going on. The power house is being refitted with new machinery. A 650 horse power compound condenser Hamilton Corliss engine will be put in besides additional boilers and generators. New cars are being received daily.

The Maumee electric road, which proposed to run from Toledo to Maumee, a distance of about ten miles up the Maumee river, is again attracting attention. T. P. Brown, an experienced railroad man, has taken hold, and the prospects are that the project will materialize in the near future. Mr. Brown has built a number of railroads in the vicinity of Toledo, and the fact of associating himself with that enterprise is assurance of active operation soon.

F. C. H.

PERSONAL.

E. R. Weeks of Kansas City, was in Chicago on Monday.

A. P. Brayton, Jr., general manager of the Pelton Water Wheel company of San Francisco, stopped in Chicago on Tuesday on his way west.

Dan. C. Hemingray, of the Hemingray Glass Works, Covington, Ky., spent several days in Chicago last week, looking up the insulator trade.

W. E Smith, formerly cashier of the National Electric Manfacturing company, Eau Claire, Wis., has been promoted to the auditorship of the company.

General Manager Morgan Brooks of the "E. E. & S. company," St. Paul, and W. D. Packard, treasurer of the New York and Ohio company, Warren, O., lunched at the Chicago Electric Club on Friday of last week.

C. A. Daigh left Chicago Friday night of last week on an extended southern tour expecting to make his first stop at Stanberry, Mo., going thence to Graniteville, S. C., taking in New York and other eastern cities on his return. Mr. Daigh may be absent about two weeks.

At the annual meeting of the stockholders of the Burton Electric company in Richmond, Va., on March 23d, W. R. Mason of Chicago was re-elected president for another year. The stockholders took advantage of the occasion to pass a set of resolutions highly complimentary to Mr. Mason's administration.

R. Walters has been appointed superintendent of the mechanical department of the National Electric Manufacturing company, Eau Claire, Wis. Mr. Walters has been with A. L. Ide & Son, Springfield, Ill., for some years, and is rated as a very efficient man. Mr. Kammeyer will, as usual, hand e the electrical problems.

G. M. Angier, well known in Chicago electrical circles, left on Saturday of last week to accept a responsible position in the home office of the Mather Electric company of Manchester, Conn. Mr. Angier was formerly with the Northwest Thomson-Houston company of St. Paul, and lately has been assistant manager of the Knapp Electrical Works, Chicago. He has many friends who rejoice at his advancement.

NEW INCORPORATIONS.

Kingston City Electric Railway company, Kingston, N. Y.; capital stock, $175,000; street surface electric railway.

Electrical Piano company, Newark, N. J.; capital stock, $300,000; to manufacture, rent and sell electrical attachments for pianos and other musical instruments, etc.; L. Hood, Newark, N. J.

Metropolitan Duplex Fire & Police Signal company, Portland, Maine; capital stock, 500,000; to manufacture and deal in fire alarm systems and other electrical apparatus; Clarence Hale, Portland, Maine.

Glenwood Electric Light & Power company, Glenwood, Iowa; capital stock, $20,000. Erection and maintenance of an electric light and power plant at Glenwood, Ia. J. H. Howe, Glenwood, Ia.

Electric Company of America, (incorporated in W. Va. New York, N. Y., capital stock, $3,000,000. Manufacturing and dealing in electrical apparatus and appliances; Wm. H. Appleton, *Times* building, New York City, N. Y.

The Mexican Electric Steam Boiler Compound company, Chicago, Ill.; capital stock, $100,000; manufacturing and selling a compound for removing and preventing incrustation in steam boilers; Barrow & Lawson, 126 Washington street, Chicago, Ill.

Austin Electric company, Austin, Minn., capital stock, $50,000; to construct, maintain and operate a plant or plants, for generating electricity; manufacture, sell and supply electricity for light, heat and power; H. C. Levis, 401 Sibley street, St. Paul, Minn.

ELECTRIC LIGHTING.

Residents of Maiden, N. C., are talking of the erection of an electric light plant.

J. H. Turner has, it is stated, received the contract for the erection of an electric light plant at Brewton, Ala.

New Carlisle, Ind., wants an electric light plant, and the question is being considered by the citizens.

The Richmond Railway & Electrical company has received the contract for lighting the city of Manchester, Va., by electricity.

A contract has been awarded to the Augusta Electric Light & Power company for lighting the city of Augusta, Ga., with electricity.

The question of the issuance of bonds to the extent of $15,000, to pay for an electric light plant, will be submitted to the people of Carthage, Ill., at the spring election.

The Richmond, Va., Railway & Electric company is reported as having purchased Johnson's island for $30,000 and as being about to erect a $125,000 plant on it for an arc light station.

The citizens of Freeport, N. Y., have held a public meeting to decide upon the question of electric lighting, and the general sentiment was favorable, but no definite action has yet been taken.

A central station is to be erected in Bremen, Germany, for the electric lighting of the town. The station, which will have a capacity of 30,000 lamps will be erected by Siemens & Halske, of Berlin.

O. P. Cunningham has been appointed receiver of the Bucksport, Me., Electric Light company. A final hearing will be held in April. The plant will be kept running, and strenuous efforts will be made to place the company upon a paying basis.

At a recent meeting of the directors of the Citizens' Gas Light company at Warsaw, N. Y., it was decided to put in an electric light plant. The new plant will be located on the same property as the gas works, and it is intended to enter into competition with the electric light company already established.

The Longmont, Colo , Electric Light company has sold its plant to a party of Denver capitalists, who have reorganized the company and elected Frank P. Arbuckle president. The title of the new company will be the Longmont Electric Light & Motor Power company, the intention of the owners being to furnish motive power also.

An English technical journal is informed that the electric light is coming more and more into favor in Madrid, and that most of the larger houses in that city are being fitted with it. The daily receipts of the central station of the Sociedad Madrilena alone are now over £120. The company, however, offers to reduce the price when the daily receipts amount to £160. This is likely to take place very soon. It is stated that two more central stations could do a profitable business in Madrid.

A press dispatch from Columbus, Ind., dated March 21st, says: A meeting of business men was held to-night looking to the organization of an electric light company to furnish light for commercial purposes in opposition to the Citizens' Electric Light company and the Columbus Gaslight company, which recently purchased the electric light franchise granted by the city to A. J. Bailey of Edinburg. This action is brought about by the alleged failure of the gaslight company to comply with the conditions of the Bailey franchise. The light question has given this city considerable trouble in the last six months. It is the intention of the new company to build a dam on White River, four miles north of the city, and generate electricity by means of water power, which will be transmitted here for lighting purposes.

ELECTRIC RAILWAYS.

During the year 1891 the City & South London Railway company carried over five million passengers.

An electric line to connect Portland, Ore., and Oregon City, and to carry both passengers and freight, is projected.

The Velasco & Surf Side Railway company will build an electric railroad from Velasco to Surf Side, Texas. Its capital stock is $200,000.

Surveys have been made with a view to building an electric railroad from Ellicott City, Md., to connect with the Baltimore Traction company's system.

Money has been raised for the preliminary survey of an electric line between Parkersburg and Oxford, Pa., which will be made as far as Cochranville at once.

Mr. Johnston, as receiver of the Coast Line railroad, has made application to the court at Savannah, Ga , for authority to equip that road with electricity.

Northern men are reported as about to build an electric railroad from Floyd Court House, Va., to a point on the Norfolk and Western railroad, twenty two miles distant.

The Atlanta, Hapeville & Manchester Railroad company, of Atlanta, Ga., has surveyed its line, and will probably soon begin construction. The road will be nine miles long.

The sale of the Keokuk, Ia., electric street railway has been ordered by the Supreme Court to satisfy a lien of the International Trust company. The sale will take place March 31st.

An electric line from St. Paul, Minn., to White Bear Lake, via North St. Paul, is proposed. Negotiations for the right of way are now in progress, and, if successful, the line will be built this summer.

The citizens of Hubbard and Youngstown, Ohio, are greatly in favor of an electric line connecting the two places. At a private meeting the question was decided favorably and financial aid promised.

The Baltimore, East Baltimore, Keller's Pavilion & North Point Railroad company has been chartered at Baltimore, to construct a railroad using electric or other motive power. The capital stock is $200,000.

The new Fredericksburg, Va., Street Railway company has purchased and will enlarge the Rappahannock Electric Light & Power company's plant. The contract for building three miles of road has already been awarded.

A bill has been introduced in the legislature of Virginia to amend and re-enact an act to incorporate the Brookland Railway & Improvement company of Richmond. Among other things this company is to be authorized to build an electric road.

New York capitalists have signified their willingness to build an electric line from Marietta, Ga., to the Chattahoochee river, provided the citizens contribute about $12,500 and the property owners along the line donate land to the amount of $35 000.

Two new companies have applied to the city council of Norfolk, Va., for the right of way over certain streets. They are the Rapid Transit Improvement company and the People's Railway company, and both are authorized to use electric power.

Surveys for the Fort Worth & Dallas Rapid Transit company's electric railroad have been completed between Fort Worth and Arlington and the profile made. The engineering corps is now at work between Arlington and Dallas. It is intended to organize a construction company as soon as the survey is finished.

The editor of the *Rochester Morning Herald* has been giving some attention to the alleged influence on watches of the motors on electric cars. In an editorial on "Watches on Electric Cars," he gives the result of his own observations as follows: "The Rochester electric cars have been running some seventeen or eighteen months, and everybody has ridden on them more or less. The present writer, who lives some two miles from the center of the city and has traveled on the cars nearly every day when in town during the period above mentioned, has given special attention to the possible effects of the electric current on his watch, and cannot discover that it has been affected in the slightest degree in the regularity of its movements and its accuracy as a time keeper."

The annual meeting of the stockholders of the Short Electric Railway company and the usual directors' meeting following were held at Cleveland on March 16th. The following named directors were elected: Sidney H. Short, Myron T. Herrick, J. Potter, John S. Bartlett, James Parmelee, Eugene Griffin and William B. Bolton. The directors elected the following officers for the ensuing year: J. Potter, president; S. H. Short, vice-president and chief electrician; Charles B. Lothrop, secretary and treasurer; E. E. Higgins, general manager; William B. Bolton, general counsel. S. H. Short, who has been from the organization of the company, its president and chief electrician, was renominated for the presidency, but declined to accept the position. He stated that owing to the growth of the company its duties had now become so onerous as to seriously interfere with his technical work and inventions, to which he desired to give his undivided attention. He therefore asked relief from his general business cares.

TELEGRAPH.

W. B. Somerville, superintendent of the press service of the Western Union, says that ten years ago the Western Union Telegraph company handled in a year a total of 28,000,000 words of special dispatches to newspapers, nearly all of them for fifty daily papers, while last year an aggregate of 260,000,000 words were sent to more than 500 newspapers, and there is no "knowing when this service will stop growing."

It is computed that there are 900,000 miles of telegraph lines, and 2,500,000 miles of wire conductors for the use of the public throughout the world, more than one-half being in Europe. There are, according to an English paper, 98,465 offices, 67,465 being in Europe. The number of messages transmitted in a year is put at 296,000,000, 207,000,000 being in Europe. Of the total, 57,500,000 were transmitted from one country to another.

A Topeka dispatch says that the grievance committee of the Order of Railway Telegraphers has decided that the schedule of wages offered by the Santa Fe company is not satisfactory. The schedule presented by the company, it is asserted, makes some advances as asked by the operators, but on an average it only gives about half what was demanded. Grand Chief Telegrapher D. G. Ramsay of Vinton, Iowa, has been sent for, and until he arrives no further action will be taken by the committee.

MISCELLANEOUS.

The Carrollton, Ga., Telephone company has been incorporated with a capital stock of $10,000.

A rate of 65 cents per 100 pounds on electric railway appliances has been made between Chicago and Hot Springs, S. D., by the Western Freight association.

Chicle, the sap of the sapotille tree, is a gum-like substance coming from Campeche and Yucatan, in Mexico, and which is now being exploited as an insulating material equal to india rubber.

The Central Electric company, Chicago, closed its doors on Saturday of last week on account of the death of Marion McKinlock, infant daughter of George A. McKinlock, treasurer of the company.

It is reported that the authorities are considering the advisability of placing a couple of electric search lights on the Welsh coast between Mumbles Head and Worms Head for the benefit of navigation in that locality.

An interesting series of experiments was recently made by two Swedish astronomers, Lemstrom and Trombolt. By means of a network of electric currents between two mountains they succeeded, it is said, in producing several artificial auroras.

According to a French paper, electricity is in successful use at the gun factory at St. Etienne for tempering gun springs. The latter consist of steel wire, which is wound spirally, and a current of 25 amperes at 35 volts is passed through it. Rapid heating results and when the required temperature has been reached, the circuit is broken, and the spring is let fall into a trough of water. One workman, it is stated, can temper 2,400 springs per day by this method.

It is announced that the block electric system of train signals will be applied to the Erie road this spring. Last summer, as an experiment, the company adopted the system on the Kent division of the Nypano road, extending from Kent to Galion, Ohio. So successfully did it work that a few weeks ago the same system went into effect on the eastern division of the Nypano, extending from Kent to Salamanca, N. Y., and now it is to be extended to Chicago. By the method of operation in vogue on the Nypano a circuit is formed between the semaphore and the instrument of the telegraph operator in such a way that it is impossible to use the wires when the semaphore points to safety. This keeps the semaphore turned to danger, and prevents the passage of trains through a mistake of the operator.

TRADE NEWS.

It is said that Burton electric heaters are in use on 115 electric railways.

Alfred F. Moore, Philadelphia, the well-known wire manufacturer has again shown his push by installing a long distance telephone in his office.

The Knapp Electric Motor and Novelty company, New York, is receiving inquiries from all quarters in relation to the little electric "cooler" which it has just placed upon the market.

The Phœnix Glass company, New York, has now in stock about two dozen different styles and shapes of gas and electric light globes. The company reports a good business for its new and attractive fixtures.

W. H. Weston & Co., of Philadelphia, is sending to patrons a new catalogue showing its full line of switches and switch-boards. This company has recently added a large line of machinery to its already well equipped shop in order to meet the growing demand for its novelties.

Cutter's rubber-handled screw-drivers are steadily gaining the favor of western central station men. Practical electrical men appreciate this well-made safeguard. These tools are made in a number of sizes, as are also the rubber plier handles which George Cutter, Chicago, is handling.

The Central Electric company, Chicago, reports the sale of three underground cables of the Okonite manufacture within the past week, and from the many proposals that are out it expects to be busy in this department. The company is also making preparations to put on the market an absolutely dust-proof bell, one that will be practically perfect in every respect.

Bradley Martin, one of New York's leading society men, created quite a sensation this season by driving to the opera in his specially built vehicle lighted by a miniature electric plant consisting of three 8 volt 6 candle power lamps; the lights were placed in the side-lights and interior of the coach. This equipment was arranged by A. T. Smith, the well-known electrician of 6 West Fourteenth street, New York.

Of the four gentlemen who organized the Engineering Equipment company, New York, at the suggestion of F. L. Perrine, who was until recently general manager, Messrs. Field, Perrine and Hale have withdrawn from official connection with the company, although remaining stockholders. A. L. Tinker, Jr., the fourth organizer of the company, is now secretary, treasurer and assistant manager, and his father, A. L. Tinker, is president.

The Institute of Technology, 151 Throop street, Chicago, has recently added a department of electro-metallurgy, which has been placed in charge of Prof. H. Gilbert Coyle. Plating, electrotyping, artistic gilding, casting, and other branches will be given special attention, the object being to work out the latest ideas in these lines, and to afford a thoroughly practical course. Prof. Coyle studied under Prof. Silliman, at Yale, and has had a varied personal experience since graduation.

The Hine Eliminator company of New York, is in receipt of an order from Prof. G. W. Bissell of the Iowa Agricultural college at Ames for one of its eliminators, to be used on the engine in the mechanical laboratory of that institution. Prof. Bissell was assistant to Prof. C. Carpenter at Sibley College Cornell University, and aided in the steam separator test made there last year, and in which the Hine eliminator was shown to have an efficiency greatly in excess of its competitors.

General Manager Antoine Bournonville, with Alfred F. Moore, Philadelphia, reports that the general trade and the prospects for future business with his house far exceeds anticipations. It may be necessary to run the factory overtime in order to supply the demand Several large contracts for points in the West are under consideration, and since at present the firm has no established agency at Chicago, parties desiring prices are requested to communicate directly with the Philadelphia office.

The *Erie Herald* is most enthusiastic in its reference to the electric light plant, recently installed by the Duplex Electric company, of Corry, Pa., in the Erie City Iron

Works of Erie, Pa. The paper says that the installation is "the largest arc light plant in Northwestern Pennsylvania." It adds further, too, that "the wiring of the great shop was was done in a superior manner, and the general construction of the whole plant has the stamp of superiority, akin to perfection," all of which is a most flattering indorsement of the manner in which customers are treated by the Duplex company.

In no way is the appreciation of electrical conveniences more apparent than in the increasing demand for them in the household. Call bells, motors, fans and numerous contrivances are rapidly becoming a part of the domestic economy. Several extensive factories are largely devoted to the manufacture of this line of goods, one of the oldest being the Electrical Supply company, at Ansonia, Conn. The product of this factory is disposed of through the company's western office and warehouse, corner Michigan avenue and Randolph streets, Chicago, its specialties in house goods being the Eureka bell and Diamond carbon battery. These two specialties have become staple articles with contractors and electrical fitters all over the west.

The Underwood Manufacturing company has just furnished the Chicago City Railway company two endless belts, 62 inches wide, and 400 feet long. This belting was ordered something over a year ago, and is being placed in the cable power house at Twentieth and State streets, Chicago. These belts when in operation will transmit about 2,500 horse power. They weigh 4,940 pounds and contain about 2,050 square feet. The company has had two belts, 48 inches wide, 350 long, in operation at the station at Fifty-fifth and State streets for about five years, running night and day 5,200 feet per minute, and driving about 700 horse power each. These belts drive the fast lines of cable from Thirty-ninth to Sixty-third street.

BUSINESS.

The Owings building is one of the most noticeable of the large modern office buildings of Chicago. It is lighted with electricity and is wired with Kerite wire.

Henry Alexander, treasurer for Alexander, Barney & Chapin, New York, has tendered his resignation and on April first will sever his connection with this company.

The Central Electric company, Chicago, is sending out a pamphlet to architects, builders, owners and others using interior conduits, covering the recent decision in favor of the Interior Conduit & Insulation company in the suit of the Conduit company vs. the Holtzer-Cabot Electric company.

W. J. Williams, Dallas, Tex., has been granted a franchise for water supply and electric lighting at Denton, Texas, and has organized the Denton Water Works & Electric Light company. He has placed an order with the Pond Engineering company for two 70 horse power steel boilers, which will be erected at once.

The following changes have recently been made in the agency department of the National Electric Manufacturing company, Eau Claire, Wis.: Cincinnati, O., P. P. Altenberg, room 50, Smith building, vice W. N. Gray resigned; St. Louis, Mo., W. E. Bailey, special southern agent, rooms 7 and 8 Equitable building. This last is a new appointment.

One of the enterprising concerns of Cleveland, O., is that of I. H. Moses, successor to A. B. Lyman & Co. This house is located at 34–38 South Water street and deals in annunciators, burglar alarms, telegraph supplies, etc. Mr. Moses is making many improvements, and pushing things generally, and will no doubt meet with the success that his enterprise deserves.

The Rose Electric Light Supply company, St. Louis, Mo., has on hand second-hand machinery representing every prominent manufacturer of electric lighting apparatus in this country, and it has under contract at the present time several large installations. The Rose company has made a specialty of second-hand apparatus for some years, and is well and favorably known to the trade.

Hussey & Co., 211 Randolph street, Chicago, have adopted a new method for fastening the mouthpiece to the flexible tube in their electric combination speaking tube system. The tube is made of a spiral, covered with a cotton or silk woven netting, which is forced inside the tube connected with the mouthpiece, and held there by the expansion of the coil. The edge of the tube is rolled so that it will not cut the covering, and besides, helps to improve the appearance.

The Edison Electric Illuminating company of Milwaukee, having retired from the business of wiring for electric light, the Wisconsin Electrical Construction company has purchased the stock and materials formerly owned by that company, and will continue the business as electrical engineers, contractors and manufacturers of electrical machinery and appliances. The offices of the new construction company will be at the corner of Biddle and Market streets, Milwaukee, with W. N. Stewart as manager.

Treasurer W. D. Packard, of the New York & Ohio company, Warren, O., was in Chicago for several days last week, in the interests of the "Packard" incandescent lamp. The "E. E. & S. company," the northwestern selling agents for this lamp, was represented at an informal meeting with Mr. Packard last week, at the company's office in this city, by Morgan Brooks, St. Paul, general manager, and C. A. Daigh, Eau Claire, president. A recent sale of 40,000 lamps in one delivery was reported, with an active demand in every direction.

The Climax company of Corry, Pa., has recently added to a municipal plant owned by them at Union City, Pa., one 250 light, one 500 light incandescent dynamo, and one 50 light arc dynamo, all of which were built in the company's factory at Corry. Twelve arc lights are now in use for street lighting in connection with the latter plant, and this number is to be largely increased at an early day. The Climax company also has a contract for lighting the city of Corry, and has under way an extension of plant to comprise 48 arc lights and two 500-light incandescent generators. The outlook for the coming season in Corry and vicinity is pronounced very promising.

The search light recently placed on the Goodrich steamer, City of Ludington, by the Chicago office of the Mather Electric company, and which was illustrated in the WESTERN ELECTRICIAN of March 19th, has a lens which is sixteen inches in diameter and throws a beam light over one thousand yards. The cylinder is made of heavy sheet iron, with polished copper trimmings. The current is furnished by a 200-light compound wound Mather generator, at 115 volts. The light is rated at ten thousand candle power or more, and requires twenty-five amperes. In addition the generator furnishes current for 170 incandescent lamps that are used for lighting the boat. The light was made from specifications furnished by the Chicago office of the Mather company and is considered a model one.

The Illinois Electric Lamp company has recently been organized in Chicago for the manufacture of the Jewel incandescent lamp, the registered trademark having been purchased from Wm. Hood. The officers of the company are: Chas. M. Howell, president; Chas. J. Loughren, secretary and treasurer, and J. F. Schaefer, superintendent. Mr. Howell resides at Bessemer, Mich., and is the prosecuting attorney for Gogebic county. Mr. Loughren is a bright young business man formerly residing in the same county, while Mr. Schaefer is a well known pioneer in the manufacture of incandescent lamps. The company has a fine factory at 171 and 173 South Canal street, Chicago, and will commence with a run of 500 lamps per day, although the capacity is double that number. The Jewel lamp is well known and the complete output of the factory will, no doubt, be readily placed.

The American Engine company of Bound Brook, N. J., of which R. V. Pierce of Buffalo is president, V. Mott Pierce of Buffalo, secretary and treasurer, and Mr. Smith, the patentee, general manager, enters upon the manufacture of its engine with well-laid plans. Land to the extent of 235 acres lying near the depot and on either side of the railroad tracks at Bound Brook, is controlled by the company and upon it there have been erected a complete modern machine shop, foundry, etc., and a number of houses. A large portion of these ample grounds has been laid out in building lots, with wide streets and avenues, with sewer and water pipes to each lot. The streets are to be macadamized and a handsome broad boulevard will surround the grounds and skirt the Raritan river which washes the borders of the property. General Manager Smith proposes at once to erect a large number of fine cottages for the occupancy of the company's large force of mechanics. The tracks of the Central railroad of New Jersey, of the Lehigh Valley railway, and of the Port Reading railway, pass on either side of the works, and from these spur tracks are laid into the shops so that engines may be loaded on the cars directly from the machine shop. Other tracks run on trestles, so as to dump the coke, iron, etc., at the mouth of the cupola, and the coal into bins at the front of the boilers. There is in all 15,000 feet of railway front. Ample and well arranged drafting rooms, pattern shops and a suite of offices are located in the second story of the main building. All the buildings, save the stock and storage shops, are of brick. Besides these buildings the company contemplate erecting large additions connecting with the main shops, which will double the present floor space and add still greater to the capacity of the works.

ELECTRICAL STOCK MARKET.

The closing quotations of electrical stocks on Saturday, March 26th, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	96½	97
Edison Illuminating company of New York	81½	82
" " " Brooklyn	76	80
" " " Boston	105	110
" " " Chicago	130	140
Edison Ore Milling company	15	20
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomson-Houston Electric company	58	58¼
" " " Preferred	28	28½
Westinghouse Electric company	16¼	16¾
North American Phonograph company	5	6
New York " "	2½	5
Automatic Exhibition company	2	3

ELECTRICAL PATENTS.

Issued March 22, 1892.

471,096. Wire Clamping Device. Orlando P. Briggs, Chicago, Ill.

471,100. Electrically Controlled Elevator. Andrew M. Coyle, Washington, D. C.

This invention contemplates means whereby all the desired movements of the car can be effected safely and with certainty without the exercise of any more care and intelligence than is required to touch a button corresponding to the number of the floor to which the car is desired to move. To this end the system comprises a series of parallel or branch circuits, one for each floor, and electrically operated devices so constructed that when one of the switches or push-buttons is actuated the car will move to and come to rest at that floor, no matter whether the car be above or below the floor.

Claim six is given:

"In a system for electrically controlling the movements of an elevator-car, the combination, with the car and mechanism for starting and stopping the same, of a series of main circuit closers, one for each landing, a main circuit having two branches, as specified, a circuit-breaker moving with the car so as to pass each circuit closer as the car reaches the corresponding landing, and two disconnected conducting strips connected, respectively, with the two branches of the main circuit extending in opposite directions from said circuit-breaker and moving therewith."

471,130. Thermostatic Instrument. Morris Martin, Malden, Mass.

471,151. Trolley Wire Support. Elmer A. Sperry, Chicago, Ill.

471,155. Alternating Current Motor. Elihu Thomson, Swampscott, Mass.

This invention relates to improvements in those alternating current motors wherein the armature is moved by the action of a shifting or rotating magnetic field produced by changes of magnetism acting successively or dissimultaneously in different portions of the field

Claim two reads:

"An alternating current motor comprising an armature, field-coils presented to different portions of such armature and connected in series to a single supply circuit, and a condenser shunting some of such field-coils, whereby the magnetic changes therein are retarded."

471,190. Carbon Holder for Arc Lamps. Charles A. Pfluger, Chicago, Ill.

471,206 Trolley Pole Catcher. Montraville M. Wood, Chicago, Ill.

471,210. Electric Striking Mechanism for Clocks. Silas C. Dickinson, Corning, Iowa.

471,230. Electric Railway Signal. Edgar C. Wiley Bristol, Tenn.

471,234 Electric Arc Lamp. Hector Dewar, Boston, Mass.

471,237. Vibrating Electric Switch. Jacob S. Gibbs, Hartford, Conn.

471,242. Electrically Welding Metals. August De Meritens, of Paris, France.

471,271. Electric Switch. Amandus Metzger, New York.

471,296. Electrical Signals for Railways. Eugene T. Turney, Chicago, Ill.

471,302. Safety Device for Electrical Conductors. Julius Marx, Nauheim, Germany.

The claim reads:

"The combination of a receptacle, electrical terminals included therein at a distance from each other, and a compound in said receptacle of low resistance, which becomes less conductive or nonconductive upon increase of temperature, and which connects said terminals."

471,310 Long-Distance Telephone System. Eugene Gwosdeff, St. Petersburg, Russia.

The claim is given:

"The telephone system for great distances, characterized by the following arrangements: The microphones and telephones conected with the lines by means of the separated condensers and connected with a return line by means of condensers the electric capacity of which corresponds with the respective resistances of the two lines."

471,311. Boiler Feed Alarm. Peter Kerekes, Budapest, Austria-Hungary.

471,351. Heating Apparatus for Buildings. Quinby N. Evans, Brooklyn, N. Y.

471 352. Telephone System. Anthony B. Ferdinand, Oshkosh, Wis.

Claim six reads:

'In a telephone or analogous electric system the combination, with the main line and a plurality of instruments or stations thereon, of a device located adjacent to and connected in shunt with each of said instruments or stations and with the main line, said device comprising a switch for cutting off the current therefrom, means for operating said switch by hand, means for locking said switch actuating device from movement, a motor for changing the relative positions of the said parts, a magnet provided with a swinging armature operatively connected with and adapted to release said motor and said locking device, and means connected with said motor for automatically restoring the parts to their initial positions."

471,371. Theatrical Illusion Apparatus. Joseph Arthur, New York, N. Y.

471,375. Conduit for Electric Railways. Francis O. Blackwell, Boston, Mass.

Of the 23 claims, the twelfth is presented:

"The combination, in an electric-railway conduit, of the transverse yokes and channel slot rail having openings leading into the conduit with the removable insulator hangers connected with the supply conductor by a bayonet or like joint, permitting ready disengagement by a rotary movement, and which are engaged when in place by the slot rail and thereby held against accidental rotation."

471,409. Apparatus for Electric Railway Signaling. Adoniram J. Wilson, Port Chester, N. Y.

471,410 Electric Railway Signaling Apparatus. Adoniram J. Wilson, Port Chester, N. Y.

471,447. Charging Table for Electric Railways. Edward P. Usher, Grafton, Mass.

The claim is quoted:

"The described charging table, comprising permanent supports adjacent to the car track and a top adapted to receive the batteries, such top being hinged at one edge and provided with means for adjusting the opposite edge of the table top vertically to correspond with the battery recess of the car.

471,491. Trolley Wire Hanger. Thomas J. McTighe, New York, N. Y.

471,524. Tellurian. John L. Riter, Brownsville, Ind., and John M. Alford, College Corner, Ohio.

471,525. Automatic Electric Block System. Joseph A. Carlton and Henry L. Johnston, Atlanta, Ga.

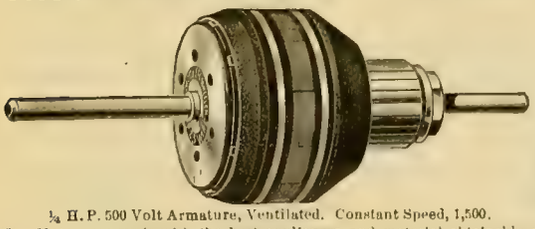
471,526. Disk Carbon for Arc Lamps. Hosea W. Libbey, Boston, Mass.

The fourth claim reads:

"A disk carbon having a groove or grooves on one or both sides, whereby the amount of carbon consumed is regulated so that the carbon will burn equally all around."

471,527. Machine for Casting Grids for Secondary Batteries. Albert F. Madden, Newark, N. J.

CROCKER-WHEELER ELECTRIC COMPANY,



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A PARTNER WANTED.

I wish to sell a half interest in a well established Electrical Supply House. Object to increase capital so as to supply the demand. $5,000 to $10,000 required.

Address, **"South,"**
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One, three and five year bids for lighting the streets and city buildings of the City of Burlington, Iowa, with sixty 60-or more arc lights of two thousand candle power each, and two hundred and fifty more incandescent lights of twenty or more candle power each, will be received at the office of the City Clerk until April 18, 1892.

All bids to be accompanied by a good and sufficient bond in the sum of $5,000 for the faithful performance of the bid.

The Council reserves the right to reject any or all bids.

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Chairman of Gas Committee

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Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

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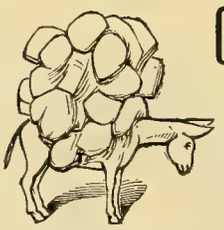

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For Electrical Purposes.

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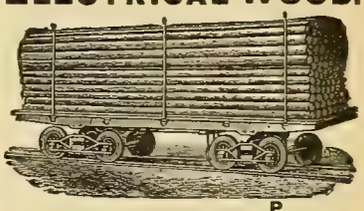

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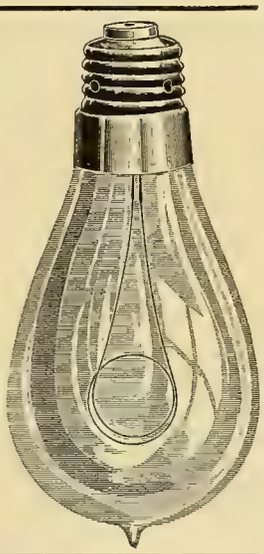

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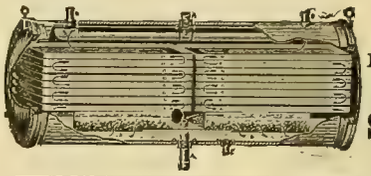

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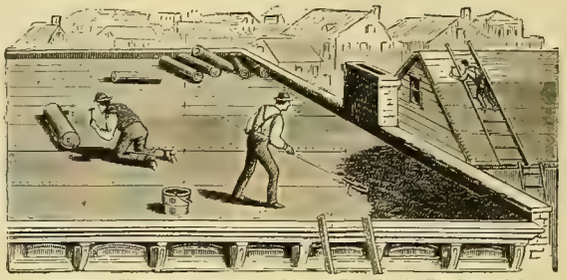

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Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

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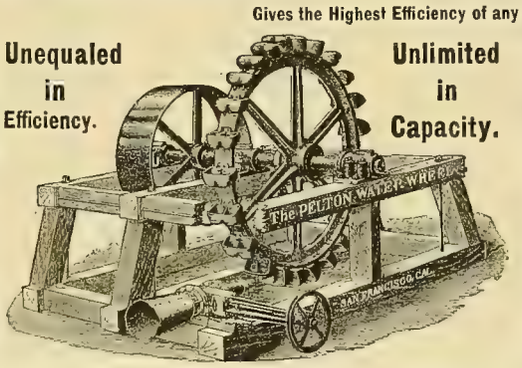

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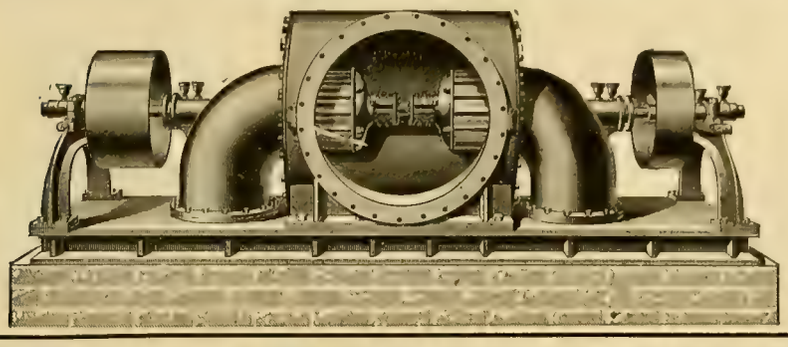

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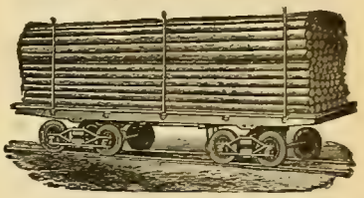

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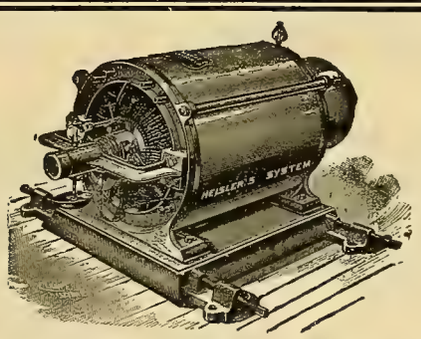

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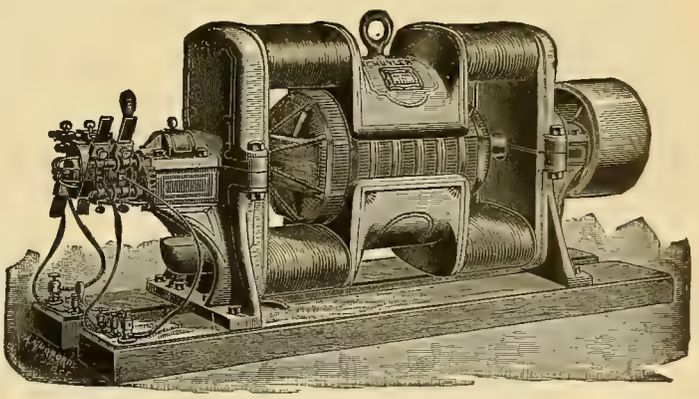

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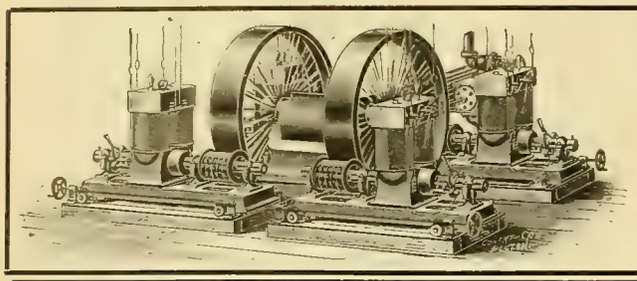

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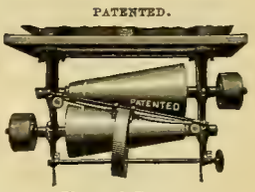

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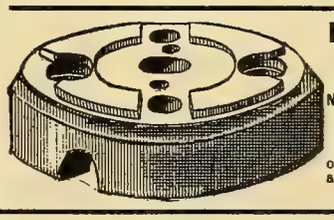

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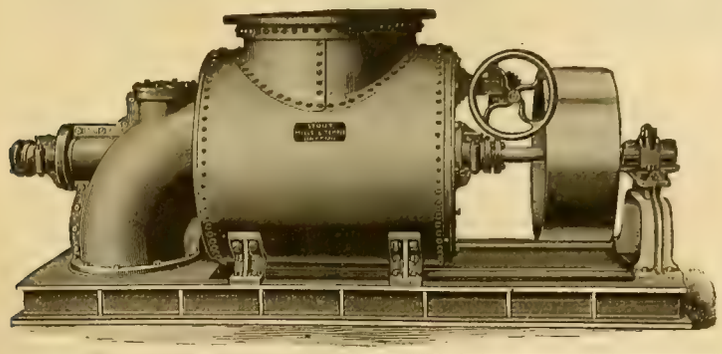

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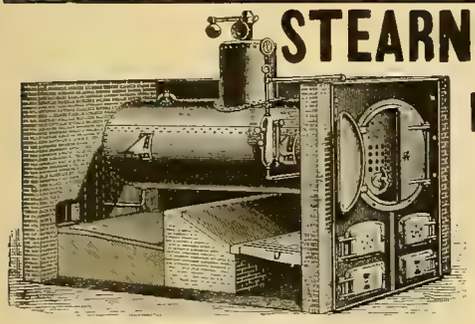

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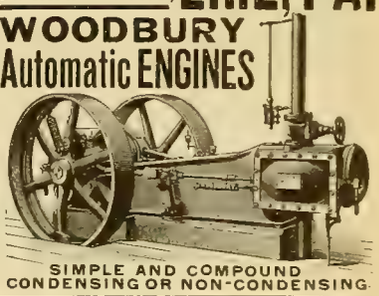

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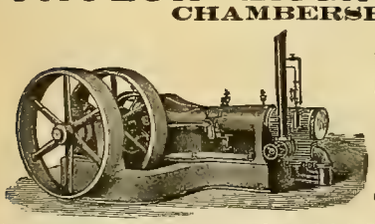

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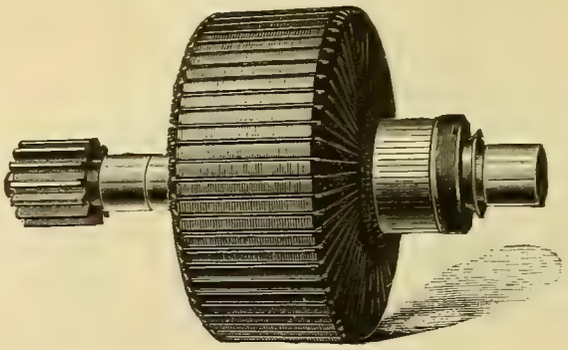

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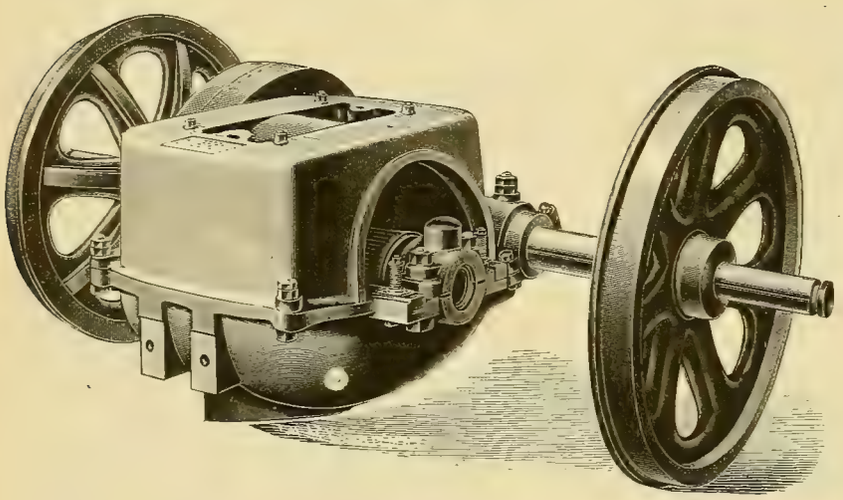

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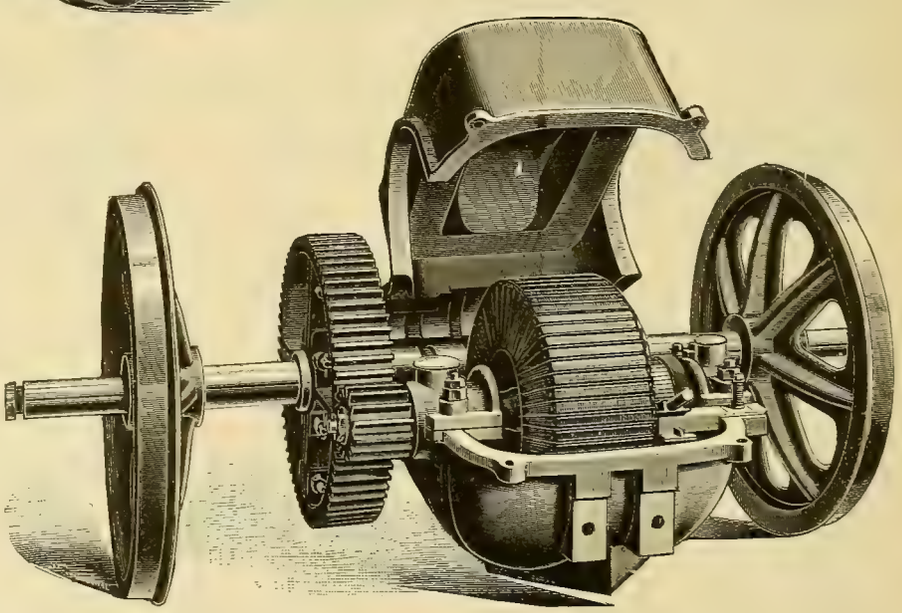

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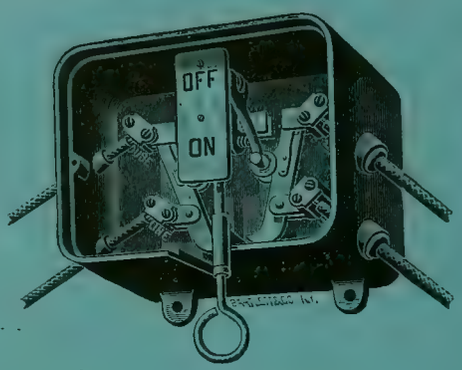

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The "Incidentals" (Loss of Revenue, Labor, Extras, etc.,) Cost More Than Material.

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DEAR SIRS:—In reply to yours of the 29th ult., asking for our experience with your motors under severe conditions, would say that the best performance we had, to my knowledge, was on Sunday, June 7th. A heavy rain had fallen in the morning, and vehicles passing along the highway had tracked considerable mud onto the rail at a point about the **Center of a 50° curve on a 7 per cent. grade.** Motor car No. 4, carrying **64 passengers and hauling trail car with 57 passengers,** stopped by reason of the trolley coming off exactly at point where wagon track crossed the railroad. Upon trolley being replaced on the wire the motor started **without difficulty.**

August 14th one motor pulled two trail cars (**168 passengers on the three cars**) from Charlotte to Manitou, eight miles, **in 38 minutes, including five stops.** On first two miles there are three 50° curves, one of which is on 7 per cent. grade and another at top of same grade, one 90 foot radius curve and two 40° curves. In this two miles there are three grades, 4 per cent., 5 per cent. and 7 per cent. respectively, the 4 per cent. grade being 1,000 feet long, the 5 per cent. 700 feet, and the 7 per cent. 400 feet long.

Quite a number of times during the season one motor pulled two loaded trailers; in fact, this was done whenever occasion required.

Hoping the above will be of service to you, I am yours very truly, (Signed) E. A. ROWORTH.

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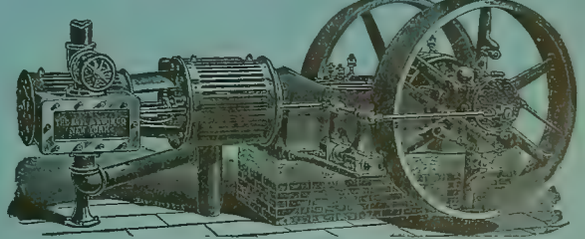

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Short Railway Generators

ARE NO LONGER A NEW TYPE. THEY ARE

STANDARD,

And the record they have made for themselves cannot be surpassed. Inquire in Rochester, Jamestown, Covington, East Liverpool, Muskegon.

The Jamestown Street Railway Company report as follows: JANUARY 6, 1892.

* * * * * * * * * * * * * * * * * * *

On Sunday morning last it commenced snowing very hard, and so continued all day Sunday, Sunday night and Monday. We were obliged to put forth every effort to prevent blockading of the road, which we succeeded in doing.

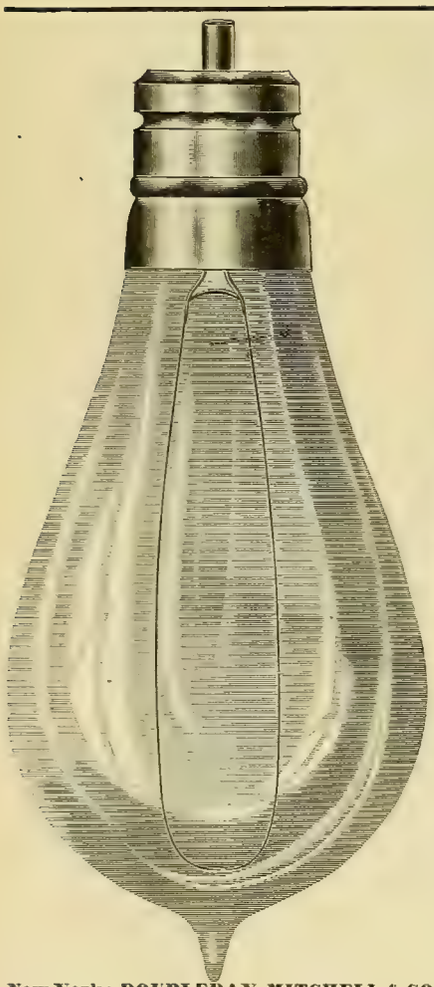
* * * * * * * * * * * * * * * * * * *

On Sunday morning we started your Generator No. 2 at 6:30 a. m., and continued to use the same until Tuesday morning at 3:30 a. m., when we shut it down. This Generator was in continuous service during the entire time, and was not even sanded, nor the brushes touched. It did not use to exceed one-half quart of oil. We consider this remarkable because of the hard work the Generator was doing. * * * * * * * *

Yours very respectfully, GEORGE E. MALLBY, Superintendent.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, OHIO.



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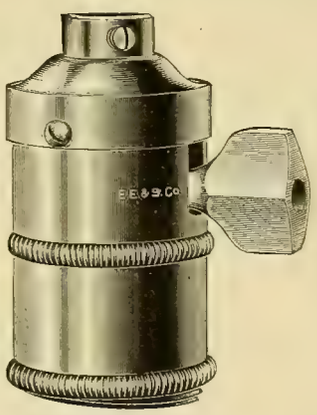

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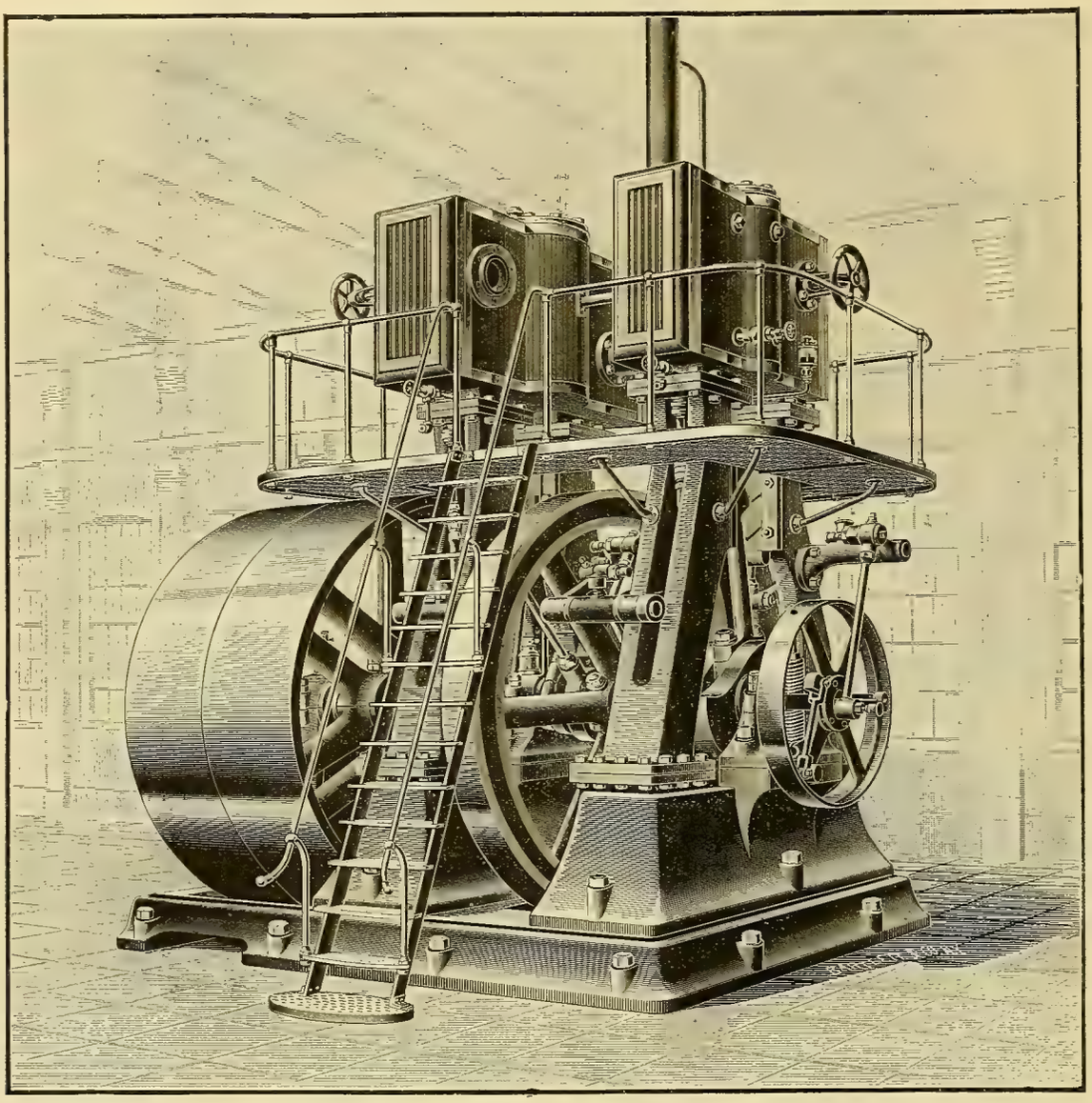

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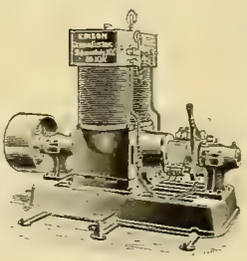

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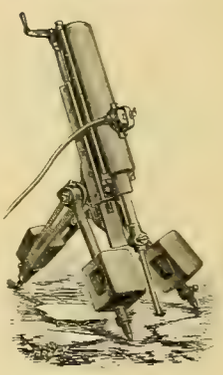

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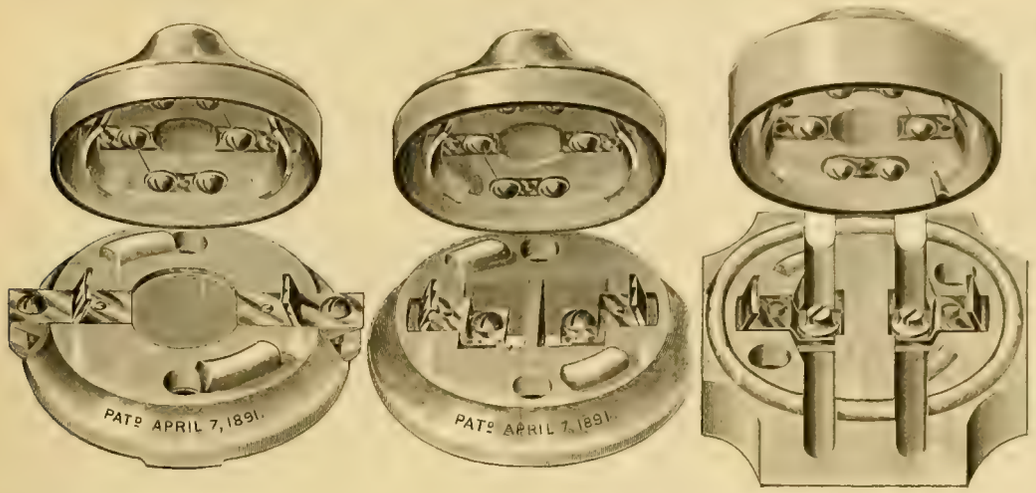

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In addition to the above mentioned courses, lectures on methods of instruction will be given by teachers in the several departments represented by the schools. These lectures will be open, without charge, to the persons who are enrolled as members of any of the summer schools in the University.

In general these courses are adapted to the needs of those who intend to be teachers in the several subjects. Several of the more elementary, however, are intended to meet the needs of beginners and may be taken by students in lieu of the corresponding courses in the College and the Lawrence Scientific School, and may be counted towards a degree.

During the session of the schools the College Library will be open from 9 A. M. till 5 P. M. The Museum of Comparative Zoology, the Peabody Museum, and the Mineralogical Collection are also accessible to students during the summer vacation.

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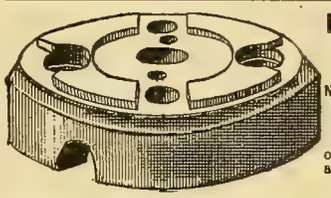

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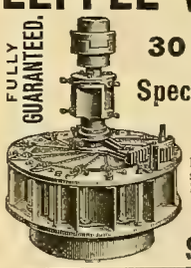

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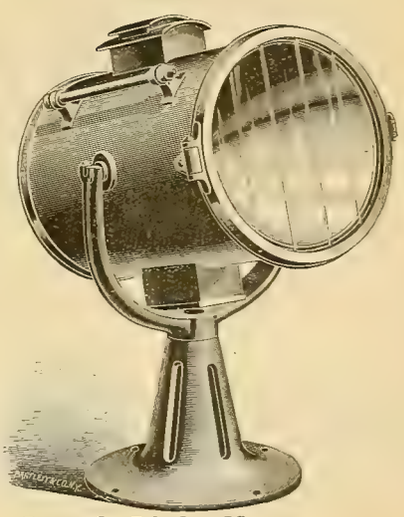

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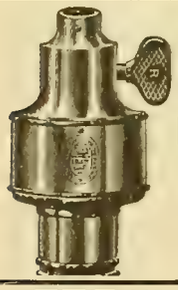

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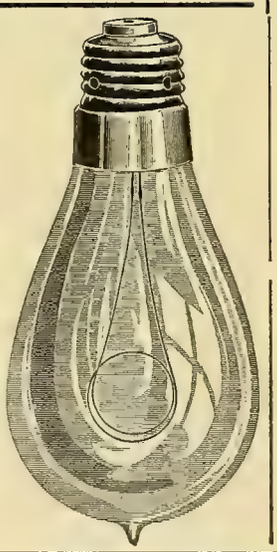

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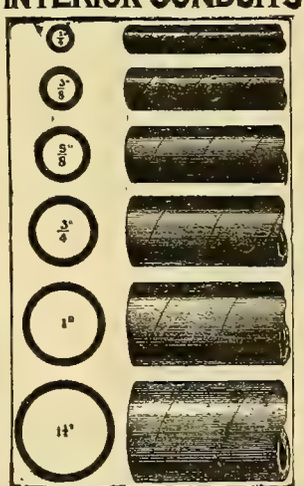

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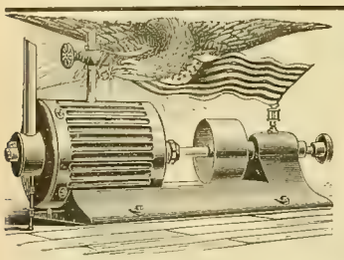

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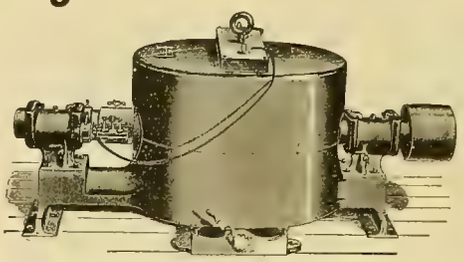

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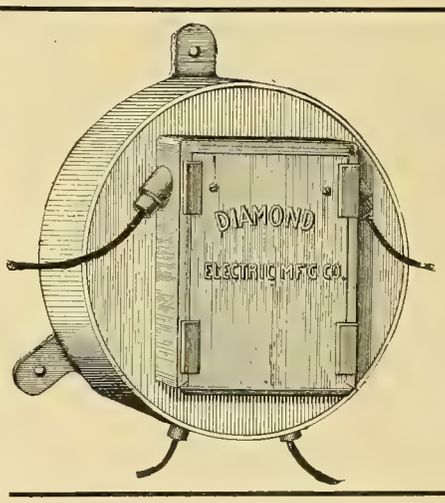

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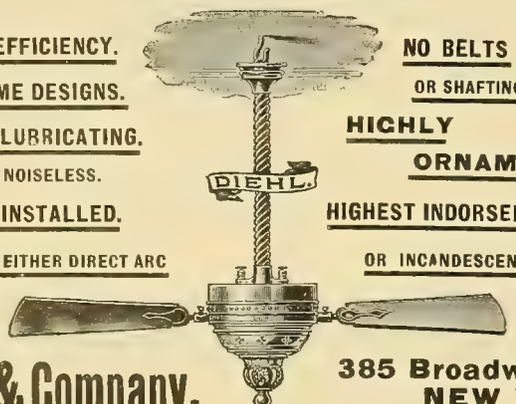

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EVERY SATURDAY.

Vol. X. CHICAGO, APRIL 9, 1892. No. 15

Electric Welding at the Studebaker Works, South Bend, Ind.

It would be an injustice alike to the Thomson Electric Welding company and the Studebaker Brothers to enter upon a description of the welding machinery now in daily service and doing such excellent work in the South Bend factories without mention of the enterprise of the men that have built up a business reputation second to that of no other American firm of carriage and wagon manufacturers.

Henry and Clem. Studebaker started a blacksmith shop in South Bend in 1852 with a capital of cash and stock in trade amounting to but $68. The first year they shod horses, did repair work, and made two wagons. In 1864, with four Studebaker brothers constituting the firm, a contract for army wagons for Utah was obtained, and this order gave the brothers their first great start. To have made the two wagons in 1852 was considered a great feat, but when one hears that after recovering from two disastrous fires, the output in 1889 was 40,000, with a demand for more, one begins to have an idea of the growth of the business. The repository in Chicago has four floors for display and four above these for fine carriage work. The building is one of the city's handsomest structures, and as a sales building it is a marvel of architectural taste. At South Bend the wagon works and lumber yards cover eighty-three acres, while the carriage works cover three and one-half acres. When certain projected improvements have been completed the capacity of these great works will be 60,000 vehicles a year.

No better example can be had of the progressive spirit that has marked the advance of the Studebaker company than its present bold advocacy of electric welding, as evidenced by the extent to which the company has replaced the old-time blacksmith methods by the more modern forging process.

About two years and a half ago Clem. Studebaker visited the works of the Thomson Welding company at Lynn, and thoroughly investigated the electric welding process with the view of applying it to his work at South Bend. Soon after his return home General Manager H. A. Royce, of the welding company, visited the South Bend factory, and the result was an order for the welding plant which is now in operation there.

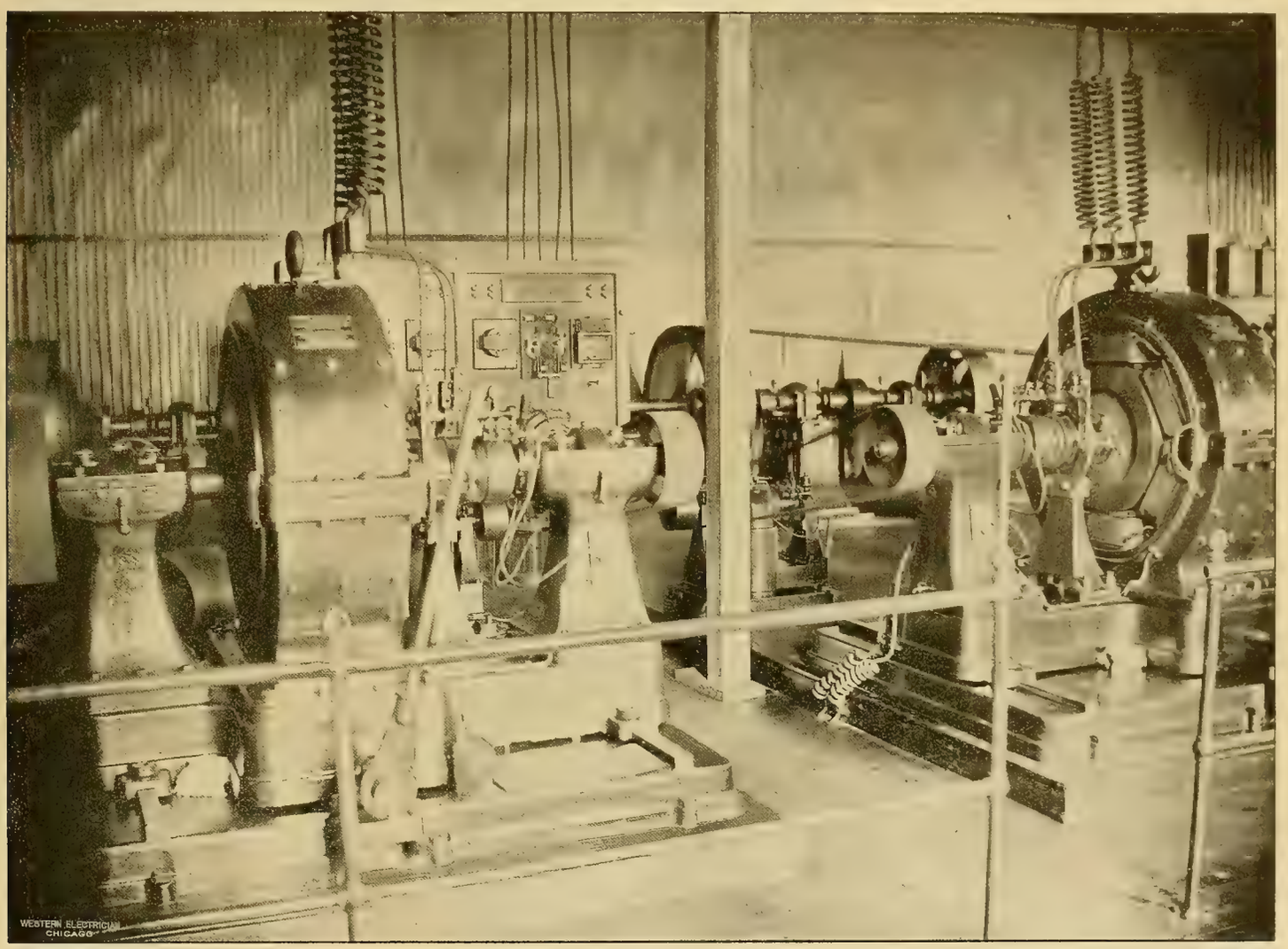


FIG. 1 ELECTRIC WELDING AT THE STUDEBAKER WORKS, SOUTH BEND, IND.

The installation of so large and varied a plant as that required by the Studebaker people was a valuable opportunity for the electrical company, as, in replacing the old forge methods, many details necessary for good commercial work have been brought out and perfected. In fact, the Thomson Electric Welding company makes no secret of its acknowledgment that much of the success attained in carriage welding is due to the facilities and courtesies extended by Studebaker Bros.

With the view of giving the readers of the WESTERN ELECTRICIAN a comprehensive idea of the Studebaker plant, a representative of this journal visited the works at South Bend and procured the photographs from which the accompanying pictures were made.

In Fig. 1 is shown the two 60,000 watt welding generators which supply current for the seven welding machines distributed throughout the works. These dynamos are but a part of the electrical generating plant, for in addition there are four fifty light Thomson Houston arc machines driven by a 200 horse power engine. These do not appear in the cut, however. The two systems, having separate switch-boards, lightning arresters and engines, are so arranged with shafting and friction clutches that the engine for either outfit can be used on one or both systems, or changed from one to the other without delay. The engine driving the welding generators is a Corliss 200 horse power. The welding dynamos run at 1,600 revolutions per minute, and are separately excited by two small compound wound constant potential dynamos of 5,000 watts capacity. From the switch-board, directly between the two dynamos, nearly 3 500 feet of No. 0 Simplex wire is run to the welding machines scattered through the several blacksmith shops of the works. Situated in one of these shops is an axle welder Fig. 2, one small tire welder, Fig. 3, and two welders, Fig. 4, for doing miscellaneous work. Over twenty different kinds of work are welded on these two last mentioned machines, the range being from pole irons to brake rods, braces and seat irons, and the cross section welded from ⅛ of an inch to 1 1-5 square inches. The small tire welder will weld iron ½ square inch in cross section, and will join from 250 to 600 tires per day, depending on the size of stock. The axle welder is said to be the most complete welding machine yet constructed, and embodies every

improvement that three years of experience in the welding business could suggest. This welder is so nearly automatic that one man can easily weld axles of four square inches cross section. The axles are clamped in the welder by hydraulic pressure (varying according to the size) of from one to nine tons on the axle, and in welding the two parts are pushed together by hydraulic pressure at from one to three tons, the operator confining himself to the movement of the two levers, which regulate the heat and hydraulic pressure. This machine has a capacity of 300 axles per day. In another shop, 400 feet away, are three band welders, Fig. 5, and two large tire welders, Fig. 6. The latter will weld tire varying from the sizes used on express wagons to those for the largest farm wagons and trucks. These two machines are also provided with hydraulic pressure devices, and have a capacity of from 400 to 600 tires per day (100 to 125 sets). The three band welders are fitted up to do all kinds of band welding, and each welder has a capacity of from 500 to 1,000 bands per day, varying with the size. These welders, as is now, of course, very generally understood, are so arranged as to be perfectly harmless in the hands of one unaccustomed to electric apparatus. From 300 volts, constant potential, on the main line, the current passes to the welders and is there transformed. In the secondary circuit of the welder the electric pressure is so extremely low that under the most favorable circumstances not the least shock is obtained; the pressure not exceeding that of one cell of primary battery, viz., one volt.

Each welder is provided with a regulating device for the different sizes of stock welded, and all the larger machines have Collins' power hammers connected with them for forging into shape the material when it has been welded.

For information relative to the welding work as carried on at South Bend the WESTERN ELECTRICIAN is indebted to Mechanical Superintendent C. M Collins. The photographs are the work of T. H. Bulla of the Studebaker works.

FIG. 5 ELECTRIC WELDING AT THE STUDEBAKER WORKS, SOUTH BEND, IND.

Electricity at the World's Fair.

Nine bids for furnishing incandescent lights at the World's Fair were opened on Saturday of last week by the officers of the construction department. The bids were made on specifications issued on February 22d, and are for the lighting of the principal buildings and for decorative lights about the grounds. A synopsis of the specifications was published in the WESTERN ELECTRICIAN of March 5th. In all, about 85,000 lamps were enumerated Some of the

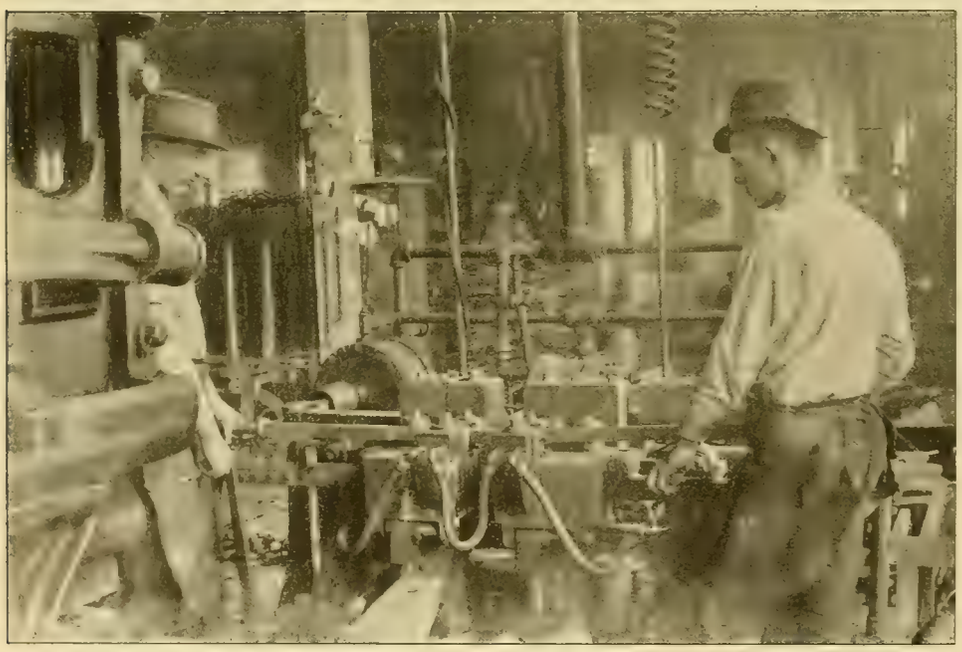


FIG. 2. ELECTRIC WELDING AT THE STUDEBAKER WORKS, SOUTH BEND, IND.

bids were for the entire installation, while several firms desired to furnish only certain portions of the equipment. As abstracted by Electrical Engineer Sargent, the bids are as follows :

Thomson-Houston Electric company, Boston, Mass.—$14.51 per lamp for machines, station apparatus and distributing mains, without inside wiring; with inside wiring, complete, from $3 to $4 per lamp additional.

Edison General Electric company, New York—$14.16 per lamp for machines, station apparatus and distributing mains; including inside wiring, $18.49 per lamp.

Brush Electric company, Cleveland, O. (Transportation, woman's and Illinois State buildings; 8,800 lamps)—$14.77 per lamp for machines, apparatus and mains; wiring woman's building, $9,334, or about $3 per lamp additional.

Fort Wayne Electric company, Fort Wayne, Ind. (State and foreign buildings, gallery of fine arts, woman's and fisheries buildings; 46,587 lamps)—$13 98 per lamp, or a total of $651,276, for generators, distributing mains and converters.

Electrical Construction company, Chicago, Ill.—$4 per lamp, or a total of $20,130, for the administration building, complete; $2.70 per lamp for machines, apparatus and mains for transportation building; inside wiring for the latter building, $2.52 additional, making a total of $5.22 per lamp.

Mather Electric company, Manchester, Conn. (Machinery hall)—$2 per lamp for generators, station apparatus, feeders and mains; $2 45 per lamp additional for service connection, making a total of $4 45, or $17,800; 50 cents per lamp for dynamos and station apparatus only.

Western Electric company, Chicago, Ill —This company offers to furnish the machines and station apparatus for 2,500 lights, to be used wherever needed, for the nominal sum of $1.

South Side Machine and Metal Works, Chicago—This company engages to furnish all the lights called for in the specifications, complete for service, for $439,469; renewals at 35 cents per lamp. It represents the La Roche Electric Works of Philadelphia and the Whitcomb Machine company.

Heisler Electric company, Philadelphia (Wooded island; 750 32 candle power lamps)—$3.75 per lamp for generators and station appliances.

All the bids include lamps, attendance and labor. No action has as yet been taken by the committee on grounds and buildings, which will award the contract.

It has been decided that the Eddy company shall furnish the exposition generators for power service of 1,000 horse power capacity at $2.50 per horse power. The Mather company will supply 804 horse power at the same rate.

No contract has as yet been made by the exposition authorities for launches on the lagoons at Jackson Park. It has been agreed, however, that four of the bidders shall furnish sample boats to be operated for a month at the exposition grounds before the committee makes its choice, as some of the directors appear to have doubts whether electricity can be successfully employed for the propulsion of vessels. The bidders who will furnish the boats for testing are Willard & Co., D R. Proctor and the Columbian Launch company of Chicago and the Electric Launch & Navigation company of New York. The launches are to be operated for experimental purposes from June 1st to July 1st.

The representatives of several leading boiler manufacturers have combined in an agreement to furnish the World's Fair a boiler capacity sufficient to evaporate hourly 450,000 pounds of water at a temperature of 212° to steam at 125 pounds' pressure for $80,000. The contractors will install, erect, equip, maintain, operate and remove the plant for that sum, starting the foundations on May 15th. The boilers are to be ready for steam connections not later than August 15th and ready for steam a month later. Babcock & Wilcox, the only big firm not in the agreement, may yet come in, in which case they will have as great a capacity of their own manufacture as any other firm. On the basis of 30 pounds of water per horse power—the usual method of calculation—this plant represents a capacity of 15,000 horse power. Most of this power will be used for electric light and power generators. It has been decided to use oil as fuel.

On Monday Frederick Sargent was still undecided in relation to his proposed trip to Europe

On the electricity building 276 men are now engaged. All the iron trusses of the transepts are in place, and men are putting in the central trusses. Carpenters are placing the gallery and roof joists, laying floors, sheathing the roof, and building the towers. The north towers are nearly up to their full height, and all the others are up to the height of the ridge of the building. Of the staff used for the exterior covering, 6,576 pieces have been cast All told, 15,692 pieces will be needed.

Space in the electrical building has formally been apportioned to France, Austria, Belgium and Mexico. The first named country has a very desirable location on the lower floor of the northwestern hemicycle near the space of Great Britain and Belgium.

It is said that the Sultan of Turkey has invented a telegraphic instrument which he desires to exhibit at the World's Fair.

As the result of the visit of Congressman Dockery's investigating committee from Washington, the World's Fair authorities have prepared a detailed statement of the expenditures for the exposition from the date of organization until

March 1, 1892. The total is $3,860 934.84. The electrical items are as follows: Electric lights and appliances $9,353 - 81; electrical engineering, $15,086.23; electricity building, $137,382.44; electric plant, $22,505 49; telegraph, $1,056.13; telephones, $2,585.81. For gas $235.32 was expended. In this connection the detailed estimate of future expenses prepared for the committee by Chief Barrett of the electricity department will be read with interest. It is as follows:

FIG. 4. ELECTRIC WELDING AT THE STUDEBAKER WORKS, SOUTH BEND, IND.

March 1, 1892, to June 30, 1892.		
Salaries—Chief at $2,500	$ 833 33	
Secretary, at $2,000	666 66	
Assistant engineer, at $2,000	666 66	
Stenographer, at $900	300 00	
Printing, stationery, etc. (including prospectus)	750 00	
Postage (including mailing 10,000 copies prospectus)	500 00	
Traveling expenses	400 00	
Telegraph and telephone service	200 00	
Plans, drawings and miscellaneous expenses	200 00	
		$ 4,516 65
July 1, 1892, to June 30, 1893.		
Salaries—Chief	$ 5,000 00	
Assistant chief	4,000 00	
Three assistants, at $2,000	6,000 00	
Secretary	3,000 00	
Four clerks, at $1,500	6,000 00	
Two stenographers at $900	1,800 00	
Two messengers, at $600	1,200 00	
Two inspectors of installation, at $1,200	2,400 00	
Four inspectors of installation, four months, at $100	1,600 00	
Four carpenters, six months, at $3.33	2,000 00	
Four superintendents machinery, four months, at $3.33	1,333 00	
One superintendent shafting, five months, at $150	750 00	
One superintendent motors, five months, at $150	750 00	
Two plumbers, four months, at $83.33	656 00	
Ten laborers, six months, at $45.00	2,700 00	
Two machinists, four months, at $75	600 00	
One head janitor, six months, at $100	600 00	
Printing, stationery and office supplies	6,000 00	
Janitors and sweepers' stores, trucks, etc.	1,000 00	
Traveling expenses	1,500 00	
Telegraph and telephone service	500 00	
Miscellaneous expenses, emergency account	1,000 00	
		$ 50,399 00
July 1, 1893, to October 30, 1893.		
Salaries—Chief, at $5,000	$ 1,666 64	
Assistant Chief, at $4 000	1,333,32	
Three assistants, at $2,000	2,000 00	
Secretary, at $3,000	1,000 00	
Four clerks, at $1,500	2,000 00	
Two stenographers, at $900	600 00	
Two messengers, at $600	400 00	
Six inspectors of installation, $100	2,400 00	
Four carpenters, at $33.33	333 32	
Four supts. machinery, at $83.33	333 32	
One supt. of shafting, at $150	600 00	
One supt. of motors, at $150	600 00	
Two plumbers, at $83 33	666 66	
Ten laborers, at $45	1,800 00	
Two machinists, at $75	600 00	
One head janitor, at $100	400 00	
Printing, stationery and office supplies	2,000 00	
Janitors' stores, trucks; etc.	800 00	
Telegraph and telephone service	500 00	
Miscellaneous expenses, emergency account	5,000 00	
		$ 23,533 26
Watchmen and Janitor Service for the Entire Time.		
Salaries—One head watchman: ten months, at $100	$ 1,000 00	
One head night watchman, ten months, at $100	1,000 00	
Ten watchmen, ten months, at $60	6,000 00	
Seventy watchmen, seven months, at $60	29,400 00	
Twenty night watchmen, seven months, at $60	8,400 00	
Ten night watchmen, ten months, at $60	6,000 00	
Four assistant janitors, eight months, at $45	1,440 00	
Forty sweepers, seven months, at $45	12,600 00	
Uniforms for watchmen, janitors, etc.	3,600 00	
		$ 69,440 00
October 30, 1893, to January 31, 1894.		
Salaries of officers, inspectors and laborers on duty during three months, while machinery and exhibits are being removed from the electrical building; also care of those exhibits and the machinery, which must be returned to owners by the department; also cost of report on the achievements of the section, three months, at $2,000 month		$ 6,000 00
Grand total		$153,888 91

Exactly in the center of the lower floor of the electrical building is a circular space surrounded by open passage ways on all sides which Secretary Hornsby considers the choicest tid-bit of all the desirable locations for exhibits. A number of prospective exhibitors are anxious to secure this prominent position. One of them offers to put up a glass pagoda that shall form one of the most attractive features of the electrical display. The structure is to be almost entirely of glass, highly ornamented and made brilliant by incandescent lighting effects. Several others have offered to make "show" displays if accorded this space, and the matter is still unsettled.

The Gas Industry Council has taken in hand the project for raising money for the display of gas appliances at the World's Fair. Contributions are solicited from producers at the rate of $4 per 1,000,000 feet of gas manufactured annually, but there are divergent opinions as to the best way to secure the money. The *American Gas Light Journal* has subscribed $250 to the fund. The building will be near the machinery annex.

FIG. 3. ELECTRIC WELDING AT THE STUDEBAKER WORKS, SOUTH BEND, IND.

A cable dispatch from London, dated March 29th, says: "A meeting of the committee on electrical display at the Chicago fair was held to-day, with the distinguished expert, William Henry Preece, F. R. S., in the chair. About a dozen other notable electricians were present. Sir Henry Wood, head of the British commission, was also in attendance. It was developed that there is every prospect that British electrical interests will be adequately represented at the fair. An especially good display of engines and dynamos will be made. It is probable that the rooms devoted to the exhibit will be lighted with electric furnishings of English style, which have proved to be a great attraction at the electrical exhibition now in progress in the Crystal Palace. European firms, however, have deferred making positive arrangements until the arrival of a representative of the fair management, who is expected shortly from Chicago."

World's Electrical Congress.

By the courtesy of Prof. Elisha Gray, chairman of the committee on the electrical congress to be held in conjunction with the World's Fair, the WESTERN ELECTRICIAN is enabled to present the preliminary address of the committee, which is signed by Prof. Elisha Gray, Col. R. C. Clowry and Prof. Henry S. Carhart. It is as follows.

It is eminently fitting that at suitable times and on suitable occasions men in all departments of science and industry should come together for interchange of thought, and for the discussion of subjects that have to do with the great activities of life—practical and intellectual. What more fitting time to hold a series of congresses than during the great World's Columbian Exposition, at Chicago, in 1893? In pursuance of this object the World's Congress Auxiliary of the World's Columbian Exposition has been organized, under the support of the exposition corporation, and has been recognized and approved by the government of the United States. Under this organization committees have been appointed to organize a series of congresses. Among others, a general committee, consisting of a local committee and an advisory council, selected from men eminent in the science, both in this and in foreign countries, has been appointed by the World's Congress authorities to organize a World's Electrical Congress, to be held at Chicago sometime during the summer of 1893.

The movement is, as yet, in a formative stage, and much thought must be given to it before a detailed programme can be formulated. It is the intention of the general committee to so organize the congress that the greatest good to the science and to all interested in electrical progress may be attained. It is desirable that the work of the congress should be divided into sections, the number of which will be determined after consultation with the advisory council. The first and most important section should give its time and thought to the more purely scientific phases of the subject, such as the revision of the existing electrical units, and the addition of such others as the state of the science may require. Other sections should be devoted to the more practical questions of applied electricity.

In addition to the meetings of the various sections, there will be general meetings, where all will come together to listen to papers from men eminent in the science from all parts of the world. An audience room will be furnished, where such general meetings of the congress will be held, in connection with which will be smaller rooms, suitable for the meetings of the various sections.

In order that their conclusions may have the authority both of scientific ability and of official sanction, the members of the first or scientific section should be appointed by the respective governments from which they come. The delegates having this very important work in charge should represent the best talent from all parts of the world, or from such countries as, by reason of achievements in the domain of electricity, are entitled to a voice. We invite the hearty co-operation of all persons interested in electrical progress, not only by any suggestions they may have to make, but also by their presence at the congress in 1893. Already there is a lively interest felt in the matter, in this and other countries, for the idea of holding an electrical congress, at the time of the World's Fair, is not a new one either to European electricians or to the profession in this country. Several associations of elec-

tricians have suggested it; for three years past the American Institute of Electrical Engineers has had an active committee on this subject;and at the electrical congresses of Paris (1889) and Frankfort (1891) its delegates extended a formal invitation to their European associates to come to America in 1893. Since those invitations were extended, the present authorities have been appointed by the World's Congress Auxiliary of the World's Columbian Exposition. When these authorities presented the matter officially to the Institute, they immediately saw the fitness of having the congress held under the auspices of the World's Fair; and by a formal and unanimous vote of its council and special congress committee it has pledged itself to give all possible support to the agencies now intrusted with the responsibility of making a success of the proposed electrical congress at Chicago in 1893. It is the hope and expectation of the committee on the electrical congress that other electrical associations at home and abroad will give us the same hearty co-operation.

The time of meeting will be most auspicious, as the representatives of the world's best thought and best work will be centered here, and the congress will meet under the shadow of the greatest palace of electricity the world will ever have seen. Other announcements will follow this one, from time to time, as the work of organization goes on. All communications in the way of suggestion or otherwise should be addressed to the chairman.

Appended to the address is the following list of names of the gentlemen composing the advisory council for the electrical congress, as at present constituted :

Sir William Thomson, F. R. S. (Lord Kelvin), The University, Glasgow, Scotland.
William H. Preece, F. R. S , electrician in chief, General Post Office, London, England.
Prof. W. E. Ayrton, F. R. S., City and Guilds of London Institute, Central Institution, Exhibition Road, London, S. W., England
Lord Rayleigh, Terling Place, Witham, Essex, England.
Prof. S. P. Thompson, D. Sc., City and Guilds of London Technical College, Finsbury, London. England.
Prof. E. Mascart, College de France, No. 176 Rue de l'Université, Paris, France.
E. Hospitaller, No. 6 Rue de Clichy, Paris, France.
Dr. Werner Siemens, Berlin, Germany.
Prof. H. Von Helmholtz, Berlin, Germany.
Prof. Galileo Ferraris, Turin, Italy.
Joseph Kareis, K. K. Baurath, Wien II., am Tabor 6, Austria.
Prof. Dr. Weber, Ecole Polytechnique, Zurich, Switzerland.
Prof. E. Gerard, Inst. Electro-Tech. de Montefiore, Liege, Belgium.
Prof. A. Repman, Moscow, Russia.
Prof. A. Stoletow, Moscow, Russia.
S. Yslas, de los Telegrafos Federales, City of Mexico, Mexico.
Director General of Telegraphs, Madrid, Spain.
Prof. Geo. F. Barker, M. D., University of Pennsylvania, Philadelphia, Pa.
Prof. C. F. Brackett, College of New Jersey, Princeton, N. J.
Prof. Henry A. Rowland, Ph. D., Johns Hopkins University, Baltimore, Md.
Prof. T. C. Mendenhall, LL. D., Director of U. S. Coast and Geodetic Survey, Washington, D. C.
Prof. B. F. Thomas, Ohio University, Columbus, Ohio.
Prof. Thomas Gray, Rose Polytechnic Institute, Terre Haute, Indiana.
Prof. A. E. Dolbear, Tufft's College, College Hill, Mass.
Prof. John Trowbridge, D. Sc., Harvard University, Cambridge. Mass.
Prof. F. E. Nipher, Washington University, St. Louis, Mo.
Prof. Sidney H. Short, Cleveland, Ohio.
Prof. Henry Morton, Stevens Institute, Hoboken, N. J.
Prof. Brown Ayres, Tulane University, New Orleans, La.
Prof. John E. Davies, LL. D., University of Wisconsin, Madison, Wis.
Prof. A. P. Carman, Purdue University, Lafayette, Ind.
Prof. Lucian I. Blake, Ph. D , University of Kansas, Lawrence, Kan.
Charles F. Brush, Cleveland, Ohio.
W. E. Channing, Pasadena, Cal.
Michael Pupin, Ph. D., Columbia College, New York, N Y.
Prof. Elihu Thomson, Lynn, Mass.
Franklin L Pope, Elizabeth, N. J.
George M. Phelps, New York, N. Y.
Frank J. Sprague, New York, N. Y.
Edward Weston, Newark, N. J.
Prof. William A. Anthony, Manchester, Conn.
Louis Duncan, Ph. D., Johns Hopkins University, Baltimore, M. D.
Prof. Alexander Graham Bell, Washington, D. C.
Francis B. Crocker, Columbia College, New York, N. Y.
Nikola Tesla, New York, N. Y.
Thomas A. Edison, Ph. D., Orange, N. J.
Carl Hering, Philadelphia Pa.
T. Commerford Martin, New York, N. Y.
Prof. Edward L. Nichols, Ph D , Cornell University, Ithaca, N. Y.
Prof. Edwin J. Houston, Central High School, Philadelphia, Pa.
Dr. William E. Geyer, Stevens Institute of Technology. Hoboken, N. J.
A. E. Kennelly, Orange, N. J.
Thomas E. Lockwood, Boston, Mass.
Prof. Charles R. Cross, Mass. Institute of Technology, Boston, Mass.
Louis Bell, Ph. D., New York, N. Y.
George A. Hamilton, Elizabeth, N. J.
Ralph W. Pope, Elizabeth, N. J.

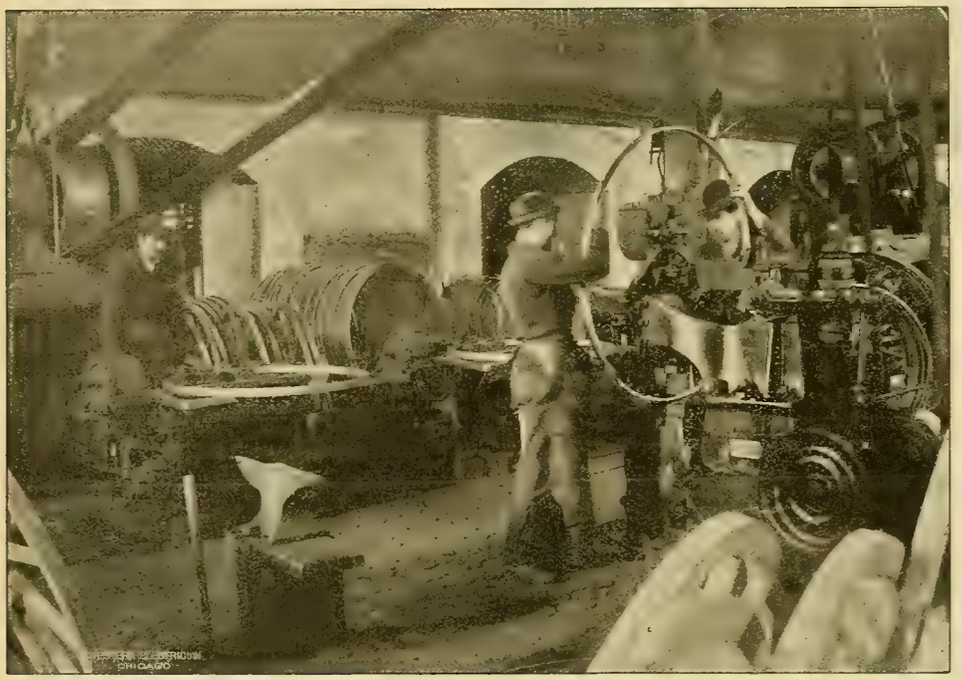


FIG. 6. ELECTRIC WELDING AT THE STUDEBAKER WORKS, SOUTH BEND, IND.

Bell Telephone Statistics.

The annual meeting of the American Bell Telephone company was held in Boston on March 29th. It was voted to increase the capital stock from $15 000,000 to $17,500,000. It was also voted that the old stockholders be given the new stock at par value in the proportion of one to six. The ballot for directors resulted in the selection of the following named gentlemen: Thomas B. Bailey, Francis Blake, Charles P. Bowditch, George L Bradley, Alexander Cochrane, William H. Forbes, Henry S. Howe, Charles Eustace Hubbard, G. G. Hubbard, John E. Hudson, Charles E. Perkins and Thomas Sanders. Treasurer Driver was also re-elected.

The report of the directors showed that there were 512,407 instruments in use Dec. 20, 1891, an increase of 28,617 over the previous year. The statistics of exchanges show that there are 788 in 1892, a gain of 14 in the year. There are 509 branch offices, a gain of 42. The number of miles of wire on poles is 180,139, an increase of 8,641. There are 14,954 miles of wire on buildings, 70,334 miles underground, and 1,029 miles submarine. The increase in miles underground is 150,664. The total number of miles of wire is 266,456, an increase in one year of 26 044. The total of circuits is 186,462, an increase of 12,797. The total number of employes is 8,376, an increase of 531. The total number of stations is 216,017, an increase of 13 086. The net gain of 13,086 subscribers in 1891 is somewhat less than that of the preceding year. More than one-half of the increased mileage is in the form of underground conduits. The entire expenditure in 1891 for new lines and equipment was $4,347,317.35, and for land and building, $800,793.93.

It is the intention this year to fill the gap between Cleveland and Hammond, Ill., thus giving through service between Boston, New York and Chicago.

Single Reduction Motor.[1]

By George K. Wheeler.

All practical electric street railway men appreciate the necessity of having a motor that shall have the greatest possible degree of self-protection from outside injury. This necessity was evident by the number and severity of the storms of the last few years; and it has been the aim of electric manufacturers to design a motor that would meet the requirements of ordinary street railway service, and so constructed as to be perfectly protected within itself, and also to reduce the number of wearing parts, reduce the weight of the motor, and construct a frame of such strength that breakage would be impossible, and to provide a more perfect magnetic circuit than that found in the double reduction motors. The important problems to be solved in making a successful single reduction motor are as follows:

First—Electrical and mechanical simplicity.

Second—Slow speed and powerful torque.

Third—Protection of field and armature from dust and water.

Fourth—Accessibility of all parts of the motor, so as to render it easy for repairs and adjustment.

Fifth—High commercial efficiency at all speeds and loads.

Sixth—Reduction of weight per horse power, developed with a view of lightening the load that must be carried at all times.

Seventh—Small expense of maintenance.

There have been various types of single reduction motors placed upon the market during the last fifteen months, and I must say that some of them have not fulfilled the above requirements. It is my opinion that much better results are obtained by a two-pole single reduction motor than by the four-pole, for the reason that it is much lighter, simpler in construction, has a smaller commutator, half the number of bobbins on the armature, also half the number of brushes, and is much more economical to maintain.

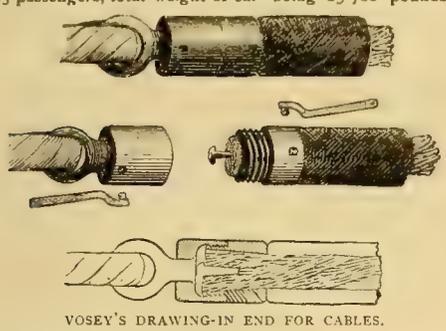
The tendency of modern improvement in railway motors is to diminish the gearing, and I do not think that anything is to be gained over the double reduction motor by placing two sets of gears and pinions, one on each side of the single reduction motor, as it not only increases the friction losses, but adds an additional weight to the motor, and, if the motor frame and armature shaft are properly constructed, there is no liability of either straining or breaking by reason of placing the gear and pinion on one side only. It is stated by a number of competent electrical engineers that the placing of one motor on a truck is ample for all ordinary street car service. By experience, I have found that with a truck having but one motor attached to one axle, the wheels on the axle to which the motor is attached do not brake as quickly as the free wheel, and flats are thus formed on the free wheels on this account; also, that it is a difficult matter to ascend grades over 3 per cent., and that it is next to an impossibility to operate a car so equipped during the winter months. It is also advocated that the proper method is to gear a single motor to both axles. This, in my opinion, is open to serious objections. In gearing a single motor to two axles of a truck, it is almost impossible to keep wheels perfectly true; that is, one set of wheels will, perhaps, wear more than the other, on account of the variation in the quality of the iron, and as soon as one set of wheels is in the slightest way different from the others, a bad action takes place between the driving gear and the wheel, for the reason that one wheel is trying to run faster than the others, which, of course, naturally will cause one set of wheels to be dragged along until that distance has been overcome; and when the wheels start anew, the gears are in a short time thrown out of mesh with each other. It will be understood that, in order to make a successful gear, driven by a single motor, it is necessary that both sets of wheels travel exactly with the same speed over the rails and that the truck on which the motor is mounted must be perfectly rigid, so that the gears will at all times mesh with each other. In practice this has been found almost impossible, especially where heavy work is required and a large number of curves are to be found, and also where the track is in bad condition, excepting, possibly, when the wheels on the truck are perfectly new, and the track in good shape and the curves very liberal; but it will be found, if one set of gearing is disconnected, it will require from 15 to 20 per cent. less power to operate. It is for these reasons that I believe the best results are obtainable by connecting a single motor to each axle of a truck. It may be argued that there is twice the liability for trouble where two motors are used, but experience proves that it is not exactly so; for, by this method, you obtain the proper traction and benefit of all wheels. And, in case of extra load, you have ample power to operate the car under all conditions of service; and, in case of injury to any part of one motor, it can be disconnected, and the car operated until an opportunity offers to make the necessary repairs.

A single reduction motor should be so constructed as to give the greatest possible distance between the bottom of the motor and the top of the rail. With the best form of motors which have, up to the present time, been constructed, the greatest distance obtainable betwen a 15 horse power motor and top of rail is 4½ inches when placed on a wheel 30 inches in diameter. I strongly recommend the use of larger wheels—either 33 or 36 inches in diameter. With a motor mounted on 36 inch wheels, this will give a clearance of 7½ inches, which is more than ample to clear ordinary track obstructions, and, if the motor is thoroughly protected in its frame, it will not be necessary to use motor-pans, which have been a necessary evil in connection with double-reduction motors. It may be stated that a car equipped with 36-inch wheels requires an excessive amount of current to operate. But this is not a fact. On a test which I made more than a year ago on a car equipped with 36-inch wheels and a car equipped with 30 inch wheels the same motor equipment and car of same

1. Read before the Chicago Electric club, March 28, 1892.

length and weight, operated over same length of road on same day and by same man, the total length of the line being 16 miles, it was found that the car equipped with 36-inch wheels required about three-fourths of a horse power more on an average than the car equipped with 30 inch wheels, although the 36-inch wheel car required more current in starting and climbing grades, but it would run longer on the level by momentum, and thus average up the current consumption. With the present form of single reduction motors I think that the 33 inch wheel is of ample size.

On tests which have been made with the best types of single reduction motors, they have been found to be from 8 to 10 per cent. more efficient than the double reduction, and are capable of attaining a much higher speed under various conditions of service. On a recent test which I made on an over-country road, being some eleven and one-eighth miles in length, the car being 34 feet in length, and with 25 passengers, total weight of car being 23 700 pounds,



VOSEY'S DRAWING-IN END FOR CABLES.

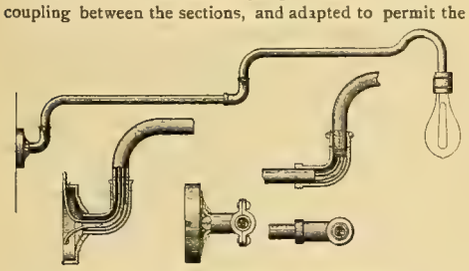
car equipped with double trucks, having two 25 horse power single reduction motors to each car, the maximum speed attained was 32 miles per hour, the car climbing grades of 4 and 5 per cent. at the rate of 17 miles per hour. On a car 16 feet in length, equipped with one fifteen horse power single reduction motor, the maximum speed attained was 25 miles per hour, on the level, and the car in climbing grades of 4 and 5 per cent. would not attain a speed of over five miles per hour.

By the use of single reduction motors the cost of maintenance and operation will be greatly reduced on any road so equipped, for the reason that the number of parts has been greatly reduced from that of the double reduction, and its efficiency greatly increased. I am of the opinion that the single reduction has come to stay and will continue to force its way to the front, and eventually supersede the double reduction motors with which the earliest roads were equipped.

Goehst's Incandescent Lamp Bracket.

The accompanying cut illustrates a simple yet ingenious incandescent lamp fixture devised by J. H. Goehst of the Chicago Edison company. In designing this bracket the object was to provide a simple and durable construction by prolonging the life of the joints through the avoidance of the screw threaded connections as bearing surfaces at the joints. A further aim was to avoid wear incident to the constant turning of a threaded joint, and to permit the joint to be operated with ease, and at the same time be so adjustable that it may be prevented from operating too easily.

A glance at the cut will make evident the details of construction. The bracket comprises a couple of tubular sections connected together by a bent tubular elbow adapted to permit the outer section of the bracket to be swung horizontally and independently of the inner section. The inner section of the bracket is connected with a base plate also by a bent tubular coupling, constructed like the coupling between the sections, and adapted to permit the



GOEHST'S INCANDESCENT LAMP BRACKET.

tube to be swung horizontally. Each pipe coupling is internally threaded at a point back from its upper outer end, so as to provide it with a smooth unthreaded wall extending from the upper end back to the thread. The ends of the sections which are to turn within these internally threaded couplings are also threaded and engage the internally threaded coupling sections.

The threaded connection between a coupling and one of the arms permits the latter to swing freely. The smooth bore of the coupling constitutes the bearing proper, and can be tightened upon the arm by screwing down the bolt through the two lugs at the split coupling, or a ring nut may be provided, as indicated in one of the enlarged sectional views.

Voysey's Drawing-in End for Cables.

When drawing electric cables into pipes or other conduits, it is necessary to make a secure connection between the cable and the rope by which it is to be pulled in. It is also necessary that such connection should be small enough to pass through the pipe or conduit. One method adopted at present is to make a splice by cutting out of the center strands of the conductor and "marrying" the outer strands to those of the rope.

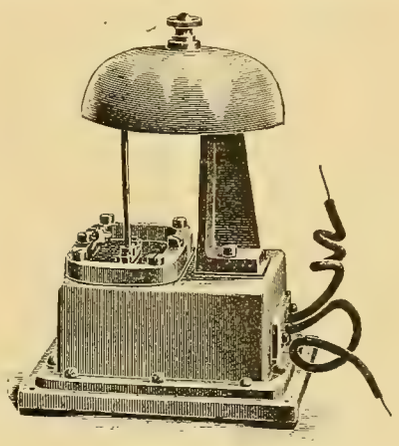
A. A. Voysey, an English inventor, has devised a grip of bar steel designed to avoid the waste of time and material entailed by the above described method. The device consists, as is indicated in the cut, of a small ferrule, two or three inches long, tapered inside, and made so the narrow end fits closely to the conductor of the cable. The ferrule is placed on the end of the conductor, narrow end foremost, the insulation being cut back two or three inches according to the length of the ferrule. When it is in position, a taper pin is driven into the center of the cable, and this spreads the strand so as to make the ferrule grip tightly. It is easy to see that any attempt to pull the ferrule off will now cause it to grip the strands more tightly. On the end of the rope is permanently connected a small cap, which can be screwed on to the end of the ferrule. After the cable is drawn in, the ferrule can be easily removed by taking out the pin, which is provided with a small head so that it can be knocked out.

It is stated that nearly a mile of cable was drawn into a Callender-Webber conduit with this grip and it acted perfectly, never in any instance showing the slightest tendency to draw off the cable. One advantage over the ordinary splice is that it does not "ruck up" when being drawn past sharp bends. The cut is taken from the London *Electrical Review*.

Hermetically Sealed Electric Bell.

The cut shows an electric bell of English make that contains a feature a knowledge of which will be of interest to bell manufacturers on this side of the water.

This bell was designed for use in collieries or mines



HERMETICALLY SEALED ELECTRIC BELL.

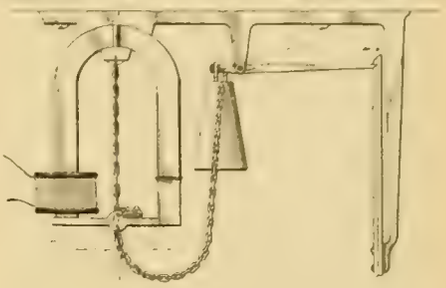
where wet or dust interferes with the working of ordinary electric bells. In the bell illustrated, the working parts, coils, etc., are all enclosed in a cast-iron case, hermetically sealed, and with only the hammer and gong outside. The hammer is suspended in the center of a flexible metal diaphragm, which allows it to move freely, at the same time doing away with the pivots or springs in use in ordinary forms of electric bells. Connection is made to the bell coils by means of wires brought through the case in stuffing boxes, so as to prevent moisture from creeping along the wires into the case. Both single stroke and trembling bells are made on this principle.

An Electric Heat Alarm without a Battery.

Electric fire alarms constructed with contact points in the circuit of a battery for automatically closing the circuit by the effect of heat and sounding an alarm, often prove ineffective from the fact that the contact points, in the course of time, become corroded or dirty, and fail to close the circuit. Batteries, too, dry up and become inoperative.

With the object of overcoming these defects, L. G. Woolley of Grand Rapids, Mich., has devised an automatic alarm constructed suddenly to separate a magnet and armature, one of which is provided with an induction coil, so that when the temperature of the room has reached any prescribed degree, a momentary current is produced in the coil and sounds an alarm at a distant point.

The cut shows the electro-magnetic alarm. The "L" shaped armature is held to the poles of the magnet by permanent magnetism, the long end of a lever pivoted as shown, engages a notch in the upper end of a thermostatic bar, while a weight is suspended upon the short end. This thermostatic bar is composed of dissimilar metals, the expansion of one being greater than that of the other, so that if the temperature of the room or building is raised the bar bends in the direction indicated by the arrow. This bar is set so that when the temperature of the room has reached a prescribed degree it will have bent sufficiently at its upper end to disengage the notch from the end of the lever and allow the weight to drop, as shown in dotted lines. A chain connects the weight and armature,



AN ELECTRIC HEAT ALARM WITHOUT A BATTERY.

so that the dropping of the weight suddenly removes the armature from the magnet, thus producing a momentary current by induction in the coil.

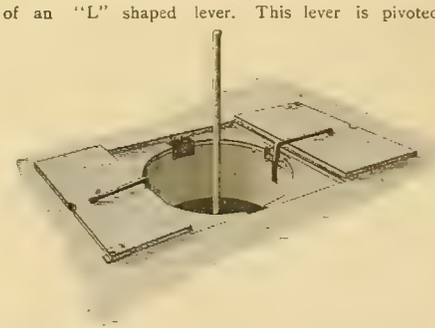
As the current generated by a single sudden removal of the armature from the magnetic poles is but momentary, and too feeble to directly operate a bell, the coil on the magnet is connected with an electromagnet in a signaling apparatus, which serves simply to release a tripping device on a large mechanical gong, actuated by weights or springs.

Opening Fire Engine Trap Doors By Electricity.

In many engine houses where the sleeping apartments for the firemen are located in an upper story there are manholes in the floor, and a slide pole extends down through each of the holes to the ground floor and affords a means by which the firemen may descend to the ground floor in the quickest possible space of time. Casualties have happened and are very liable to happen, owing to accidental falls through the unprotected manholes, as it is deemed inadvisable to close the holes by covers or doors which have to be opened manually.

From the above, therefore, it will be seen that it would be most desirable to open automatically the trap doors, and the cut shows an arrangement devised for this purpose by L. C. Callahan of Bridgeport, Conn.

As will be seen from the illustration each half of the trap door has bearing against it the roller end of an "L" shaped lever. This lever is pivoted as



OPENING FIRE ENGINE TRAP DOORS BY ELECTICITY.

indicated, and is provided at the pivot with coil springs which tend to throw the lever upward. At the outer ends of the levers are friction rolls, which have a constant bearing against the doors. It will thus be readily understood that the action of the levers will tend to keep the doors open. Within the floor there are fixed two electro-magnets, and the doors carry armatures so located that they will be in contact with the poles of the magnets when the doors are closed. The magnets are in circuit with the alarm, the latter being sounded by breaking the circuit.

The operation of the arrangement is as follows: The doors being closed, the attraction of the armatures by the magnets will keep the former closed against the resiliency of the levers. When an alarm is sounded the circuit is broken, the magnets will be deprived of vitality, and the doors will be thrown open by the action of the levers.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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OUR Kansas City correspondent gives some interesting particulars of the advancement of electric railways in that city. On one road connecting Kansas City and Independence electric motor cars are to be substituted for steam dummies, and a cable road will be utilized as a feeder to the line. The motor cars will be unusually powerful, as there are to be two 25 horse power motors on each. On another line electric cars are to supersede both the cable system and steam dummies at an estimated expense of $500,000. These are cheering signs of progress, and Kansas City is to be congratulated. It becomes more and more evident that the electric system is destined to supplant all others in all save the very largest cities.

A CONTEMPORARY makes, in another column, a good point in favor of the application of individual electric motors to machine tools. After dilating on the many advantages of electric power transmission for shops in place of shafting and belts, the journal referred to reminds the reader that the application of a motor to each particular tool would result in an entire elimination of the overhead mechanism, or, as it expressed it, would clear away "the forest of belting with its attendant turmoil." By thus opening the space above the tools, it would then be possible to apply the overhead crane to great advantage. The point made is a good one, and is one of many that will arise when mechanics reach a more thorough understanding as to the methods of applying the electric agent.

THE extent to which the electric welding process is coming to the front will be better understood after a perusal of this issue of the WESTERN ELECTRICIAN. In the Studebaker carriage and wagon works electricity plays a most important part, and one which can only be thoroughly appreciated by a personal inspection of the plant. This welding equipment has been in service about two years—long enough to convince the purchaser by practical experience that the claims advanced for the new method were founded on facts. In completing the Studebaker welding equipment the welding company gained a valuable experience. Many details had to be worked out and special features devised before the process was brought to its present state of perfection. But as the plant is now developed it stands as a landmark indicating a thoroughly practical achievement in one of the newest and most valuable of the arts of this electrical era.

THE World's Fair authorities cannot complain that there is a lack of diversity in the prices submitted to them in the bids for incandescent lighting. To be exact, they have had offers for the performance of all or certain portions of the work at prices ranging from $ 0004 to $18.49 per lamp. The former is, of course, a purely nominal bid, put in by the Western Electric company, which proposes to donate a plant of 2,500 lamps, capacity for use at the fair. But the variance of the tenders in which the expectation of compensation enters is hardly less marked, although the figures of four leading companies present a marked similarity. There can be no complaint, this time, that a preconcerted attempt has been made by all the electrical companies to "sand-bag" the fair, as several of the bids are remarkably low. No doubt an adjustment will be made by which all of the principal companies will be given a chance to participate in the work at a moderate price.

ATTENTION is called to the preliminary address of the local sub-committee on the World's Electrical Congress, which is presented on another page. This gathering promises to be of the greatest importance to the science, and practical development of electricity, and it deserves the hearty support of electricians all the world over. The scope of the gathering is world-wide, and the larger share of the work that is to make it of value must be done outside of Chicago by the men to whom the appeal just issued is addressed. The local committee will use every effort in its power to make the congress a success—that goes without saying—but, in a general sense, the value and importance of the conference will depend on the interest and co-operation of the members of the electrical fraternity at large. It is in their hands, and we think that they can be relied upon to make it deserving of the science and industry that they represent. In this endeavor we bespeak the assistance of the electrical press, both at home and abroad, which is ever in the van in all progressive movements. An imposing array of scientists and engineers has already been named as an advisory council, and if the gentlemen selected take hold of the project heartily, as no doubt they will, its success is assured from the start.

THE publication at this time of statistics showing the extent of development of the telephone business in the United States is significant in view of the preparations that are now in progress for the establishment of rival concerns At the last annual meeting of the American Bell Telephone company it was announced that there were in operation in the United States at the close of the last year over half a million telephones, an increase of 28 617 instruments over the previous year. Fourteen new exchanges were established in 1891, and there was an increase of 13,086 stations reported during the same time. This is a significant fact, and one which the opponents of the old company cannot disregard.

Attention has frequently been directed to the fact that the company has been quietly preparing for the opposition which has been threatened. It is well fortified with patents, but litigation is an expensive and slow method of establishing one's rights and the Bell company, which has had ample evidence of this fact, is now pursuing the policy of making itself as far as possible independent of these patents. While it has been buying up all the improvements of any value that have been brought out, it has also been extending and improving its service, until to-day its network of lines cover the entire country and its exchanges are well established in every populous district. It is here that the opponents of the old company will find the greatest obstacle. They will experience considerable difficulty in finding practical business men, and it is on this class they must draw for support, who will substitute a well organized and thoroughly developed telephone service for something that has yet to be established. The new companies will find it hard, therefore, to compete with the old concern, which will have not only this improved service to rely upon but will possess as well all the advantages which years of experience give.

REFERRING to the action of the Philadelphia city council in passing the trolley ordinance over Mayor Stuart's veto, and the outlook for an electric service on some of Chicago's streets, the *Chicago Herald* says: "It is to be hoped that this city may escape such a fate, for we need real railway trains here with real steam engines, running on elevated tracks."

Most people in Chicago, however, would be glad to get along without "real railway trains with real steam engines" and the attending "real" smoke and dirt, of which there is already too much in all parts of the city. It is not expected that the "real railway trains" when they eventually begin "running on elevated tracks" in Chicago—if they should ever get started—will give better service than the Illinois Central, which is now furnishing rapid transit for the finest residence district in the city, yet the people of Kenwood and Hyde Park would hail with delight any proposition to relieve them from the terrible nuisance entailed by the "real railway trains with real steam engines" that scatter smoke and soot and cinders all over the district along the Lake Front on the South Side.

The paragraphers of the daily press who are guilty of such nonsense as the quotation referred to should be spanked and sent back to the nursery.

IN another column a correspondent refers to the possible adaptation of electricity in agricultural work. Mention is made of the great field that now exists in the West for the application of the electric system of power transmission to the machinery of the farm, and attention is called particularly to the fact that a bill has been introduced by a Kansas senator to provide a station at which experiments with electrical agricultural machinery may be carried on.

The project of establishing such an experimental station as the one referred to is praiseworthy, for there is no question but that electric power could be put to a variety of uses about the farm. It is only a matter of time, too, when the wealthier husbandman will be brought to an appreciation of this fact.

One cause for the lack of progress in this application of electric power, is that the electrical manufacturer and the plow maker are as yet strangers. Electric motors can be bought and innumerable electrical engineers found that could design a thoroughly practical central station system, through which power could be delivered, say, to centers of distribution on the farm, thence to be fed out through temporarily erected trolley wires or cables to various machines in the field; there would be no insurmountable difficulty in getting current to the moving reaper or plow, and without doubt these and other machines could be made to propel themselves. But at present there is, as far as we are aware, no manufacturer of agricultural implements that has made any attempt to co-operate with an electrical firm or company to work out details in the development of such a system. The mechanical world in general, though, is awakening to the extreme flexibility and adaptability of the electric system, and without doubt an experimental station will direct the attention of electricians and agricultural mechanics to the now slumbering demand, and tend to bring about a co-operation that cannot be otherwise than beneficial to both classes of manufactures. So much for the development of the system.

The question as to whether there would be economy in the use of electricity on the farm, is one that can only be answered after a consideration of the conditions of particular cases. The cost of fuel, or possibly water power and the nearness of water, the lay of the land, the area over which current would have to be distributed—these, and many other considerations in each instance, would enter into the problem.

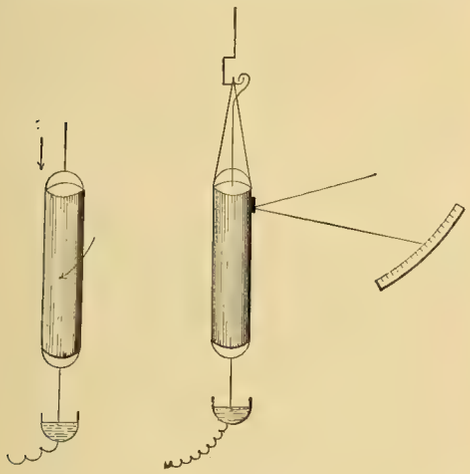
The establishment of an experimental station would be an important move in the right direction; it would be at least a start. When agriculturists begin to hear what can be accomplished through an agent to them now practically unkonwn, there will undoubtedly arise an interest which will ultimately lead to a demand, at least from the more progressive farmers.

Note on the Molecular Movement in a Conductor.[1]

By Prof. A. E. Dolbear.

Maxwell and others have made experiments to discover whether there was any evidence of momentum in a conductor carrying an electric current. So far as I know all the experimenters looked for a longitudinal momentum, that is, one in the direction of the current in the conductor, but no evidence appears to have been discovered that the molecules are thus moved. Still it is as near certain as anything can be and not be demonstrated, that the molecules in a conductor are moved in some way by an electric current. If they be thus moved then there must be momentum in some direction. If it be not longitudinal it may be transverse. If there should be movement in the transverse direction, what kind of experiment would be needed to show it? This is the way the question presented itself to me. When a current is sent through an iron wire the latter is twisted to the right or the left, according to the direction of the current. This is interpreted as due to the specific magnetic quality of the conductor, for it does not occur in a copper or other conductor.

Suppose the molecules of a conductor to be rotated, each upon its own axis, the axis being longitudinal with the wire, what evidence of such motion would be externally exhibited by the conductor, as a whole? Evidently it would be masked altogether in a common wire, for the momentum of any one molecule in one direction would be just balanced by that of the contiguous one in the opposite direction—a condition of things mechanically propagated through the diameter of the wire. In order to discover it, it would be necessary to prevent such mechanical transference of the movement, and this can be done by making the conductor a hollow cylinder. I therefore made a cylinder of gilt paper about 20 inches long and 4 inches in diameter. This I provided at each end with a bail for suspension, thus: The suspending wire being eight or ten feet long, the lower end of a short wire dipping into a mercury cup as shown in Fig. 1. With this arrangement a decided evidence of twist could be noticed, but on account of the resistance of the gilt paper, a strong current could not be used without so high a voltage, that the paper took fire several times. I then had a thin copper cylinder made of nearly the same dimensions and suspended in a similar manner, and could use a current of thirty or forty amperes. The rotary motions were in the same direction as before—when the current was going down, the twist was always right-handed as indicated by the arrow, and of course opposite when the current was reversed. While there was no doubt about the rotary movement, the weight of the apparatus was so great, I concluded to see if one made of lighter material—aluminum—would not give greater amplitude with the same current. A similar cylinder of aluminum foil was prepared and so hung that all tangential movement would be due solely to itself and not at all to any other part of the apparatus, that is, it was mounted with bi-filar suspension. The weight of the foil with its connections was 1.85 oz. 55.6 grams. A bit of mirror was fastened to the upper end, and a beam of sunlight reflected from it upon a scale 16 feet distant, and 25 feet long, Fig. 2. With this arrangement, the twist produced by the current was such that it was not difficult by timing the swings and changing the directions of the current, to make the cylinder swing through 90°. A current of fifteen amperes swung it through a foot and a half of the scale. It would come to rest at about half the distance of the greatest amplitude of the swing, for each different current employed, and therefore showed the continuous action of the torsional force for a constant current. If this be the interpretation of the phenomenon, then the molecules are rotating when there is a constant current, and thus the explanation of the heating effect of the current, is brought back to dynamical and mechanical principles. Adjacent molecules must be rotating in opposite directions at their point of contact, but this vibrating or heat motion, necessitates more or less separation, when such rotation goes on; on impact it is arrested so there must be impact and slip, impact and slip, the arrest of motion being the immediate antecedent of the heat, as is friction in any case. These experiments have not been carried out quantitatively for lack of facilities. Maybe the interpretation is wrong, and some wise one who knows all about it, can point out its inadequacy. I think the experiments are new, and may lead to an understanding of what goes on in a conductor when a current of electricity traverses it, if this be not the whole of it.



FIGS. 1 AND 2. NOTE ON THE MOLECULAR MOVEMENT IN A CONDUCTOR.

1. Read before the American Institute of Electrical Engineers, New York, February 16, 1892.

Discussion.

Mr. Mailloux: I do not want to have it thought that I am that wise one who knows all about it. Yet, while the paper was being read I could not help surmising that the horizontal component of the earth's magnetism may have had a great deal to do with the rotation. It does not seem to me that the experiment is conclusive until it shall have been tried in different relations with respect to the earth's magnetism, and the effect of different magnetic fields in its neighborhood has been tested. Since the current travels in a vertical direction and the lines of force form circles concentric with its line of motion, it is quite evident that any magnetic field, however feeble, must have some effect upon the conductor. The difference of magnetic potential on two sides of that tube has a different relation to the magnetomotive force of the earth's magnetic circuit. One side would tend to add such portions or elements of its force as are of the same magnetic polarity or direction, while those on the other side being of contrary direction would interpose a contrary magnetomotive force. The effect of that might be to tend to rotate the wire slightly, as well as to translate it laterally.

Townsend Wolcott: Mr. Mailloux's remarks, I think, would hardly apply to continuous rotation. If that tube is perfectly straight and perfectly uniform in resistance, there is no reason for a continuous rotation, but if that tube is crooked it might revolve partially. The reason I take this view of it is that somewhat more than a year ago I saw an experiment tried which was supposed to upset one of Maxwell's experiments; that is, a current going through a straight vertical wire, and when I examined the apparatus I found the wire was not straight. In the experiment of Maxwell it was proved that there was no tendency to rotate magnets. If you place two or more magnets with the similar poles toward the vertical wire and pass a current through it there is no rotation, that is, on the assumption that the wire is straight. The gentleman who tried the experiment, in order to show that there was some rotation kept commutating the current, just as Prof. Dolbear mentioned. In that way he succeeded in amplifying the swing so that it showed a very considerable amount. It seems there was not a complete revolution in this experiment. With the very long suspension mentioned in the paper it seems to me you ought to get at least one revolution if the torque was of any account whatever.

Mr. Kennelly: Without pretending to make any remarks as to whether this action observed was really due to the cause that Prof. Dolbear has suggested, I merely desire to point out that if that particular cylinder did turn it is reasonable to suppose that another cylinder inside, concentric with it, would also independently turn, a third one within that would also turn, and so on. Now, if they would each and all separately turn, surely when they were united in one solid mass the whole mass would revolve, and I think it is very strange that if such an action would take place a solid rod of copper pivoted upon its axis should not have been observed to rotate when a current passes through it independent of all magnetic forces.

Dr. Pupin: I would like to call attention to an experiment made some years ago by Prof. Braun, of the University of Tubingen (Braun, F. Deformationsstrome, Wiedemann's Annalen, vol. 37, pp. 97, 107; vol. 38, p. 53; vol. 39, p 130). He found that a wire made of a magnetizable substance, when twisted one way will generate an electromotive force acting in one direction, and if twisted the opposite way it will produce an electromotive force acting in the opposite direction. Prof. Rowland called my attention to a current interrupter constructed on that principle where a twisted wire is made to untwist by sending a current through it Perhaps the phenomenon observed in Prof. Dolbear's interesting experiment may be due to a similar cause.

Harold Binney: I think there is a third point not brought out, and that is, the effect of the bails. It seems his (Dr. Dun's) experiments were not conclusive, as he used currents first in one direction and then in the other. It is clear that the current in passing downward would go more in one bail than in another, owing to its tendency to lateral shifting in the magnetic field. In that case, in starting to go downward, it would, let us say, go more in the right hand bail, and if that bail were not exactly perpendicular to the lines of force it would tend to shift it across the field of force and so cause rotation. Then when the current was turned in the opposite direction, if properly timed to the period of the apparatus, the twist would be in the same direction as the swing, although it would flow through the other bail, and these infinitesimal impulses properly timed well might cause appreciable rotary oscillations. This may have something to do with the phenomenon observed and is not based on the supposition that there was lack of symmetry in the apparatus. Fig. 3.

The Chairman [Vice-president Crocker]: I should expect a lack of symmetry there, as Mr. Wolcott suggests. If one side was a little thicker than the other, the current would be stronger on that side. That would throw it out of balance and cause rotation, but if it were perfectly symmetrical, according to our present knowledge of electric currents, there would be no tendency to rotate.

Mr. Mailloux: I think it would be well to call attention to the fact that a wire or a cylinder situated as that is in the earth's magnetism would have present in it Hall's phenomenon, that is to say, the current would not be distributed equally throughout the mass of that cylinder. It would be unequally distributed by the very fact that it was placed in the magnetic field not symmetrically related to the flow of current. That effect, though it might be slight, would further complicate the case and might be in itself a partial explanation of the peculiar actions observed.

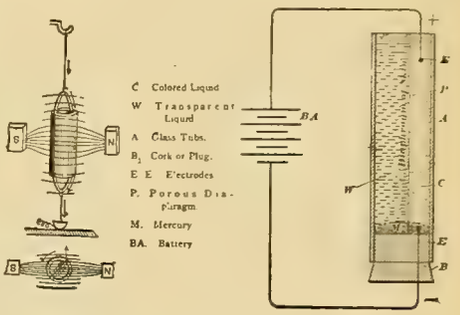
Mr. Wolcott: I think the whole effect is entirely too small to be noticed there. It will be remembered that Mr. Hall looked for the effect some time before he found it himself, with the very best apparatus

Dr. Samuel Sheldon: Prof. Hall used, I think, between forty and fifty amperes, passing through an ordinary university pattern of the Ruhmkorff magnet, and then used a Thomson reflecting galvanometer of the ordinary pattern and even then obtained a very small deflection.

Carl Hering: Some interesting results might be obtained if that conducting cylinder were surrounded by a fixed iron cylinder. This would shield it from the earth's field, and if the motion was due to the magnetic lines circulating around that conductor, the effect should be increased, because of the iron cylinder, which increases these magnetic lines.

The Chairman: It certainly can be said that this experiment is only suggestive and not at all conclusive. There are a great many possible things that might cause this rotation other than any molecular action, such as Prof. Dolbear suggests. He evidently thinks that it is open to suspicion, and I think it would have to be carried very much farther before it could be accepted as one of the phenomena of nature.

Chas. J. Kintner: I suggest a modified form of the apparatus which perhaps might bring about the results that Prof. Dolbear seeks. Instead of a metallic cylinder, suppose we take a light glass cylinder, Fig. 4, and attach in some way a porous diaphragm through the center thereof, with mercury at the bottom and a wire running upward into the mercury, connected at one pole of the generator, and with a conductor running from above into two liquids, a colored liquid on one side of the diaphragm and a perfectly transparent liquid on the other If there be any tendency to molecular movement there, I think it is possible the colored liquid would be forced to rotate through the diaphragm and mix with the transparent liquid.



FIGS. 3 AND 4. NOTE ON THE MOLECULAR MOVEMENT IN A CONDUCTOR.

Transformation of a Cable Road.

Building cable railways in cities, and then replacing them with the more efficient electric system, is a costly experiment, as the following from the *St. Louis Globe-Democrat* will show:

In about thirty days the curtain will go down upon the last act of that magnificent but costly experiment which was formerly known as the St. Louis Cable and Western Railway. For three weeks workmen have been busy tearing down and removing the great wheels and cable machinery which have stood in the old power house at Channing and Franklin avenues since 1888. It will take a month to complete the work. When it is done the last vestige of the equipment of the old road will have disappeared except a few cars in the car-house beyond Vandeventer avenue. It will be remembered only as a victim of the relentless progress of electricity, which has driven it out and replaced it.

The road was not only the first one in the city to be operated by one of the new methods, but it was, in some respects, unique. This was particularly true of the iron conduit through which the cable ran. At the time when it was laid, cast iron was worth about three times as much as its present price. The projectors of the road believed that they could find a cheaper material. They therefore conceived the novel idea of using wrought iron. In carrying it out, rails were melted and forged into the shape of the yokes, joined sections of which formed the conduit. The plan proved expensive in the end. Over 3 000,000 pounds of iron went into the conduits and tracks. It cost somewhere in the neighborhood of $150,000. The other day it was sold by weight to Col. Hirsch for about $30,000. It was fit for nothing but to be shipped away, melted up, cast into pigs and billets and sold again as raw material. But the road had, for the time, the distinction of being the only one in the world with a wrought iron conduit.

While it was run on the cable system, the road used more cables than any system of equal length in existence. This proved another very costly feature. The life of a cable on most roads averages about nine months. The Cable & Western company found it necessary to put a new one down every five months. Each cable weighed from thirty to forty tons. The average price was 12c. a pound. Thus, the cost of cables alone reached about $20,000 a year, to say nothing of the cost of transporting and laying them. The number of very sharp curves in the line served to wear out the cables with distressing rapidity. Each cable is composed of a number of interwoven strands of

fine wires not more than a sixteenth of an inch in diameter. The strain on the curves was too much for these. When the cables wore out they, too, were useless, except as old steel. They were sold to the iron dealers for 3c. or 4c. a pound.

When electricity proved successful as a motive power and proved so much cheaper as a means of operating, it became evident that the only method of successfully running the road would be by discarding the cable system and adopting the electric. In this respect the road is also unique. It is the only one in the world which has been completely torn up from end to end and replaced with an entirely new equipment. At the present time the only things used on the road that were used under the cable system are the two engines which ran the cables and now run the dynamos, with the help of two new ones. For some time after the transformation of the road the immense drum wheels, fly wheels and other machinery lay idle in the Channing avenue power-house. Under the new system it was useless. Finally it was sold to the original builder, the Walker-Manufacturing company of Cleveland, O. Under its direction the work of removing it is going on. The great weight of the pieces necessarily renders it very slow. The great fifty-ton fly wheel has to be handled with the utmost care, notwithstanding the fact that it is cast in four pieces. The immense drum wheels have been partially moved with a derrick and pulleys. The outer rims, in which the cables formerly turned, have been carefully removed. The frame work, upon which the machinery rests, contains hundreds of tons of iron, which will be packed upon cars and shipped to Cleveland. Although the machinery was sold at a figure far below its cost price, it is still in remarkably good condition, and will probably be utilized elsewhere for the purpose for which it was originally designed. The thirty-nine old cars of the cable company, stored in the Vandeventer avenue car-house, will probably get into active use during the coming summer. The officials of the road state that they expect a 50 per cent. increase in their business during the heated months, and they expect to be obliged to put on at least a part of the cable cars. Such as are not used will be sold, and then there will be nothing upon the streets to remind St. Louis people that the pioneer cable road of the city ever existed.

Underground Wires in Rochester, N. Y.

The subject of placing electric wires underground has been under consideration in Rochester, N. Y., several months, and a special committee of the common council has been investigating the problem in other cities. The committee's report, which was presented last week, contains the following suggestions and conclusions:

"First—That wires carrying ordinary electric current, such as are in commercial use in this city, can be both successfully placed and operated in suitable underground conduits.

"Second—That all wires on our main streets should be placed in proper underground conduits without delay, and that all of these wires and cables be concentrated in a single conduit on the narrower streets, and in not more than two conduits in the broader streets, one on each side, as near the curbstone as practicable.

"Third—That the proposed conduit, when constructed, should be of sufficient capacity to meet all probable or reasonably possible future contingencies, as well as to accommodate all existing circuits.

"Fourth—That the conduits should be of such material and so constructed that the necessity for tearing up the pavement in order to make repairs should be almost an impossibility during a reasonable term of years, and that, in their construction, provision should be made for the use of single ducts for any wire carrying a current of 500 volts or over.

"Fifth—That an ordinance be passed governing the use and management of such conduits.

"So far as we have been able to ascertain, but few cities own any portion of their conduit systems, although it is obvious that municipal ownership and control of all such constructions would be for the best interests of the community. To accomplish a similar end certain cities have licensed private corporations to construct large conduits for the concentration of the wires and cables of the various electrical companies, and to collect an equitable rental from the latter for the use of the ducts. In other cities electrical corporations have been permitted to construct and operate conduits for their exclusive use and benefit. It will thus be seen that there are three methods of accomplishing the burial of electrical wires within the corporate limits, each of which has advantages and disadvantages. In cities where the rate of taxation is low and the public debt small, it would no doubt be wise for cities to construct and maintain the subways, deriving therefrom a revenue as well as protecting in a proper manner the various electrical interests operating within their limits. On the other hand, it is quite evident, from what we have seen and know of the licensed general conduit business, that good results can be obtained by granting a reasonable franchise to a reliable company which shall construct, operate and maintain a general conduit under the direction of the city authorities. As to the method of granting permits to the various individual corporations to construct and maintain separate conduits, your committee considers it inadvisable, it being evident from the experience in other cities, that it creates a multiplicity of conduits, and never results in a uniform and satisfactory system of underground service. Our local conditions are such that to place more than one conduit, containing the necessary number of ducts, on each side of the street, would seriously interfere with our gas and water mains. Furthermore, at this age of electrical development, it is altogether probable that additional telephone, light and power circuits will be inevitable, which strongly emphasizes the necessity of having proper conduits constructed under one of the conditions first named."

The Last of the Great Eastern.

In view of the fact that the Great Eastern, the largest ship ever built, has but recently been broken up, some facts about the career of the vessel that was so intimately connected with the laying of the first Atlantic cable will be read with interest. The information is taken from the *Engineer* of London:

The dimensions of the ship were as follows: Length, 693 feet; breadth, 83 feet; breadth over paddle-boxes, 120 feet; moulded depth, 58 feet; gross tonnage, 22,500, registered tonnage, 13 335. She was built throughout of the best quality Lowmoor iron. The interior of the ship and the cellular hull were each divided into eleven separate water-tight compartments. The holds below the lower deck contained the machinery, boilers, stores and coal; and the upper part, three tiers of decks all fore and aft, was appropriated for passengers, the lowest of these decks being about 6 feet above the water-line. The cylinders of the oscillating paddle engines were four in number, 74 inches in diameter, 14 feet stroke. The paddle-wheels were 56 feet in diameter, and steam for these enines was supplied from four double-ended tubular boilers, containing 39 tons of water, and provided with 40 furnaces. The chimneys were only 6 feet in diameter, but being 100 feet high above the grate bars, there was an excellent draught. The cylinders of the screw engines were also four in number, 84 inches in diameter, 48-inch stroke. The propeller was four-bladed, 24 feet in diameter. Steam was supplied to these engines by six tubular boilers with 60 furnaces. The working pressure was 25 pounds per square inch. Her calculated speed was 15 knots per hour. She was designed to carry 4,000 passengers. 5,000 tons of cargo, and 10,000 tons of coal, and if fitted up to carry troops alone she had accommodation for 10,000. The total weight of ship and engines was over 12,000 tons, and when fully laden with passengers, cargo, and coal, she would weigh 27,000 tons, and be at a draught of 30 feet. She had five funnels and six masts.

Immmediately after the formation of the Telegraph Construction & Maintenance company, with John Pender as chairman, its directors offered to make and lay an Atlantic cable. The Atlantic Telegraph company accepted their terms, and a contract was signed on May 9, 1864 The Great Eastern was chartered to carry the cable; and on July 15, 1865, left Sheerness for Valentia under the command of Captain James Anderson. Samuel Canning was in charge of the expedition, and Mr. de Sauty was at the head of the electrical department, having Mr. Saunders as chief assistant. Prof. Thomson and C. F. Varley represented the Atlantic Telegraph company, and Willoughby Smith the Telegraph Construction & Maintenance company. On Sunday, July 23d, the shore-end and intermediate having been laid by the Caroline, and splices effected, paying out was commenced at six in the evening. As the cable was paid out several faults were discovered and remedied. On August 2d, while picking up to recover a fault, the cable fouled the ship and parted, 1 214 knots having been paid out at that time. After nine days of fruitless endeavors to regain the cable the Great Eastern was headed for home, and on August 20th anchored off Sheerness. A new length of cable was forthwith commenced, and on March 1, 1866, a fresh agreement was signed. On June 30, 1866, the Great Eastern left the mouth of the Thames again, under the command of Captain Anderson; and among those on board were Cyrus Field, Daniel Gooch, Philip Rawson and Captain Hamilton. On Friday, July 13th, paying out commenced; and on Friday, July 27th, the Great Eastern ran into Heart's Content Bay, and the first Atlantic cable was laid.

In 1868 the Great Eastern laid a telegraph cable from Brest to St. Pierre; in 1869 an Indian cable; and in 1871, 1872 and 1874 she successfully laid other Atlantic cables, and thus closed the mercantile career of the largest vessel ever floated, without even an attempt at the voyage to India, for which she was designed and built, at a cost of £750,000.

Milford Haven was her final resting place, and there she lay idle for twelve years. From 1885 to 1888 she was chartered as a show ship, and visited Liverpool, Dublin and Greenock In 1888 the owners, Bath & Sons, Swansea, decided to break her up at Liverpool, and sell her as old metal. On November 20 to 25, 1888, every piece of timber, rope, metal and furniture in her was sold by auction. The process of breaking up lasted until September 20, 1891.

Electric Railway Patents.

The financial columns of the Pittsburg *Chronicle-Telegraph* of March 22d contained the following remarks regarding street railway patents:

"It is a matter of general interest that Pittsburgh parties claim to have an important hold upon the electric railway industry by the ownership of a control in the Finney overhead conductor patents. The latter received a practical test in Allegheny City nearly ten years ago, and it is said that they fully cover what is generally known as the overhead trolley system. A gentleman who keeps track of electrical matters said to-day:

Before the Thomson-Houston company bought the patents of the Van Depoele company, active negotiations were opened by the latter with the owners of the Overhead Conductor Electric Railway company, to which had been assigned the Finney patents, with the view of making some arrangement to avoid a conflict with the trolley inventions of Finney, the patents for which had been allowed with sweeping claims after protracted interference proceedings in the patent office. Efforts were made by parties connected with the Thomson-Houston and the Sprague (Edison) companies to secure licenses under the Finney patents from the Overhead Conductor company and liberal royalties were offered in the interest of both concerns for such licenses, thus practically conceding the importance of the inventions. Some of the minority holders in the Overhead company have been seriously objecting to the Westinghouse interests, which hold the majority of the stock, for refusing to grant licenses to the Thomson-Houston and Sprague companies. The Westinghouse people claim, however, that the value of the patents has been greatly enhanced by the development of the business, and that every overhead arrangement now in operation in the United States is in direct violation of the claims of the patents, and that the course adopted of not granting licenses until the full value of the invention is developed is a wise one.

"The broad character of the Finney invention is shown by the two following claims from one of the patents: 'I. The combination, in an electric railway, of a battery or other generator of electricity, an overhead main conductor a branch conductor connected to a car, and having a traveling contact with the main conductor, an electromotor mounted on the car, and power transmitting devices connecting the motor shaft to the wheel or axle of the car. 2. In combination with a car motor operated by a branch circuit from a main circuit, an adjustable resistance placed in such branch circuit and regulated by a lever or equivalent device placed on the platform or other accessible part of the car, substantially as and for the purpose described.'"

Shocks from Trolley Wires.

A St. Louis man has brought suit against the Lindell Railway company for $3,000 damages which he claims as compensation for injuries sustained by a shock received in an electric car. One of the witnesses for the defense was Prof. Nipher of the Washington University. A *Globe-Democrat* reporter took advantage of the occasion to secure the following interview on the subject:

"When one talks of the dangers from electric wires one should specify conditions. If a man lies down on a wet railway track and the trolley wire then falls down upon him and stays in contact with him for half an hour, he would be very likely to get serious injury. It would be tempting death to make such an experiment. If he were to stand upright on the track and get a contact from the trolley wire on his hand he would receive a shock which would be very unpleasant. It would be like a blow in the face from some man's fist. No person wishes to get such a shock, but there is no real danger to a healthy person. To a person about to die from heart disease such a shock might result in instant death. If a person stands on the ground at a point where one steps from the car the shock would be still less, and if the ground was dry would be wholly inappreciable."

"Then there is really no danger in the trolley wire?"

"The worst shock which one could get from a trolley wire, if he were to stand with wet shoes on a wet rail of a track, touching the trolley wire with his hand would not be dangerous; but it would be unpleasant. I do not say a man might not be killed if the wire were to be thus in contact for a long time. You could kill a man with your fists by pounding him all day The dangers to passengers in an electric car which is in the worst possible order are not worth considering. There is no danger of even a burn. A passenger can only make contact with the ground with his feet and with some metal part of the car with his hands. The resistance of the whole body protects him from serious danger. The slight shocks that one may get within a car which is very wet are not in the least dangerous. I should pay no more attention to them than to sparks from woolen underwear."

"Casualties among employes of electric lines are often reported; how do you account for them?"

"Of course employes, and the line men in particular, of an electric railway are frequently in circumstances entirely different from those of a passenger. The extra risks they take are well known to them. So far I have not heard of a single human death from a 500 volt trolley wire. This voltage is now in universal use, because it was thought best to sacrifice economy to considerations of public safety. Horses are much more likely to be killed by wires than men, because they are shod with iron shoes, the nails of which often lead the current into the soft tissues of the foot. Then again they have on the average less intelligence, and flounder into entanglement with wires which a man would avoid. They throw themselves, and thus maintain often a long contact, which would do no harm if kept up for a second and might prove fatal in ten minutes."

Electric Cooking.

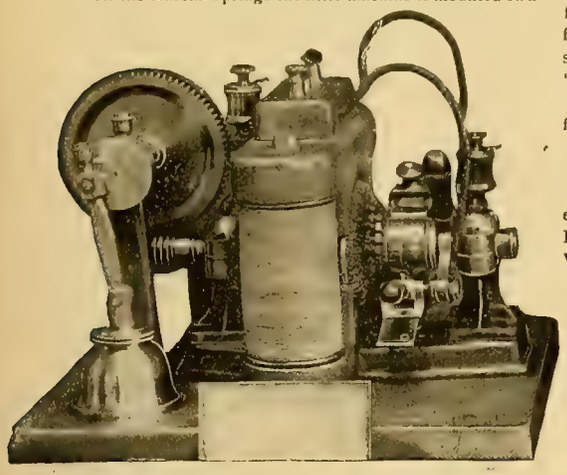
Cooking by electricity is becoming, as we prophesied, quite the fashion. We notice that the proprietor of the Eldon Dining Hall and the Pine apple Grill at Newcastle-on-Tyne has had trials of this novelty in cooking. At the former place on Friday some cutlets, and at the latter on Saturday a thick chop, were cooked by this new process—the cutlets in 7 minutes and the chop in 14—to the entire satisfaction of the manageresses and chefs. We believe electric cookers are being fitted in several of the West End flats in London. They deserve to be widely adopted. Mr. Dowsing's demonstrations at the Crystal Palace will greatly foster this cleanly and easy method of every day cooking. —*London Electrical Engineer.*

It is said that the world last year paid nearly $450,000,000 for its telegraph messages.

Duplex Motor and Pump Combination.

About a year ago the Duplex Electric company, limited, of Corry, Pa., placed on the market an electric pump that possessed a number of valuable features. One of these machines was immediately installed at the Eureka mineral springs at Sagertown, Pa., and has been in service ever since. The motor used in the Duplex combination is a ½ horse power.

At the Eureka Springs the little machine is mounted on a

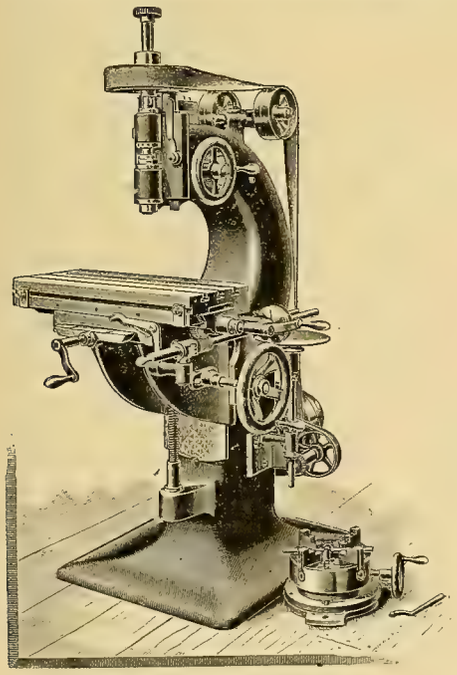


DUPLEX MOTOR AND PUMP COMBINATION.

stone pedestal, about five feet high, in an open pavilion. It is run by a storage battery beneath the floor. As the connecting wires are run through the pedestal, and as there is an entire absence of spark it has the appearance of a perpetual motion machine. When in operation it draws water from a depth of about 14 feet and throws one gallon per minute into a tank 150 feet away and 22 feet from the ground. The motor is wound for 110 volts and runs at a speed of 1,200 revolutions per minute, the armature shaft being geared to that of the pump in the ratio of 20 to 1. The entire floor space occupied is 16x18 inches. In this combination and in all of its motors and generators the Duplex company uses no rheostats.

Becker Vertical Miller "No. 3."

The spindle in this machine is mounted upon a vertically sliding head, having a motion of four inches, with means for locking it at any desired point within the limits of its



BECKER VERTICAL MILLER "NO. 3."

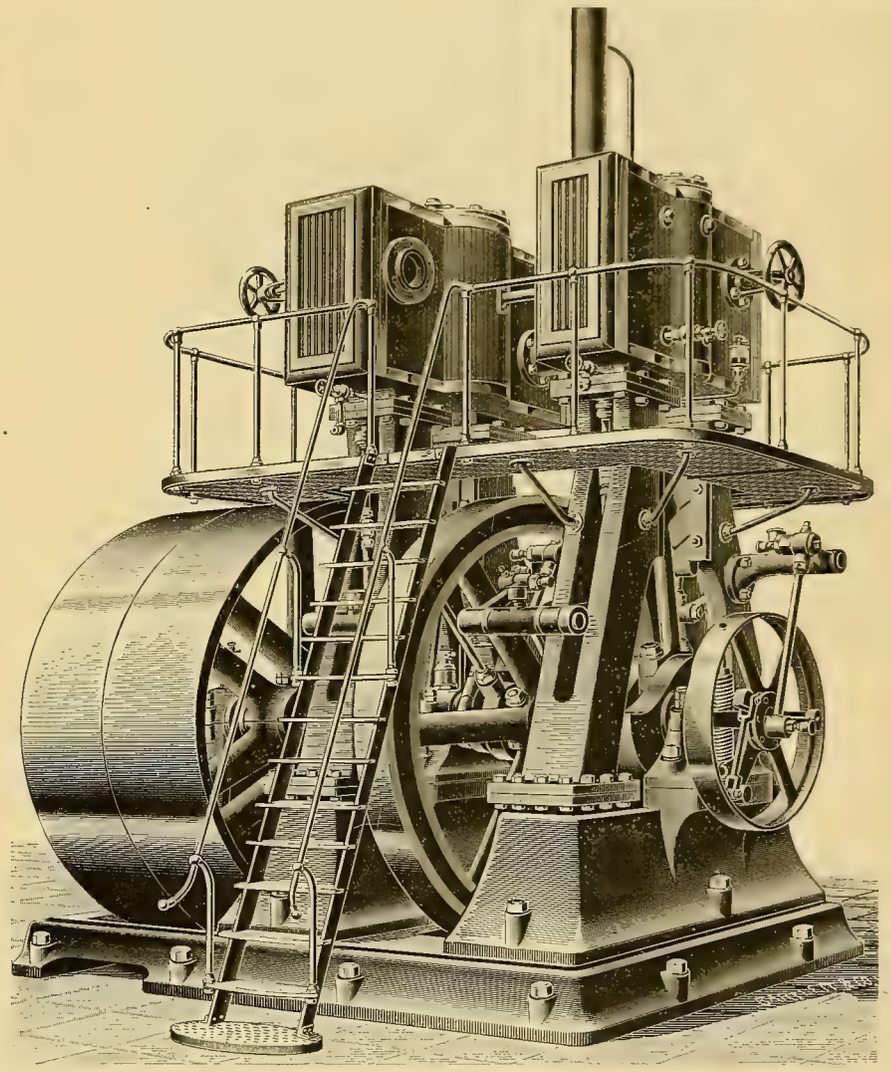
movement. It is made of tool steel, and is hardened and finished by grinding. Tools are fastened by means of a draw bar passing through the center of a spindle having a threaded end to receive either the shank of an end mill or a split collet. The driving pulley of the spindle is independently mounted upon an adjustable roller bearing. The spindle passes through its splined hub, the latter riding upon two wide faced rolls upon which the entire belt pull is taken, thus relieving the spindle and its bearings from the usual wear in one direction, and keeping it constantly in alignment and perpendicular with the platen. The spindle being therefore free from belt pull, can be run at extremely high speed when the nature of the work requires the use of delicate cutters of small diameters. The sliding head receives its motion through a hand wheel powerfully geared, and is also provided with an adjustable stop gauge.

The platen has a lateral power feed of 16 inch; cross feed from face of column, 11 inches, and also above face of column 13 inches. It is provided with three T slots. The feed is derived from a friction disk, which gives a variable feed right or left hand, from nothing up to any desired speed. The rotary attachment has fitted to it a nine inch "Whiten" chuck, and is rotated by means of a worm gear.

This miller is manufactured by the John Becker Manufactu ing company, Fitchburg, Mass.

The Hammond-Williams Engine.

The accompanying cut shows the standard compound engine built by the Lake Erie Engineering Works, Buffalo, N. Y., and handled throughout the West by W. B. Pearson & Co., Chicago.



THE HAMMOND-WILLIAMS ENGINE.

From the clear illustration presented there will be but little difficulty in discovering the many excellent points in the design of this engine. A few words though, as to the most important features will not be amiss. The steam distribution to each cylinder is effected by means of four light flat, double ported and perfectly balanced valves, the exhaust valves being controlled independently from the steam valves, and giving different degrees of cut-off and compression. The clearance is cut down to as low a point as is consistent with necessary compression. The receiver is located between the cylinders.

The steam valves on the low-pressure cylinder have a peculiar, quick motion, caused by an eccentric operating through the intervention of a set of rocker arms. This arrangement gives a sharp cut-off on the low pressure cylinder.

The speed of revolution of the engine is regulated by means of a shaft governor. All are aware of the necessity for good regulation in any engine under sudden changes of load, and especially in electric railway work. The steam valves on the high pressure cylinder are controlled directly by this shaft governor.

There has been a question raised as to the possibility of governing the speed of such a large unit as this engine represents, by means of a centrifugal shaft governor so arranged that it could move the valves direct and yet be sensitive to changes of load. That this is possible is shown by the fact that this engine is operated in this very manner, and varies only by ½ revolution in a change of load from 360 to 700 amperes. The governor itself is very sensitive having only one weight, two arms and four pivoted joints.

The details of the engine have been very carefully worked out. The cross head slippers are babbitted and set out by means of liners instead of wedges. The cross-head is forged solid on the end of the piston rod. The crank end of the connecting rod is of the standard marine type and the cross-head ends are forked. All bearings are babbitted, and in the case of the main bearings have cast iron babbitt-lined shells, around which water may be circulated to prevent serious trouble in case of overheating. The back of the slides is also water-jacketed.

The lubrication of the different parts is effected by means of grease instead of oil; it is distributed in pipes by pressure from a central reservoir, very much like an accumulator in a hydraulic plant, the grease being forced to every part on the engine and controlled in amount by stop cocks at each bearing.

While the above are but a few of the strong claims made for the Hammond-Williams engine, sufficient information has been given as to the best points, to enable central station men to see that W. B. Pearson & Co. are pushing a machine possessing features worthy of the most careful consideration.

Search Lights in Balloons.

If recent cable dispatches from Europe are true, the Germans appear to have solved the problem of aerial navigation, to a great extent, at least, and, according to the story, there are no toy balloons used, but powerful air-ships of sufficient lifting capacity to carry material for brilliant search lights. A recent telegram says:

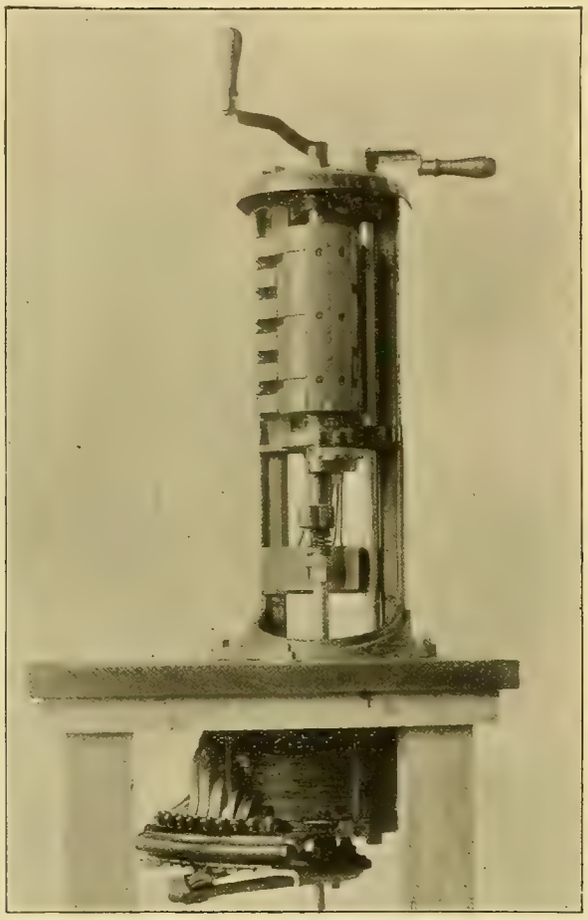
A few nights ago the inhabitants of Warsaw were startled by an intensely bright light that fell from the sky upon their city. All eyes were turned upward, but nothing could be seen save a path of light that ended in

small focus. Many people in their excitement thought it was a comet in close proximity to the earth and were greatly frightened. Suddenly the ray of light swept in another direction, and when their eyes became accustomed to the darkness that followed, they could see far up in the sky a balloon. Then it dawned upon the people that it was an electric search light that had caused the brilliant illumination, and that the Germans were continuing their observations of Russian defenses with its aid. The balloon remained over the city until 1 o'clock in the morning, when the light was extinguished and the balloon, heading westward toward the frontier of Prussia, disappeared.

New Edison Car Controlling Switch.

The Edison General Electric company has devised a new type of street car controlling switch, which it intends shall take the place of the present platform switch for equipments of large motors of 25 horse power and upward.

The cut shows the general details of the switch and the arrangement of the parts. In starting the car the switch



NEW EDISON CAR CONTROLLING SWITCH.

handle is turned from the position marked "off" with a "counter clockwise" movement; this has the effect of carrying the arm of the rheostat placed under the switch around on its contact segments, and the resistance is gradually cut out of circuit. After this arm has been carried around so that all the resistance is cut out, it is released from the cylinder shaft and left locked in this position. Further movement of the handle then affects only the cylinder and commutates the field magnet coils of the motors from series to parallel in the usual way.

In stopping, the field coils are turned from parallel to series, the resistance coil is then again put in circuit, and finally the circuit is broken by the contact lever on the last segment of the resistance coil, and not, as formerly, upon the cylinder contacts. The only caution to be observed in stopping is to see that the switch handle is turned to the position marked "off." As the motors are reversed by means of a separate lever operating a reversing switch placed under the car, the reversing lever is connected to a shaft separated from the cylinder shaft, but interlocking with the cylinder shaft in such a manner that it is impossible to reverse the motors until the cylinder shaft is in an "off" position. The cylinder plates and contacts are made of thick iron stampings, as experience has shown that iron is a better material to use than the brass used hitherto. It has been found that sparking does not burn the iron as much as the brass, and a greater certainty of good contact is therefore insured. The rheostat is of the regular circular pattern resistance coil, which has been in use for some months past as the standard slow starting device. This rheostat is protected by a galvanized iron case, made to suit different car constructions. When fitting the switch it should be placed with a sheet of iron and a layer of asbestos between the rheostat and the car floor. This will prevent any danger from fire either from heating or sparking in case of accident to the rheostat.

The current from the trolley wire first goes through the field coils and switch cylinder for commutation, then through the armature and reversing switch, and thence through the switch contact lever and resistance coil to ground.

Only six wires are run to the platform switch; these are the field magnet wires. The three wires running to the reversing switch are of the same size as the regular armature wires, as is the wire between the metal terminal of the reversing switch and the contact lever of the rheostat. When fitting switches to cars already wired, the cables in use can be utilized, but the terminals of the wires left idle should be well insulated.

Electric Power in Agricultural Work.

To the Editor of the WESTERN ELECTRICIAN:

Senator Peffer of Kansas has introduced a bill to establish an electrical station for the purpose of investigating and determining whether electricity can be profitably used and applied as a motive power in the propulsion of farm machinery, and this bill has been referred to the committee on agriculture.

At this time the possible use of electrical power in agricultural work is a matter of great interest in the West. The plains in this section of the country are vast in extent, level and free from obstructions to the plow, and are adapted to the production of grain, but are, to a large extent not utilized as yet.

To plow one acre seven to eight inches deep requires the turning of about 1,000 tons of earth. The only power now available in cultivating the great prairies is animal power. The steam plow was in use eighty years ago. It is still practically unavailable in field work. It seems improbable that it can ever become generally useful in such work, although efforts to use it will be repeated in Kansas this season. The farmers of the West see the electric motor displacing horses in street railway work, and they see it finding new and extensive uses. Its light weight and simplicity seem to favor it as an agricultural motor. The work to be done is simply to drag a plow or other implements across a field and back again. If electric power should cost quite as much as animal power, still it may perform work much cheaper. In the West it is not considered advantageous for one man to drive more than two, or three, or at most four, horses. One motor man may control 25 horse power and thus perform work more cheaply. In Kansas unskilled manual labor may be rated at a cost of twelve and one-half to fifteen cents per hour; horse power, at six to seven cents per hour. Slack coal is worth $2.40 per ton; unscreened coal, $4.50 per ton. Perhaps, therefore it is not impossible that electricity may come to the farm, that the Western agriculturist may yet switch the current into his motor and harvest his grain.

A. A. DENTON,
Assistant in Charge Sorghum Experiment Station, U. S. Dept. Agriculture.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 2.—Electrical executions are becoming everyday affairs, at least to the newspapers in New York. Now that the reporters are allowed to witness the fascinating proceedings, the scribes have no need to use the imagination to obtain the "only account." We get facts now, and in spite of the natural and justifiable repugnance of electricians to seeing their beloved art applied to such barbarous work, it will have to be admitted that from the standpoint of a spectator there are more horrible deaths than the electrical. The execution of Murderer Cotto on Thursday seems to bear evidence of this fact. Your correspondent did not witness the execution—he is not interested in electrical engineering of this sort, so he took good care to be elsewhere. But from all accounts, it was a perfect success. "Five currents killed him," said the *New York Times*, and death came apparently without pain. The *Times* mentioned a fact which, if it is so, is a curious one. The statement was made that the rush of the electric current through the body heated it very much. According to the newspaper one of the physicians drew up the lid of the dead man's eye to touch the eyeball for signs of nervous excitement. When he touched the eye it was like a ball of hot glass. The body was heated through, and this caused considerable comment on the part of the physicians. Little has been noted of the other victims of the death chair in this respect. The bulb of the thermometer was placed on Cotto's thigh some minutes after the body had been taken from the chair, and the temperature was 160°. I give this statement for what it is worth.

The Brooklyn surface railroad companies are pushing their electrical work at a rapid rate, and everything indicates that the overhead wires will line all the principal streets by the time the open cars are put on. Gen. Slocum is the first one to get his trolley cars into the city proper, and he is now operating them up Fifteenth street from the city line and along Ninth avenue to Ninth street. He has also erected the poles along the latter thoroughfare as far as Fourth avenue, and has wires strung on them part of the way. The Atlantic Avenue company has contracted with the Westinghouse Electric & Manufacturing company for motor equipments for one hundred cars, each carrying two 30 horse power motors. Fifty equipments are to be delivered before the 15th of June next, and fifty more by the 1st of October, the railroad company reserving the right to call for the necessary equipments, with the same size of motors, for two hundred additional cars. The Atlantic Avenue company has also contracted for two 400 horse power and two 700 horse power generators, making a total of 2,200 horse power, which are to be delivered and put up by the 1st of July next. The railroad company has the right to call for additional generators on the same terms. The motor cars used will be from the St. Louis Car company, and will be mounted on "No. 4 B" trucks, made by the Peckham Motor Truck and Wheel company. The question of boilers and engines is still under advisement; but the power station is being prepared as rapidly as possible for their reception and erection. The Pennsylvania Steel company has the contract to furnish rails and other material for straight and special track construction for ten miles.

The telephone company had its hearing at Albany last Thursday. Joseph H. Choate appeared before the assembly committee on gas, electricity and water, as counsel for the Metropolitan Telephone company against the Telephone Subscribers' association, which is aiming to establish a commission to regulate the telephone business in cities of over 500,000 inhabitants. The committee in executive session decided to lay the bill over until next week.

W. F. O.

Milwaukee, Wis.

MILWAUKEE, April 2.—The auditorium of the new Unitarian church, a handsome gothic structure which has just been completed, will be illuminated in a novel manner. The ceiling follows the lines of the roof, to preserve the gothic style, and it is spanned with heavy trusses, which are ornamented with perpendicular tracery. On the face of these trusses incandescent lamps are to be strung, in place

of chandeliers, and it is thought that when the lamps are lighted the effect will be brilliant and unique, as there are six trusses, and forty-two incandescent lamps are to be strung on each. The Unitarian church is the first one in Milwaukee to put in electric lights throughout. Several churches have electric plants for their organs, but none has even proposed to put in a general electric lighting plant.

Chief Foley, of the fire department, proposes to expend $23,337.73 in improving the fire alarm telegraph system this season. There are 47 miles and 2,888 feet of single conductor cable under ground, and the overhead service consists of 288 miles of wire. The underground service is to be materially increased. The cables, where practicable, will be placed in the telephone conduits. The low stage of water may make it necessary to dig new trenches for the cables under the river at Broadway and at Mason street.

Edward C. Wall is now president and general manager of the Edison Electric Light company, as well as of the Badger Illuminating company. In the Edison company he succeeded Henry C. Payne as president. Though Mr. Wall is now at the head of both companies, and they are Villard concerns, their affairs are conducted separately, and will probably continue to be so. The Badger plant, instead of being consolidated with the Edison plant on River street, is to remain in its present location, and be materially enlarged. It now furnishes 900 arc lamps, and, although its capacity has not been taxed to the full, it is thought advisable to take time by the forelock, and the company is figuring on putting in a lot of new machinery. The Edison company, by the way, is furnishing incandescent lights at a cent per lamp per hour.

In the Circuit Court Linus J. Hall's suit against the Milwaukee and Wawatosa Motor Railway company has been discontinued without costs to either party. Land belonging to Hall was taken for right-of-way of the Motor line, and the jury appointed to assess the damages, rendered a report awarding him $5,700 for one piece, and $6,379 for the other. He appealed from the award, and it is the appeal which has been dropped.

Benj. M. Weil, the real estate agent, has filed his answer in the suit brought against him to recover for stock alleged to have been purchased by him in the Jacobs Electric companies. He denies the principal allegations of Newton S. Murphey, the plaintiff. He alleges that on April 27, 1887, he entered into a contract with Murphey and the late Henry C. Jacobs, whereby they agreed to sell him 250 shares of the stock of the Jacobs Electric company for $25,000, of which amount $13,500 was to be paid down, and the balance in four installments. Of the sum of $13,500 paid them, Murphey and Jacobs were to assign $12 500 to the company. For the same consideration Murphey and Jacobs were to transfer to Weil 250 shares of stock in the Jacobs Electric Temperature Controlling company, it being specified that if the patents were invalid, Murphey and Jacobs were to refund to Weil the sum of $12,500 paid for his stock. Weil charges that Murphey and Jacobs had entered into a conspiracy to defraud him of his money by making false statements. It was represented that each of the companies was incorporated for $100,000, and that the stock was fully paid up. It was also averred that each company owned valuable patents; that applications for other patents were certain to be granted, and that the patents would be fully equal to the Johnson patents. Weil alleges that he relied on these statements, and paid in upwards of $6,500, besides spending in the management of the companies, time which was easily worth $5,000. The stock, he avers, finally proved worthless, and the appliances could not compete with the Johnson patents. The device was thrown out wherever it was put in. Mr. Weil asks for judgment for $12,000 against Murphey.

The floor of a Greenfield avenue electric car caught fire from the motor a few days ago. The car was stopped very suddenly at the corner of Third and Chestnut streets, and the passengers lost no time in getting out. An alarm of fire was turned in, and part of the fire department, as well as the fire patrol and police patrol, hastened to respond. Before they arrived, however, the blaze was extinguished with a few pails of water. The novel fire attracted more than 2,000 people.

A report that some of the drivers on the Milwaukee street railway would strike for shorter hours appears to be unfounded. On the lines not equipped with electricity, it is learned, the men are working about fourteen hours a day. On the electric lines the men are working only eleven hours a day, the time being shortened on account of the more exacting duties and greater responsibility of running electric cars. The hours were formerly the same on all lines. On the horse-car lines the men state that they understand that their hours will be shortened to eleven hours a day, and they are satisfied to allow the present arrangement to remain in force until that time. If the change is not made then, they say, they will indulge in a kick, but they have no present intention of demanding or enforcing shorter hours.

The Milwaukee Power and Lighting company is in trouble. On Monday George Hiles, holder of a mortgage of $28,000 on the company's plant, applied to Judge Gilson, of the Superior Court, for the appointment of a receiver. He alleged that the mortgage was past due; that the company had not paid the taxes on its property, and that it was insolvent. Dr. Earles was president of the company, and the other officers were John J. Kempf and Oscar Altpeter. The company was organized three or four years ago, and its plant, which is valued at something like $100,000, is located on Commerce street. Mr. Altpeter was disposed to criticize the course taken by Mr. Hiles. The first he knew of the proceedings, he said, was when he read about them in the newspapers. The company had been led to believe that Mr. Hiles would not crowd it, and Hiles was scared because Manager Wall, of the Badger Illuminating company, would not buy his mortgage on the plant. Mr. Altpeter declared that the company would pay the loan and that Manager Wall would not get a chance to bid on the plant. Mr. Hiles answered this statement by saying that during the previous week Messrs. Earles, Kempf and Altpeter signed an agreement that they would accept the foreman of the plant as receiver. He never promised, he said, not to foreclose the mortgage. It is true, he said, that he went to Mr. Wall, but it was at the suggestion of Mr. Kempf and Dr. Earles, and with their knowledge. Mr. Wall, after conferring with Mr. Payne, said that they would have nothing to do with the matter.

The minor stockholders in the Milwaukee Power and Lighting company were in a high state of indignation on Tuesday, and they held a meeting in the evening. They aver that the company's affairs have been mismanaged. The books, they say, are in such a shape that no definite information can be secured from them, and they do not know how matters stand. They claim to have discovered that, while they had paid for their stock, the amounts they hold ranging from $100 to $1,000, the principal stockholders have not put their full share of money into the business. They are afraid that they will be frozen out entirely. It certainly looks as though the Badger company would gobble the plant, and thus complete its monopoly. If any money remains from the sale, after Hiles' claim is settled, the large stockholders and the small ones may indulge in a fight for it. It is said by Dr Earles that half of the capital stock of $150,000 has been paid in and that there is no desire to freeze out the smaller stockholders. The company, it seems, had been trying to float $40,000 of bonds in New York, and was negotiating with the Western Electric company, of Chicago, when Hiles took his claim into court. It is said that that company may buy the plant for the stockholders. The company has been financially embarrassed for some time, and reports that a receiver would be appointed were current a day or two before the application was filed. C.

Kansas City, Mo.

KANSAS CITY, April 2.—Electrical engineers representing the Thomson Houston Electric company have been in the city for the last three weeks looking over the Kansas City & Independence Rapid Transit company's line and making estimates preparatory to changing the motive power from steam to electricity. They report the plan as being most feasible, and the company has decided to adopt the system, which will insure rapid transit in fact, and give the people of the two cities the best service possible. The cost of the proposed change will be about $250,000. The plan mapped out by the Rapid Transit company is an elaborate one, and when carried out will make a most complete system for suburban traffic. As soon as the electric system can be introduced, the present dummy engines will be taken off the line except for the handling of freight and for heavy excursion business to Washington Park. Electric cars will be run every ten minutes, and when the excursion business is at its height a five-minute service will be provided. It is proposed to make connections with the Twelfth and Ninth street cable lines, and the trailers on the cable lines will be transferred to the electric cars. This will make a continuous line from the stock yards and the Union depot to Independence, fifteen miles distant, and, with the aid of one transfer, from Kansas City, Kan., and Argentine to Independence. The electric plant for operating the system will be located at Washington Park, about midway on the line. The motors on each car will be of 50 horse power capacity, 25 horse power on each truck. As soon as the business of the system requires it an extra track will be laid for the handling of freight, and the dummy engines will be taken off the electric tracks entirely. The electric plant will also furnish light for Washington Park, and the entire railway will be lighted by electricity during the summer excursion months. The company is also about to secure additional terminal facilities at Independence.

The Inter-state Consolidated Rapid Transit company's system—the elevated road, including a short cable line in this city, is to be changed to an electric line, thoroughly repaired and newly equipped. The estimated expense will be $500,000. Messrs. Jarvis and Conklin of the Jarvis-Conklin Mortgage & Trust company are closely identified with the new organization. R. R. Conklin has been in the East, together with Robert Gillham, engineer, and Judge Hoag, secretary of the old company, and at a meeting held at New York the change was decided upon and the business of the road put into such shape that actual work can be begun at once, even though the formality of taking the road out of the hands of the receiver and placing it in the possession of the new organization be subject to necessary court delays. The new company is not actually organized as yet, but Messrs. Jarvis and Conklin will push the work at once. The plans for effecting the transformation of the road into a modern electric line have already been prepared and accepted. The contract for the electrical equipment will be let soon and actual work will be begun promptly. The operation of the road, it is said, will not be stopped for an hour by the change. The system now includes the cable line in this city on Eighth street, from Delaware to the depot, a half mile, the main dummy line, elevated and surface road, to Chelsea Park; the branch to Edgerton Place, the old cable road to Riverview, now operated by steam, and the electric line from Riverview to Armourdale, all in Kansas City, Kan. Messrs. Jarvis and Conklin are no novices in the electrical railway business. They built the system in Augusta, Ga., and later the one in Ogden, Utah.

The Electrical Construction company of Chicago is seeking a franchise in Kansas City, Kan., for the purpose of building and operating an electric light plant for furnishing electric light and motive power.

The Topeka Rapid Transit Railroad company has been purchased by Topeka capitalists from the Metropolitan Trust company for $250,000. It owns the entire electric street railway system of Topeka and suburbs, consisting of sixteen miles of track.

Carrollton, Mo., will soon have an electric street car line, a franchise having been granted for one, work to begin in thirty days.

The Leavenworth Electric Railway company has been incorporated. It will build and operate fifteen miles of electric railway at a cost of $300 000. The road will be a counterpart of the Burlington, Ia., system, owned by the stockholders of the same company. P.

Detroit, Mich.

DETROIT, April 2.—Although the local railway company and the city officials have been writing a good deal about rapid transit and the daily papers have been urging immediate steps for the relief of residents in outlying districts especially, absolutely nothing has been done in the matter, and the problem is as far from solution as ever. There have been many plans proposed, but it is generally believed that if the city ever gets rapid transit it will be through electric roads. A. S. Littlefield of Chicago is quoted as saying that the street car lines in this city are not laid out right for cable systems, as the lines do not come together until they get near the termini of all the lines, and that consequently "trailers" could not be used. He says that the electric system is the only one that is feasible in Detroit.

The surveying of the electric street car line from Detroit to South Detroit, which is just south of Wyandotte, and about twelve miles from Detroit, has been completed, and the track, it is expected, will be laid by the first of June.

A fine electric light plant has recently been put in operation at the Normandie Hotel, this city, consisting of two separate engines and dynamos. The dynamos were furnished by the Fisher Electrical company, Detroit, and the engines by Fairbanks, Morse & Co. of Chicago. Both machines have an aggregate capacity of 600 lights. One is run at night and the other during the day.

It has been stated in local papers that the Detroit Electric Light & Power company had decided to issue bonds for $350,000, which were to be guaranteed by the Fort Wayne Electic company. This statement is contradicted by the attorney for the Detroit company, who says that no action was taken on the proposition to issue bonds, and that the only deal the company has had with the Fort Wayne company is the settlement of certain lawsuits which grew out of the use of electric towers for lighting Detroit.

Negotiations are pending between the city of Marshall, Mich., and the Perrin estate for the purchase of a large

water power, which is to be utilized for operating a proposed electric plant.

A patient at one of the hospitals in this city is to have the interior of his stomach illuminated by an incandescent electric light for the purpose of discovering, if possible, the cause of an obstruction of the gullet, which prevents any food from entering the stomach. The patient has been kept alive for several weeks by introducing food by a tube through an opening made in the stomach. G.

Indianapolis, Ind.

INDIANAPOLIS, April 2.—An official of the Cincinnati, Hamilton & Dayton railroad recently said that every first-class railroad in the country would soon be equipped with electric headlights on both passenger and freight engines, and train men say that they are becoming almost a necessity. An old engineer says that they are the best preventives of accidents within his knowledge. Railroad men are giving them more attention than formerly. The National Electric Headlight company of this city has seventy of these lights on nine different roads, viz.: Chicago & Eastern Illinois, Vandalia, Cincinnati, Hamilton & Dayton, Indianapolis, Decatur & Western, Columbus & Hocking Valley, Milwaukee, Lake Shore & Northern, Queen & Crescent, Chesapeake & Ohio, and New Monon. Recently the company received an order from the Philadelphia & Reading for lights to be put on the engines hauling the "Royal Blue," said to be the fastest train in America.

Thomas Dillon, superintendent of the Brush Light & Power company, has invented a device to be applied to mast arms by which lamps may be cut out of circuit by lowering the arm. The company intends equipping all poles for the city lighting contract with the new cut-out.

The Brush company is pushing the work of putting in underground conduits, inside the old plat of the city, as called for by city ordinance.

President Frenzel, of the Citizens' Street Railway company, is reported to have said that the company would not extend the electric lines in this city. It has been generally understood that two or three of the more important lines would be converted into electric lines this spring. M.

PERSONAL.

Treasurer J S. Crider of the Washington Carbon company, Pittsburg, spent several days in Chicago last week.

C. M. Giddings, president and general manager of the Sioux City Engine Works, spent several days in Chicago last week.

H. L. Lufkin of the C. & C. Motor company left Chicago for New York on Thursday of last week after having visited Denver and several other western cities.

President C. J. Ives of the Burlington, Cedar Rapids & Northern Railway company, of Cedar Rapids, Ia., registered at the Grand Pacific Hotel, Chicago, on Friday of last week.

George Edensor Dorman, a familiar personality at the Chicago Electric club, has written a letter to the *Electrical Review* of London, on "Transmission from Niagara to Chicago at One Million Volts."

Charles P Gilbert, secretary and manager of the Edison Illuminating company of Detroit, is making an extended tour in the Rocky Mountains and Pacific coast region. He is making the trip for health and recreation, and expects to return about June 1st.

George P Low of San Francisco has been elected president of the California Electrical society and also an honorary member of the Fire Underwriters' Association of the Pacific. Mr. Low is the author of the admirable series of papers on electrical fire hazards read before the latter organization and recently published in the WESTERN ELECTRICIAN.

NEW INCORPORATIONS.

New Omaha Thomson-Houston Electric Light company, Omaha, Neb.; capital stock, $1,100,000.

Citizens' Lighting company, Hempstead, N. Y.; capital stock, $25,000; to manufacture and use electricity for light, heat and power.

Hinton Electric Light & Power company, Hinton, W. Va.; capital stock, $50,000; to furnish light and power; Thompson & Lively, Hinton, W. Va.

Canton Electrical company, Canton, Mo.; capital stock, $4,500; to furnish electric light, heat and power to the citizens of Canton; H. C. Chinn, Canton, Mo.

Lewistown & Reedsville Electric Railway company, Lewistown, Pa., capital stock, $25,000; to operate an electric railway in Lewistown; W. W. Trout, Lewistown, Pa.

Crafton Light & Power company, capital stock, $10,000; to supply light, heat and power by means of electricity; Wm. M. Galbraith, 414 Grant street, Pittsburg, Pa.

Bryan Heights Railway, Bryan, Tex.; capital stock, $25,000; a suburban railway from a point on the west side of Brazos river opposite city of Velasco to Bryan Heights, on S. F. Austin survey, etc., in Brazoria county, and from Bryan Heights to the beach on the Gulf of Mexico, and from said beach to Quintana, to run with either horse, steam or electric power; Bryan & Robbins, Velasco, Tex.

Iona Manufacturing company, Portland, Me.; capital stock, $15,000; to manufacture and deal in electric gongs, bells, batteries, etc.; Drummond & Drummond, Portland, Me.

Syracuse Storage Battery company; Syracuse, N. Y.; capital stock, $300,000; to manufacture and sell secondary or storage batteries; to furnish motive power and electric lighting.

Storm Lake Electric Light & Power company, Storm Lake, Ia; capital stock, $35,000; to build and operate an electric light and power plant; E. E. Mack, Storm Lake, Ia.

Hope Electric Appliance company, Portland, Me; capital stock, $300,000; to manufacture and deal in all kinds of electrical machinery and apparatus; H. R. Virgin, Portland, Me.

Coatsville Electric Light, Heat & Power company, Coatsville, Pa.; capital stock, $25,000; to supply light, heat and power by means of electricity; M. W. Pownall, Coatsville, Pa.

Electric Light & Water company, Hillsboro, Ore.; capital stock, $40,000; to construct and operate an electric light and waterworks plant at Hillsboro; H. V. Gales, Hillsboro, Ore.

Foreign Storelectro company (incorporated in W. Va.), Cleveland, O; capital stock, $1,500,000; manufacturing and selling electrical instruments; Sherman, Hoyt & Dustin, Cleveland, O.

South Side Passenger Railway company, Williamsport, Pa.; capital stock, $15,000; operating an electric railway in the city of Williamsport, Pa.; H. C. & S. T. McCormick, Williamsport, Pa.

Delafield Construction company, Jersey City, N. J.; capital stock, $100,000; to construct, build and equip railways and electric light works; F. G. Dow, 192 Broadway, New York, N. Y.

Buffalo, North Main Street & Tonawanda Electric Railroad company, Buffalo, N. Y.; capital stock, $60,000; street surface railroad from Buffalo to the village of Tonawanda, about six miles.

Johnson's Creek Electric Light & Water Power company, Johnson's Creek, Wis; capital stock, $2,000; to acquire franchises proper for such business; Kirkland & Grime, Jefferson, Wis.

Kenosha Electric Street Railway company, Kenosha, Wis; capital stock, $100,000; to build and operate a street railway in Kenosha and to furnish light, etc.; Cavanaugh & Fisher, Kenosha, Wis.

White Fish Bay Water, Light & Power company, Milwaukee, Wis.; capital stock, $50,000; real estate, building and operating gas works, electric plants, street railways, etc; C. R. Gether, Milwaukee, Wis.

Vallamont Passenger Railway company, Williamsport, Pa.; capital stock, $10,000; operating an electric railway in Loyalsock Township, Lycoming County, Pa; H. C & S. T. McCormick, Williamsport, Pa.

York Manufacturing company, Portland, Me.; capital stock, $500,000; to manufacture and deal in electric lamps of all kinds and apparatus and appliances for the use of electricity; Clarence Hale, Portland Me.

Portland West Side Railway company, Portland, Ore.; capital stock, $600,000; the construction and operation of railways and tramways to be operated by steam, electricity or otherwise; T. A. Wood, Portland, Ore.

O'Neil Crossing Alarm company, Chicago, Ill., capital stock, $500,000; to manufacture, buy and sell railway crossing alarms and electric railway appliances; Frank Higley, 23 Blackstone building, Chicago, Ill.

American Magnetic Boiler Cleaning company (incorporated in West Virginia), Pittsburg, Pa.; capital stock, $150,000; manufacturing electro-magnetic boiler cleaners; D. W. C. Carroll, 94 Fourth avenue, Pittsburg, Pa.

Waddell-Entz company (incorporated in West Virginia), Bridgeport, Conn; capital stock, $5 000,000; manufacturing and selling electrical batteries, dynamos, motors, insulated wire, etc.; Antonio Knauth, 229 Broadway, New York, N. Y.

Wheeling & Belmont Railway company, Martin's Ferry, O.; capital stock, $100,000; constructing and operating street railroads, to be operated by steam, horse, cable, electric or other motive power, etc.; John S. Cochran, Martin's Ferry, O.

Felt Electric Light & Power company (incorporated in W. Va.), New York, N. Y.; capital stock, $5,000,000; manufacturing and selling secondary batteries, primary batteries, dynamos, motors, etc. Noel B. Armory, 258 West Twenty-ninth street, New York, N. Y.

Palestine Water & Power company, Palestine, Tex.; capital stock, $100,000; supplying water, manufacturing electricity and furnishing same for heat, light and power; manufacturing gas and furnishing same for light, heat and power to the city of Palestine and its citizens, etc; J. W. Ozment, Palestine, Tex.

ELECTRIC LIGHTING.

It is reported that the town of Cuthbert, Ga., will erect its own electric lighting plant.

The Brush Electric Engineering company of London, England, has just secured a contract for furnishing a large arc electric light plant for the city of Worcester, England, for the purpose of lighting the city. There were upwards of ten competitors.

It is possible that the city of Athens, Ga., may purchase and operate the plant of the Athens Gas Light & Electric company.

Mayor G. N. Guthrie of Gallatin, Tenn., is receiving propositions for the lighting of the town either by gas or electricity.

Of $180,000 recently appropriated for electric lights in Chicago, the West Side will get $90,000, the South Side $50,000 and the North Side $40,000.

The Appleton, Wis., city council has authorized the installation of a municipal plant for street lighting, comprising 100 arc lights, steam power and other apparatus.

The Monongahela, Pa., Electric Light company threatens to close its works if the city will not give it a contract to light the streets. The old gas company lights the city at present.

An electric light company has been formed, and contracts signed for the completion of the plant within sixty days, for the lighting of Fremont, Colo., and the town of Moreland on the east.

The trustees of Grant's Pass, Ore., have contracted with the Water, Light and Power company of that place for eight 2,000 candle power arc lights, at $800 per year. The lights to be burned until midnight.

At a recent election of the Indianapolis Brush Electric Light & Power company John Caven of Indianapolis was elected president; J Potter of Cleveland, treasurer and S. M. Hamill of Cleveland, secretary.

The United Electric Light company of Springfield, Mass., has decided to meter its entire service. Meters have been put in in most cases, where the light has been introduced during the last year, so that more than 100 of the company's 350 customers, using 7,000 lights are already equipped.

Stockholders in the United States Electric Power & Light company of Baltimore have asked for a receiver for the company. The charge is made that the Brush company has secured control and that at the last election, of the eight directors elected seven together own only twenty shares of stock, and are nearly all officers in the Brush company.

The electric light companies of Seattle have consolidated with a capital of $1,000,000. Henry Villard was a large stockholder in one of the companies which merged, but had sold out. A debt of $500,000 has been incurred by the new company to the New York Guaranty & Indemnity company to settle all back debts of the participating companies.

The Vincennes Electric Light & Power company of Vincennes, Ind., has added to its plant one 1,300 Brush alternator, one Armington & Sims double disk engine, two No. 4 Blake pumps, boiler, heater, separators, etc. The newly elected officers of the company are Chas. Bierhans, president; H. W. Frund, secretary and manager, H. A. Foulks, treasurer.

The Brush Electric company of Cleveland has disposed of a controlling interest in the stock of the Brush Electric Lighting company of Lafayette, Ind., to local capitalists. The old officers resigned, and the following named new ones were elected: S. M. Hamill, Cleveland, president; William Wallace, Lafayette, Ind., vice president; John O. Morgan, Lafayette, secretary and treasurer; R H. McMullen, Lafayette, manager. The station will be enlarged, new apparatus purchased and the electric lighting of Lafayette materially increased. A new five years' contract with the city, at an advance of $25 per year over the old contract, was recently executed.

ELECTRIC RAILWAYS.

Electric postal cars are proposed in Rochester for use on the street railway system.

The Asheville, N. C, Street Railway company will erect a power station at a cost of $100,000.

The Waterville & Fairfield, Me, Street Railway company has closed a contract with the Westinghouse company for six car equipments, each to have the gearless motor, and two 150 horse power generators.

The Norwich, Conn., Street Railway company has ordered 700 poles and 6,000 ties for the building of electric road. The managers hope to have the trolley system in operation on the main line by the 1st of May.

The Westinghouse company has made a contract with a western syndicate to furnish 210 motors and six 250 horse power generators for street railways in Evansville and Fort Wayne, Ind., and Lincoln, Neb. The contract will, it is said, amount to $218,000.

An application has been made for the appointment of a receiver for the Allen and Swiney line at Dubuque, Iowa. The application is made in the interest of the St. Louis Car company and others. The company is bonded for $250,000, stocked for $300,000, and had a floating debt of $140,000.

The Benton & Bellefontaine Railroad company of St. Louis has entered into a contract with the Municipal Electric Light & Power company to supply it with electricity from April 1st until its power station is completed. The new power house will be one of the finest electric street railway stations in the United States. Work on it is being pushed as rapidly as possible, but it is hardly probable that it can be finished before May 1st. The St. Louis Car

company has completed twenty-seven of the thirty new cars for the road, and nearly everything is in readiness to begin operating with electricity.

The Short Electric Railway company has closed a contract with Francis H. Cook of Spokane, Wash., for remodeling his steam motor line into an electric railway equipped with gearless motors. Many railroad managers in the Northwest have been anxious to see the Short system in operation. Chas. H. Baker & Co. secured the contract for the Short company.

During the heavy snowstorms which prevailed in Massachusetts in the early part of March the Worcester, Spencer & Leicester Electric Railway company operated its eight electric cars over 14 miles of road without a delay exceeding ten minutes on any of the car trips. Four electric snow plows were kept in constant operation during the fall of snow.

Owing to an open switch two electric cars of the West End Street railway of Boston came into collision on Beacon street in Brookline on March 18th. Joseph Parkhurst, motorman, had his hip broken, and every one in the car was more or less shaken up. A lady, whose name could not be learned, was thought to be hurt internally, and was taken home in a carriage. The front platforms of the cars were torn completely off, and several windows in each of them were broken.

The Northwest Thomson-Houston Electric company has secured from the Duluth Street Railroad company a contract for 21 complete car equipments, consisting of two single reduction motors of 15 horse power each. The same company has the contract for the installation of two multipolar generators equivalent to 335 horse power each for the new power house of the Duluth street railroad. Power is supplied by a triple expansion 1,000 horse power engine, built by the E. P. Allis Co. of Milwaukee.

The surveyors who are laying out the route for the widely advertised "air line electric railroad" between Chicago and St. Louis are near Fairbury, Ill. A correspondent at that point writes that the party is progressing at the rate of about six miles a day, and will reach Chicago about April 15th. "The residents are greatly worked up over the prospects of a new railroad," he writes, "but many are skeptical and question the honesty of purpose of the incorporators, who, on the other hand, claim to control a patent on a high speed electric motor capable of making one hundred miles an hour, from which they expect to make enormous amounts of money after they have demonstrated the practicability of the invention, which they claim will revolutionize railroading. They claim that the road will be in operation for the World's Fair."

Street railway managers will be interested in a novel case reported from Baltimore, involving the question of what is a reasonable sum to present a conductor in payment of a five cent fare. The action in question was brought by Benj. Barker, Jr, to recover damages for being ejected from one of the cars of the Central Park, North & East River Railroad company. Mr. Barker, who is a young lawyer, boarded one of the cars of the company. He had but a nickel and a five dollar bill in his pocket. He paid his fare with the nickel and then found that he should have taken a car in the opposite direction. He got off the car, took the other car, and tendered the five dollar bill, remarking that it was all he had. The conductor replied that he was not supposed to give change for more than two dollars, and told Mr. Barker that he must get off. Mr. Barker remonstrated, but in vain, and was finally ejected from the car, but without any force. When the case for the plaintiff was concluded a motion to dismiss the complaint was made upon the ground that the company was not bound to make any change at all; that it made change only to accommodate the public; that it was not in any event bound to change more than a two-dollar bill, and that a five-dollar bill was an unreasonable tender for a five cent fare. The motion was granted, the court saying that he was in doubt as to whether he should submit to the jury the question as to what was a legal tender, but he held that a five-dollar bill was an unreasonable sum to tender for a five-cent fare. He would not say whether a street car company was obliged to accept anything but the actual fare. The case will be appealed in order that the question may be passed upon in the highest court.

ELECTRIC MINING.

The Electrical Engineering company of San Francisco is installing for the Taylor mine, in El Dorado county, an electric plant consisting of 120 lights, two 10 horse power electric pumps, two electric power rock drills and the necessary generators.

When the improvements that are being made at the Earl of Durham's collieries are completed, this plant will contain one of the most complete electric mining installations in England. The operations will consist of electric haulage, winding, pumping, lighting, signaling, telephoning, etc.

The electrical equipment for the Alta Mining company's concentrator at Corbin, Jefferson county, Montana, will soon be in operation. The plant is sufficiently powerful to operate the railroad between the mine and the concentrator, and electricity will be used in a short time for power on the road.

Under the heading "Electricity Progresses," a mining exchange notes that "arrangements are being perfected to light and run the Idlewild mine, located two and one-half miles from Greenwood, El Dorado county, California, by electricity. Three dynamos and the necessary machinery have arrived. The drills and all machinery will be operated by electricity. It is claimed that the ore can be milled at the low cost of forty cents per ton. This mine is familiarly known as the old Taylor mine. Electricity is now used in the St. Lawrence and Del Marcie mines."

TELEPHONE.

Long-distance telephone lines to connect Centralia with Portland and Olympia, Ore., are projected.

It is said that the largest telephone switch-board in the world is that in the exchange in Berlin, with 7,000 wires.

One of the most prominent exhibits of telephone apparatus at the Crystal Palace exhibition in London is made by the Western Electric company of Chicago.

The Wisconsin Telephone company, Appleton, Wis., is rebuilding the entire line and making a very creditable piece of work of it, using sixty foot cedar poles and copper wire throughout.

The Pike's Peak telephone line recently described in this paper is said be eclipsed in altitude by a line that crosses the Andes on the Trans-Andean railroad at an elevation of about 16,500 feet above sea level.

Recently the British postmaster-general announced in the House of Common that the government would promote a measure placing the telephone trunk lines in the hands of the postoffice department, which would use the present telephone systems in alliance with the trunk lines.

The Pineville, Ky., Telephone company has been organized and will establish a telephone connection between Pineville and Middlesborough. Andrew Johnson is president; M. J. Moss, secretary, and J. W. Johnson, manager of the Company.

The span over the River Dart, connecting Dartmouth with the trunk lines between Torquay and Plymouth, is 2,400 feet long and is said to be the longest span of telephone wires in England. The wires, of silicon bronze, are seventeen in number.

An ordinance has been introduced in the Chicago common council granting to the Chicago Twin Wire Telephone company, a corporation said to have no legal corporate existence as yet, a twenty-five year franchise to maintain and operate a telephone service under the D'Unger system.

In order to assist the fishing in the Ostland district of Norway, which is at present isolated, it is proposed to erect a state telephone between Popperhavuen and Skjarhalden, with some intermediate stations. It is of great importance to the fishing industry that frequent and reliable reports can be published as to the results of the fishing with the view of assisting sales.

A curious commentary on state telephone supervision is given in the following despatch from Vienna: Employes of the telephone company here have informed the Minister of Commerce that the director of telephones has been in the habit of instructing subordinates to call him to enable him to listen whenever the Emperor is talking to the ministers, to councilors, or to any prominent financiers. Pending an inquiry, a government official takes the place of the director.

An interesting and amusing instance of the efficacy of the London-Paris telephone which, if true, is worth recording, is reported in the English papers. The Salvation Army band, according to the story, was marching from the Royal Exchange playing the "Marseillaise," when some one in the telephone room threw open the windows and doors and the attendant at the Paris end was asked if he could hear anything. The response was immediate: "Yes, I can hear a band playing the 'Marseillaise.'"

MISCELLANEOUS.

The annual catalogue of the Massachusetts Institute of Technology of Boston for 1891-92 is out.

The name of the periodical heretofore known as the *Electric Railway Advertiser* has been changed to *Electricity and Railroading*.

As the result of a severe storm that visited Omaha on March 26th, telegraphic and telephonic communication was interrupted for several hours.

Electrolysis, it seems, is now used by swindlers in California to "sweat" double eagles. Several coins thus treated have lately been received at the sub-treasury in New York.

The anarchist agitation in Paris has brought to light the fact that some of the bombs used were supplied with electric batteries attached to clock work, so arranged as to explode the dynamite at a given time.

C. E. Doolittle, of the Roaring Fork Electric Light & Power company, has perfected a water wheel governor that is claimed to give almost perfect regulation, much better, in fact, than can be obtained by having a man constantly at the wheel.

The annual meeting of the stockholders of the Thomson-Houston Electric company will be held on April 11, 1892, at 1 15 P. M., at 93 Main street, Middletown, Conn. The transfer books are closed from April 2d to April 11th, both days inclusive.

It is interesting to note that all of the holes in the eighteen inch armor of the great English battleship Ramillies, just launched, were drilled by electric power. The holes are five and one-half inches in diameter, and the work was done with specially devised machinery, the perforation of the hole in the plate and in the teak backing being one operation.

In an address on electricity in railroad service, delivered recently before the Verein fur Eisenbahnkunde, at Berlin, Mr. Bork directed special attention to the adaptability of electric motors to the operation of turntables and transfer tables generally, and to their extending use for that work. Rapidity and certainty of action and low cost of operation are among the principal advantages claimed for the method.

A bill has been introduced in the Ohio legislature at Columbus requiring all electric wires carrying a current of sufficient force to de troy human life to be put under ground. It provides for a penalty of $100 to be paid into the state treasury, and $50 additional for each day the wires remain above ground after notice has been served. A similar bill was introduced two years ago, but was smothered in committee.

Apropos of the claims of the charlatans who exploit "electric" belts, rings and similar traps for the unwary, an Indian correspondent of the *Electrical Review* of London writes to describe an "electric penholder," which is said to be manufactured in England. The penis said to have a battery set at the point where the writer holds it, and by the use of this a 'candidate for examination becomes undaunted." "It sharpens the memory, prevents the shivering of the hand and enables him to write quickly." It also has the marvelous effect of curing short-sightedness.

A course of six lectures on physics will be given at the Hull House, 335 South Halsted street, Chicago, during the spring. The importance of physics in electrical engineering is acknowledged, and it is hoped that those engaged in electrical work will give this course their hearty support. At the start the subject will be treated in an elementary manner, with a view of a more comprehensive course in the fall. There will be six lectures in all. The schedule is as follows: April 12th, 8 P. M., Introductory Remarks on Physics and the Determination of Units—an Explanation of the Metric System; April 19th, The Laws of Motion; April 26th, The Forces of Nature; May 3d, Energy; May 10th, Heat; May 17th, Sound.

TRADE NEWS.

The Premier Electric company of Brooklyn, is now furnishing a set of castings of a battery motor, complete, ready to be put together and wound by students and amateurs.

The increasing demand for East India mica is shown by the large number of orders received during the past month from different parts of the country by A. O. Schoonmaker of New York.

The New York Insulated Wire company, New York, reports business booming. The largest order from its western agents during the past week was one for 200,000 feet of wire, from San Francisco.

The Chicago office of the Detroit Electrical Works owing to an increase of business, after the 15th inst., will be moved from its present quarters to larger ones in the Monadnock building, suite 917 and 918.

The Indurated Fibre Pipe company, New York, have just moved from its old office in the Central building, and will now be found in a suite of offices in Aldrich court, 45 Broadway, where there is more room for transacting its increasing business.

The Mosher Arc Lamp company, Chicago, has recently received an inquiry from San Salvador as to the price of 500 Mosher arc lamps. The Mosher advertisement was seen in the WESTERN ELECTRICIAN, and the company has had inquiries from the same advertisement from France, Russia, China and Australia. Another sale was recently effected at Canton, China, and the lamps have been put in operation.

The Central Electric company, Chicago, is sending out a very handsome circular in reference to tested fuse wire and terminal fuses. The circular contains an article on fuse wire that was read before the Chicago Electric club Dec. 7, 1891, by Elmer A. Sperry, and which gives some valuable information on this most important subject. The company is also preparing a house goods catalogue, which, it is expected, will be ready in April. The catalogue will be replete with cuts and descriptive matter of the latest designs in this department.

The Stilwell & Bierce Manufacturing company, Dayton, O., has just issued a pamphlet containing a report of the litigation between that company and S. N. Brown & Co., of Dayton, for alleged infringement of a patent controlled by the Stilwell & Bierce company. The defendant had been using a Hoppes live steam feed water purifier. The result of the litigation is a victory for the Stilwell & Bierce company. The Stilwell patent is broadly sustained, and the Hoppes purifier pronounced an infringement. A decree for an injunction, accounting and costs was granted by Judge Sage of the Southern District of Ohio.

F. P. Little & Co, Buffalo, N. Y., have just closed a contract with the Terminal Railroad company of Buffalo for installing a plant consisting of one 500 light Thomson-Houston dynamo, one 38 horse power engine of the John T. Noye Manufacturing company's make, 24 2,000 candle power Mosher arc lamps, and 125 16 candle power incandescent lamps. The same firm has lately closed a contract for wiring the Columbia Bank building of Buffalo for incandescent lights, and is wiring the city elevator for 300 incandescent lights and five arc lights, with engine, dynamo, etc.; the Bell Telephone company's building for 150 lights; and is rewiring Weyand's brewery for 225 lights.

The Electric Heat Alarm company, Boston, has recently issued a very neat little pamphlet describing the various uses to which its automatic electric heat alarm is applicable. One of the most important applications is to the bearings of shafting in steamships and central power stations. The alarm is placed upon the bearings and connected by wire to an annunciator having a large alarm bell, each bearing being numbered and having a corresponding number on the annunciator. As soon as a bear-

ing becomes heated to the degree for which the alarm is set, the mercury expands and closes the circuit, ringing the alarm bell and indicating on the annunciator the particular bearing requiring attention.

Queen & Co., Philadelphia, are just placing on the market a new portable tachometer which has peculiar advantages that render it of great value for instantly determining the speed of rotating shafts Three spindles are geared to the rotating parts inside of the case, each one of them having a separate scale on the dial, so that the indications are direct reading throughout. A detachable point, with slightly flexible end to fit any of the spindles is supplied, the flexibility of which acts as a safeguard. If the detachable point was made perfectly rigid there would be danger of breakage when not applied exactly at right angles to the shaft. A scale to correspond with each spindle is graduated on the dial, and the ranges covered are 40 to 200, 120 to 600 and 600 to 3,000, which give a maximum capacity of 40 to 3,000 turns per minute. A conveniently shaped handle is attached to the body of the instrument so that it can easily be held in the hand. The apparatus presents a handsome appearance, the different parts being nickel-plated.

Through General Manager H. A. Royce of the Thomson Electric Welding company, Boston, it is learned that a patent has been issued to his company for a process of working metals by means of the electric arc, and that this patent gives the company complete control of the only practical method of utilizing the intense heat of an electric arc for general metal working purposes The process referred to is the invention of Auguste de Heritons of Paris, and the United States patent office has definitely decided in his favor after prolonged interference proceedings with the claims of de Bernados and Olszowski. The arc process is applicable to the longitudinal joining of large tubes, the making of large pipe fittings, the filling of blow holes in castings and a great variety of similar work which it has not been possible to accomplish by the Thomson method, and its control will give the Welding company an entirely new field, which is likely to be remunerative. The application of this method to commercial work has already been demonstrated abroad by Lloyd & Lloyd, Birmingham. The Thomson Welding company will immediately proceed to place machines for this work on the market.

BUSINESS.

J. S. Crider of the Washington Carbon company, Pittsburg, when in Chicago last week, sold to the Central Electric company a carload of carbons. Mr. Crider spent ten days in the West, and reports the outlook for business as most flattering.

F. J. Cram, general agent for the Electric Engineering & Supply company, with headquarters in St. Paul, spent several days last week at his company's office, the Rookery, Chicago. Mr. Cram reports the outlook for business throughout the entire Northwest for the coming season as most promising.

The Sioux City Engine Works have recently sold to the U. S. Electric Light company at Dubuque, Ia., a Sioux City standard Corliss engine, 22x48, 400 horse power. This engine is to be used to provide power for an extension of the plant, necessitated by a contract just closed for lighting the streets of the city with arc lights. The engine is to be put in place at once.

The Chicago Electric Motor company has received recently a number of large armatures, to be repaired, from one of the leading street railway lines in the West. This company has unexcelled facilities for handling this class of work in the way of heavy machinery and first class workmen, so that in every case satisfaction can be guaranteed. A large amount of general repair work is also being received by this company, making it necessary to add a number of men to the pa-yroll during the month. Excellent prospects for a busy season are reported as being assured.

W. W. Nugent, for many years with the Hoffman & Billings company, Milwaukee, has recently opened an office in the Home Insurance building, Chicago, and has secured the following agencies: Goubert Manufacturing company, 32 Cortlandt street, New York, feed water heaters; Kelly Bros., Goshen, Ind., grate bars; the Nordberg Manufacturing company of Milwaukee, Claussen friction clutch; and Perry & Demeritt Montpelier, Vt., the "L. P. & D." power transmitter. Mr. Nugent is an engineer of experience and is beside a business man of unquestionable standing.

In the WESTERN ELECTRICIAN of February 13th an illustrated article appeared giving H. N. Bates & Co. of Boston credit for bringing out a new system for driving dynamos, the "L. P. & D." The information was obtained from a catalogue issued by Bates & Co., who are acting as agents for this apparatus in Boston and vicinity, the inventors and manufacturers being Perry & Demeritt of Montpelier, Vt. This company has recently appointed W. W. Nugent, room 823, Home Insurance building, Chicago, its western agent. Mr. Nugent has had charge of the engine department for the Hoffman & Billings company, Milwaukee, until a recent date, and is well and favorably known to the trade.

The Vincennes, Ind., Electric Light & Power company is making arrangements to put in a 1200-light alternating incandescent machine for commercial and domestic service. Bids for enlarging and remodeling the power plant were solicited from all the principal steam engineering contracting firms in the country, and a number of very elaborate plans and specifications were submitted. After long and careful consideration of the twenty proposals handed in, that of the Pond Engineering company, St. Louis, was accepted, although the price asked was among the highest. The electric lighting company will require one 110 horse power Armington & Sims engine, a 66x16 flange steel boiler with rocking grates, and a Pond improved furnace; a 200 horse power Hoppes feed water heater, and two No. 4 Blake boiler feed pumps. The Pond company is to deliver and erect all this machinery in Vincennes, at the same time remodeling the pipe work, so as to make a compact and well arranged system throughout. It is expected that the new plant will be in operation early in May.

"Every class and make of apparatus comes to our shop for repairs," writes the Electric Supply & Contracting company, Cincinnati, O., "and we have the best chance in the world to compare the good, bad or indifferent points in each. We keep the good points ourselves and give our customers the benefit of our experience." This concern, whose offices are in the Nevada building, also handles the "American" incandescent lamp, and attention should be called to its special railway lamp, which has met with most gratifying success. In this lamp the filament is particularly adapted to withstand sudden variations of potential, and, being "anchored," is not susceptible to the constant vibration and strain incident to street car service.

"He may use one instrument throughout a period of thirty years or more, when the weight, feel and location of the parts become so familiar that the operations are performed instinctively, and the mind is left entirely free for its legitimate work, and is not hampered by any demands upon it in connection with the merely mechanical part of the draughting. But such an instrument must be perfect originally, and must be so well constructed and all its parts so well fitted that they will retain their qualities." The above fact is one that can be best appreciated by those who possess an "Alteneder" drawing pen. Electrical draughtsmen will find the catalogue for 1892, just issued by Theodore Alteneder & Sons, 939 Ridge avenue, Philadelphia, as comprehensive as usual.

A new grate bar, placed on the market by Kelly Bros., Goshen, Ind., it is claimed, is meeting with marked success. The heavy service required in an electric light or power plant makes necessary a grate bar of unusual strength and one that permits free and rapid combustion. The manufacturers claim many strong points for this grate and offer to back it against all competitors. Kelly Bros.' foundry has had facilities of more than average extent, but in order to supply the demand for the new grate bar they have been compelled to build an addition 65x150 feet in size. Their new building will be equipped with several cupolas manufactured by Victor Callian, Detroit, incandescent lights, etc., using the best of modern improvements. The new plant will be ready for the first heat on May 1st.

ELECTRICAL STOCK MARKET.

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, April 21, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	96½	97
Edison Illuminating company of New York	82½	82
" " " Brooklyn	77	80
" " " Boston	105	115
" " " Chicago	130	140
Edison Ore Milling company	15	20
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomson-Houston Electric company	58	58½
" " " Preferred	28	28½
Westinghouse Electric company	17	18
North American Phonograph company	7	10
New York " "	2½	5
Automatic Exhibition company	4	5

ELECTRICAL PATENTS.

Issued March 29, 1892.

471,534. System for Transmitting Signals. Henry A. Chase, Boston, Mass.

471,535. Telephone Receiver. James A. Christy and Elias J. Baldwin, San Francisco, Cal.

471,538. Storage Battery Plate and Process of Making the Same. William W. Donaldson and Roderick Macrae, Baltimore, Md.

471,543. Electric Railway. William C. Goss, Lynn, Mass.

471,549. Attachment for Telephones. James E. Hills, New York, N. Y.

471,576. Manufacture of Incandescent Electric Lamps. Frank S. Smith, Pittsburg, Pa.

This invention consists of a carbonized conductor, an inclosing bulb of glass, leading in conductors of iron wire, glass fused upon the wires and to which the bulb is fused, and a cement or sealing substance surrounding the iron wires at the point of entrance into the glass.

471,587. Insulated Electric Conductor. James B. Williams, Oakland, Cal.

471,588. Insulated Electric Conductor. James B. Williams, Oakland, Cal.

471,590. Secondary Battery. Charles F. Winkler, Troy, N. Y.

471,591. Secondary Battery Electrode. Charles F. Winkler, Troy, N. Y.

471,592. Secondary Battery. Charles F. Winkler, Troy, N. Y.

471,612. Electric Switch. Harvey Hubbell, Bridgeport, Conn.

471,625. Joint for Electric Wires. Roger H. Smith, Lexington, Ky.

471,645. Support for Electric Lamps. Charles J Klein, New York, N. Y.

471,686. Automatic Guest Call. William H. Perry, Chicago, Ill.

The claim reads:

"In an electric guest call the combination with clock circuits and insulated time strips in said circuits of a series of relay magnets permanently included in the normally open clock circuits, said circuits being closable by flexible conductors attached to one side of the relay magnets and insertible in the time strips, and a corresponding series of bell circuits connected through the relay armatures."

471,691. Dynamo Electric Generator or Motor. Claude W. Atkinson and Llewellyn B. Atkinson, London, England.

471,693. Dynamo Electric Machine or Motor. Walter T. Goolden and Llewelyn B. Atkinson, London, England.

471,725. Governor for Marine Engines. Ernest F. Wallgren, Philadelphia, Pa.

471,730. Mast Arm Switch for Electric Lamps. Thomas Dillon, Indianapolis, Ind.

471,732. Bracket for Incandescent Electric Lamps. John H. Goehst, Chicago, Ill.

471,745. Telephone. James H. Howard, Medford, Mass.

The first claim reads:

"A telephone having the bell-ringing or ringer-actuating coils or magnets arranged inside of the curve of the horseshoe magnets."

471,750. Safety Attachment for Cable or Electric Cars. Albert Raynal, New York, N. Y.

471,759. Pole for Supporting Electric Wires. John H. Huntress, Janesville, Wis.

471,760. Electric Switch. Charles G. Perkins, Hartford, Conn.

This invention consists of the combination with two circuit terminals of a curved contact plate constructed of spring metal, and moving block or plug, to which the contact plate is swiveled midway between its two ends, so as to bear with a yielding or spring pressure upon one or both of the terminals.

471,790. Electric Telpherage Apparatus. Midbury W. Hassan, Rochester, N. Y.

471,792. Commutator Brush. Robert Hirsch, Milwaukee, Wis.

471,819. Brush Holder for Electric Motors or Dynamo Electric Machines. Charles A. Hussey, New York, N. Y.

471,837. Support for Electric Lights. James J. Walsh, Paris, Tex.

471,850. Electro Therapeutic Electrode. Harry Bonis, Blanchard, Ontario, Canada.

471,877. Dental Engine. Andrew C. Miller and Gardner F. Wells, Auburn, N. Y.

471,913. Electric Lock. James G. Thompson, Boston Mass.

471,929. Automatic Electric Fire Alarm. Leonidas G. Woolley, Grand Rapids, Mich.

Of the six claims the first reads:

"An automatic electric fire alarm comprising a permanent magnet an armature therefor, an induction coil, a stored power for suddenly separating the armature and magnet, and a thermostatic releasing device."

471,945. Galvanic Battery. William Burnley, North East, Pa.

471,947. Electrically Controlled Trap Door. Frank C. Callahan, Bridgeport, Conn.

471,968. Electric Light Crane. James Gallagher, Oakland, Cal.

471,986. Electrical Annunciator. Nelson M. Watson, Detroit, Mich.

471,987. Electrical Annunciator. Nelson M. Watson, Detroit, Mich.

Claim one reads:

"In an electric annunciator the combination of two electro magnets mounted together, an electric circuit for each of said magnets having a circuit closer therein, the centrally pivoted armature located in front of said magnets, said armature having the projecting arm formed integral therewith, the case or dial having characters mounted thereon, and the pointer pivotally mounted on said case, the lower end of said pointer being in direct but free engagement with said arm of the armature."

471,990. Endoscopic Instrument. John W. Daily, Denver, Colo.

Claim one follows:

"An endoscopic instrument having a recess formed therein, an incandescent electric lamp located therein, and a removable fenestrated plate secured to the instrument in such a manner as to permit the light to illuminate the cavity during use."

471,993. Reciprocating Snap Switch. Jacob S. Gibbs, Hartford, Conn.

471,997. Automatic Electric Cut-out. Edward A. Manship, Minneapolis, Minn.

The last claim reads:

"In an electric cut-out the combination, with an electric switch, of a pawl adapted to hold the same in a closed position, a solenoid, a core therefor, and adjustable extensions thereon."

471,999. Valve Controller. Nathan E. Nash and George A. Eddy, Cleveland, O.

472,019. Method of and Apparatus for Producing Musical Tones by Electro Magnetism. Eli C. Ohmart, Detroit, Mich.

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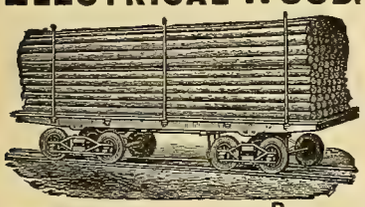

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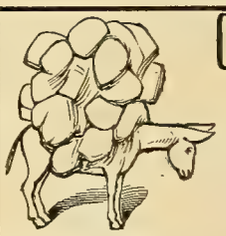

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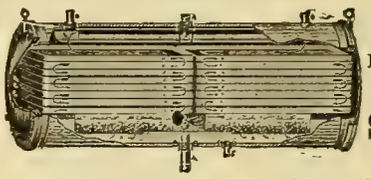

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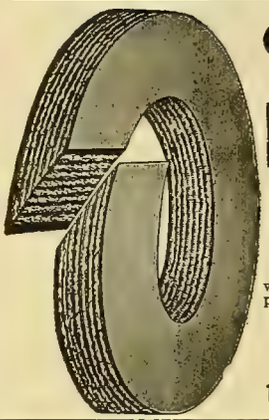

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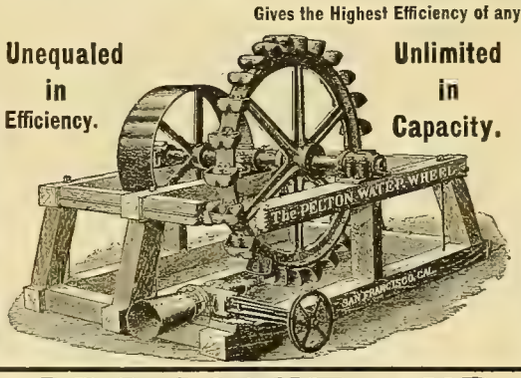

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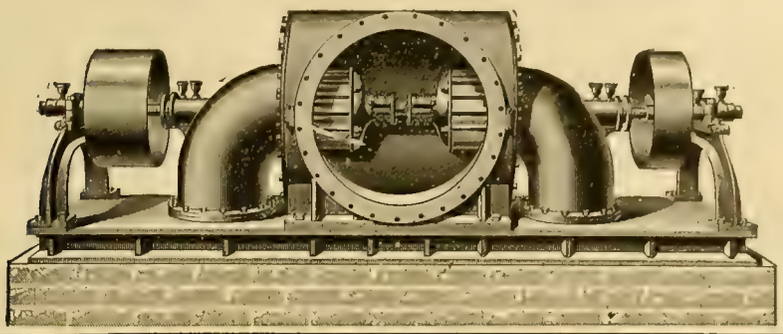

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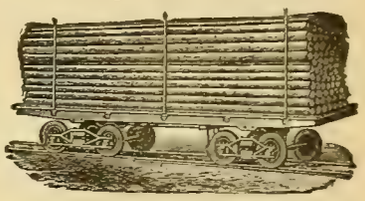

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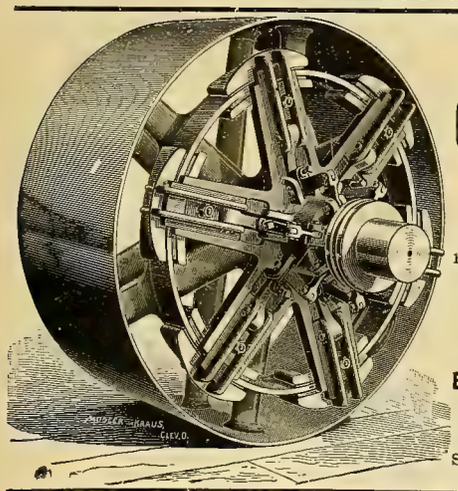

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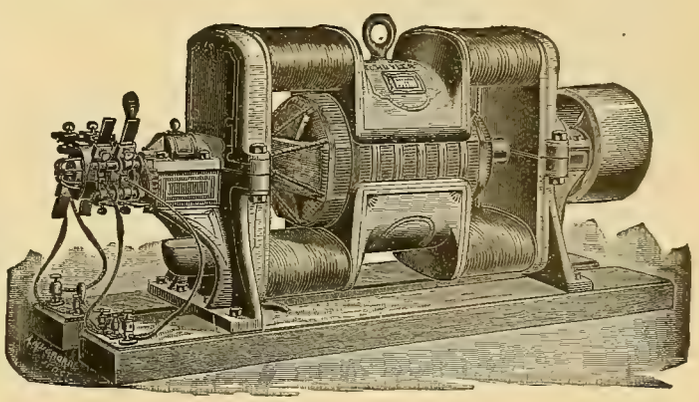

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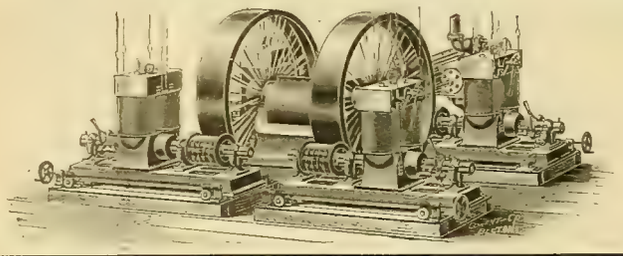

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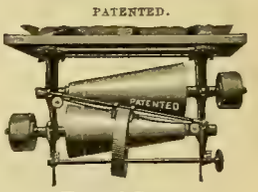

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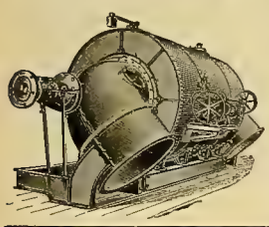

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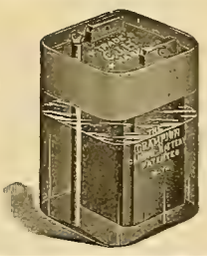

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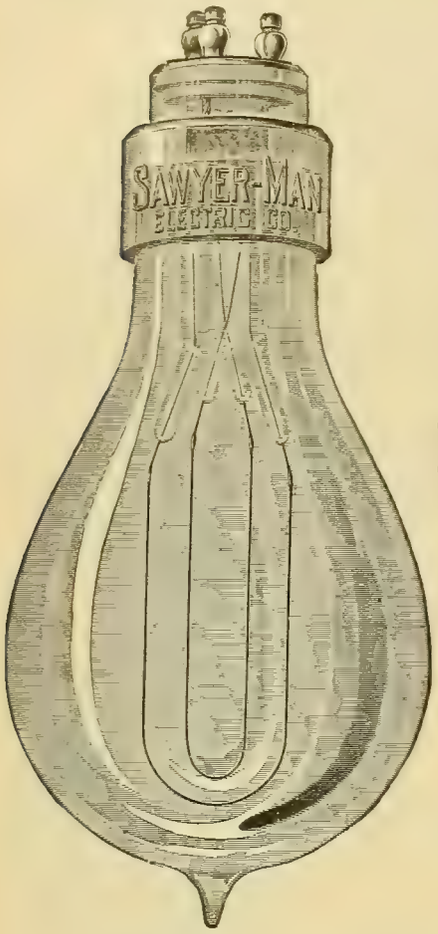

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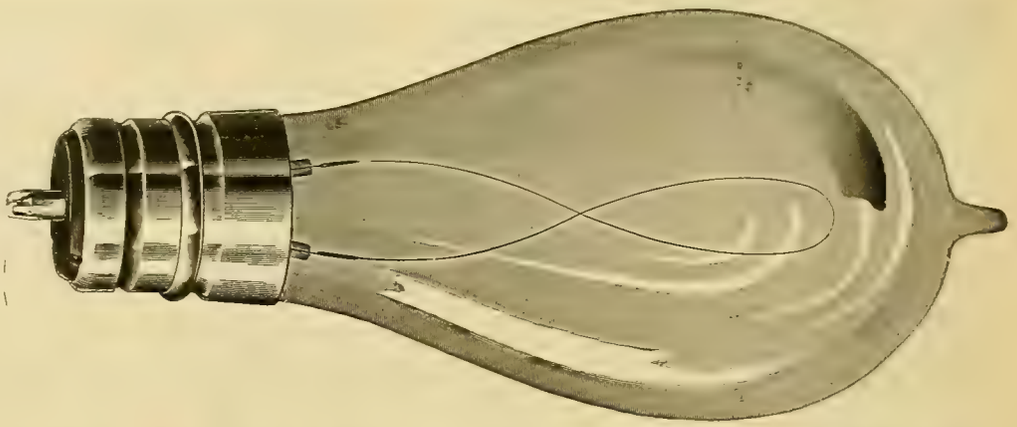

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SOCKETS, SWITCHES, CUT-OUTS AND GENERAL SUPPLIES.

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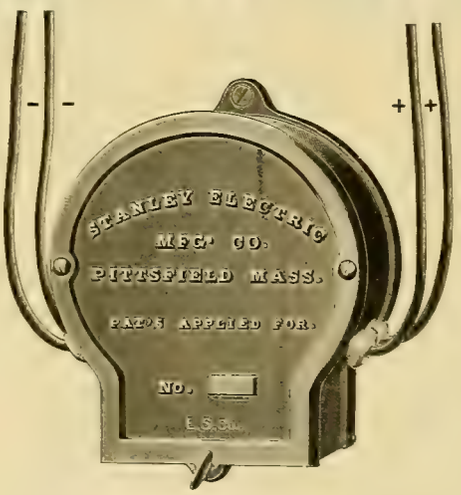
ITS SPECIAL FEATURES ARE:

Absolute Safety in replacing fuses on a live line. Inability of Arc being sustained, and following from one terminal to the other.



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INEXPENSIVE. { Quickness with which fuses can be replaced. } DURABLE.

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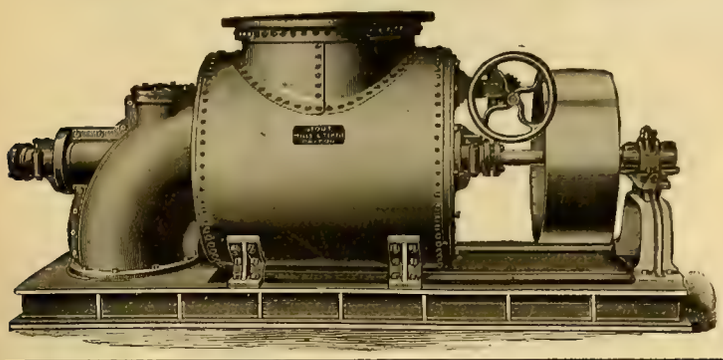

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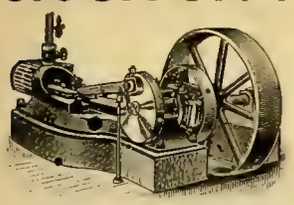

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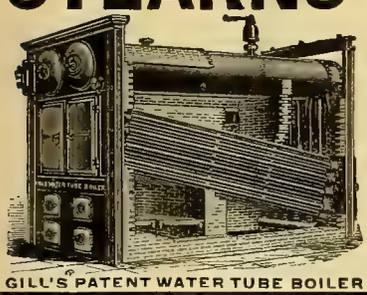

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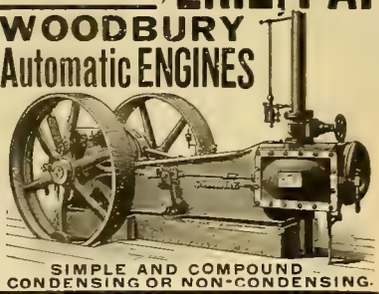

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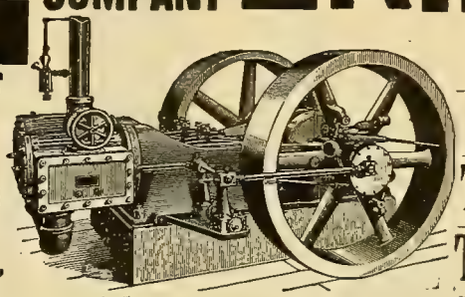

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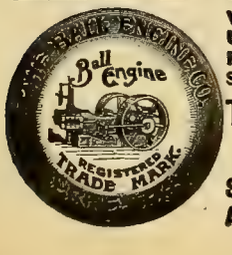

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Highest Economy, Durability, Smooth and Quiet Running.

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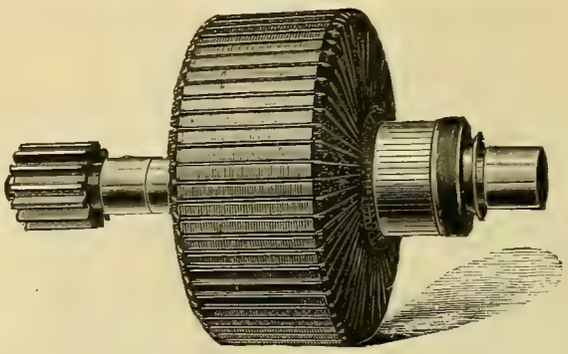
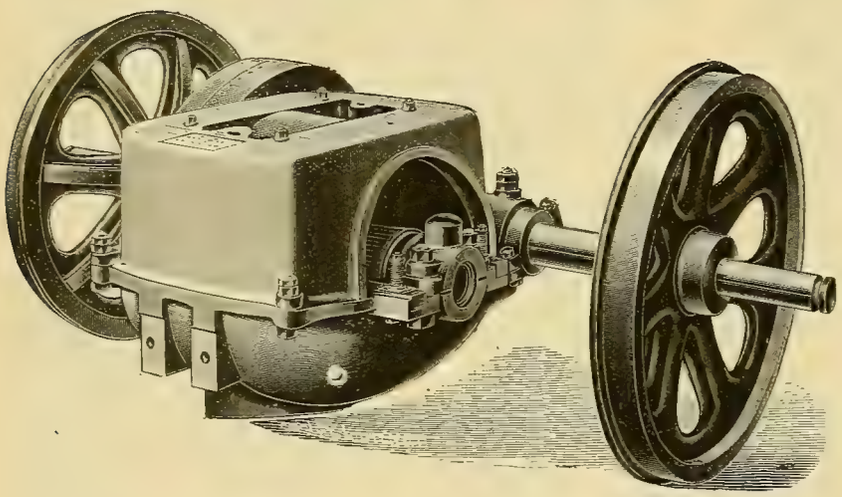


THE THOMSON-HOUSTON ELECTRIC CO.

HAVE PLACED UPON THE MARKET A

NEW STREET RAILWAY MOTOR.



It Excels all Preceding Motors.

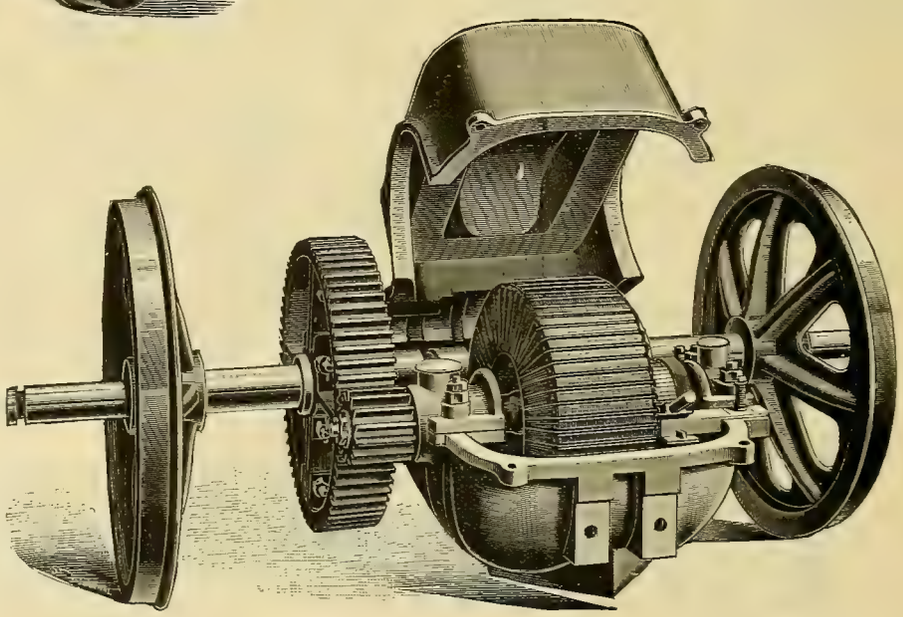
Cost of Maintenance Reduced to a Minimum.

$10 per Year for Renewal of Pinion and Gear.

3382 Already Sold to Railway Companies.

Strong Indorsements from those using it.

Send to us for Prices and Information.



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Boston Office: 620 Atlantic Ave. **Chicago Office: 148 Michigan Ave.**

THEY DO TALK A GOOD DEAL

About Perkins Lamps being the best lamp manufactured, and they have good reason to do so. The thousands that are in use, the good satisfaction they give, their high efficiency and the large duplicate orders we are constantly receiving, clearly indicate, to an intelligent man, that no central station can afford to use any lamp excep THE PERKINS.

Perkins Lamps are not the only good things we sell; everything we handle is of the best.

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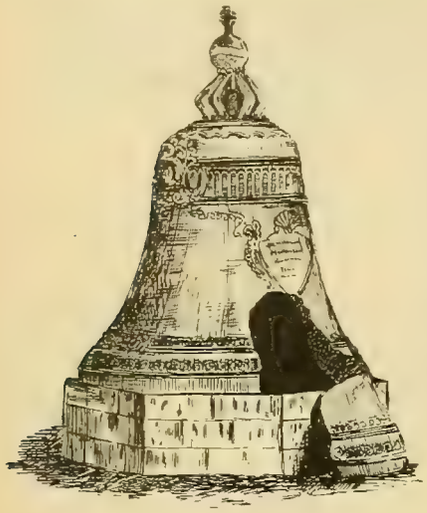

Two Bells.

ONE of the largest—if not the very largest—bells ever made, is the great bell of Moscow, known as the Czar Ko-lo-kol. It was cast sometime during 1733 and is supposed to weigh about 440,000 pounds. Our friend Jones of Binghamton says he thinks that this is way off, but as he hasn't had a chance to heft it with his little weigh, we must accept the figures of the historian. The construction of the Kolokol was the culmination of a religious enthusiasm, and all the young maids and belles were asked to chip in to help pay the freight by contributing their jewelry, pin money and bangles. The result—as a bell—was a failure; as a monument to a fanatical idea it was a success. It is likely to endure for all ages.

Another bell, but of more recent origin, is the Eu-re-ka which was discovered in the vicinity of An-so-nia. This is a veritable midget compared with the great Ko-lo-kol, in fact about 50,000 of them, packed ready for shipment, could be stored in the Czar. Though of such insignificant comparison, the Eu-re-ka has made a deal more noise in the world. Its ringing tones can be heard from Hell Gate to the Bay of Frisco. It is an uncommon bell in many ways. Some dealers who have used it are delighted with its good qualities.

One says:

"I have never found a bell that equaled your Eureka for service or sound. Its particularly good points are the stamped soft metal base, on which the parts are mounted, and the continuous armature and hammer. For first-class work it has no superior."

Another says:

"I have given the Eureka bell and the Cartridge battery a thorough test, and find them first-class in every way."

We make them in Wood and Iron box styles; the wood boxes to match any finish, the Iron Boxes handsomely ornamented.

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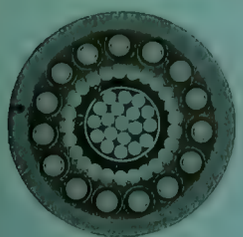
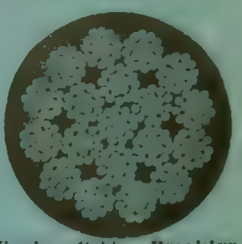

Underground Core.

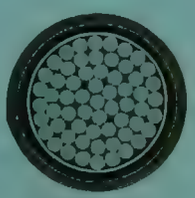
THE RUBBER USED IN

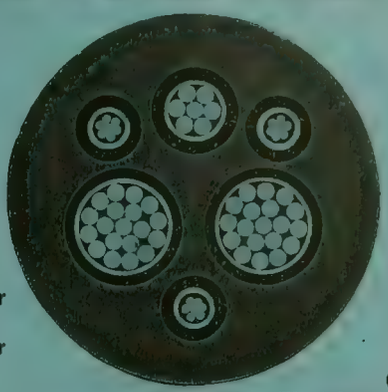
HABIRSHAW INSULATION

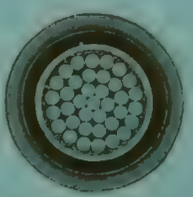
IS PURE PARA.


Feeder Cable, Brooklyn Edison Electric Light Co.

Underground Core, N. J. Central R. R.


Feeder Core, Broadway Theater.


Submarine Work, Edison Electric Light Co., Easton, Pa.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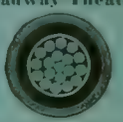
Feeder Conductor, "Bryplaces," Grand Central Depot.

Adopted by the Navy Department, and thus far employed on board the United States steamships Trenton, Chicago, Boston, Yorktown, Pensacola, Philadelphia, Petrel, Atlanta, Baltimore, Newark, Vermont, Charleston, San Francisco, Concord, Bennington and monitor Miantonomah.

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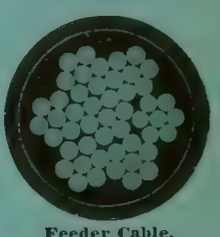
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INCANDESCENT LAMPS OF SUPERIOR QUALITY.

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ARC CUT-OUTS.

The Best is The Cheapest!

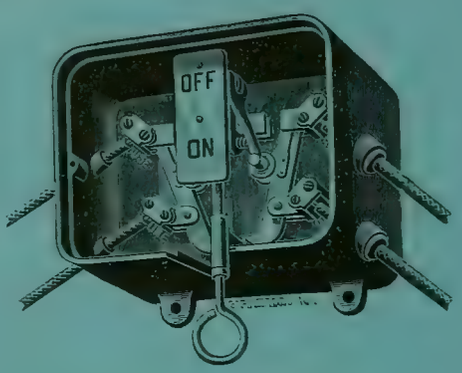
THE WOOD CUT-OUT BOX,

MANUFACTURED BY THE

Fort Wayne Electric Co., is the BEST.

DOUBLEBREAK.

INCOMBUSTIBLE.



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FORT WAYNE, INDIANA.

REPAIRS Form the Uncertain Element In Operating Expenses.

The "Incidentals" (Loss of Revenue, Labor, Extras, etc.,) Cost More Than Material.

"Theory" is all right, but RESULTS are what count.

Read This:

GRAND VIEW BEACH RAILROAD.

ROCHESTER, N. Y., February 8, 1892.

DETROIT ELECTRICAL WORKS, Detroit, Mich.

DEAR SIRS:—In reply to yours of the 29th ult., asking for our experience with your motors under severe conditions, would say that the best performance we had, to my knowledge, was on Sunday, June 7th. A heavy rain had fallen in the morning, and vehicles passing along the highway had tracked considerable mud onto the rail at a point about the **Center of a 50° curve on a 7 per cent. grade.** Motor car No. 4, carrying **64 passengers and hauling trail car with 57 passengers,** stopped by reason of the trolley coming off exactly at point where wagon track crossed the railroad. Upon trolley being replaced on the wire the motor started **without difficulty.**

August 14th one motor pulled two trail cars (**168 passengers on the three cars**) from Charlotte to Manitou, eight miles, **in 38 minutes, including five stops.** On first two miles there are three 50° curves, one of which is on 7 per cent. grade and another at top of same grade, one 90 foot radius curve and two 40° curves. In this two miles there are three grades, 4 per cent., 5 per cent. and 7 per cent. respectively, the 4 per cent. grade being 1,000 feet long, the 5 per cent. 700 feet, and the 7 per cent. 400 feet long.

Quite a number of times during the season one motor pulled two loaded trailers; in fact, this was done whenever occasion required.

Hoping the above will be of service to you, I am yours very truly. (Signed) E. A. ROWORTH.

Detroit Electrical Works,

DETROIT, MICH., U. S. A.

431 "THE ROOKERY," Chicago, Ill.

Correspondence Solicited.

F. I. STONE, Chattanooga, Tenn.

Western Electrician

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. X. CHICAGO, APRIL 16, 1892. No. 16

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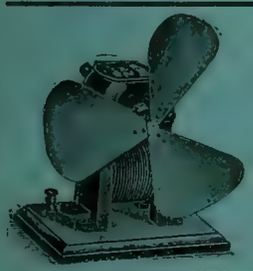
Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.



That Tired Feeling

So prevalent at this season, relieved, at slight expense and no trouble, by the refreshing and invigorating breezes from the

PREMIER FAN MOTORS.

THREE REGULAR SIZES.

Send for a Sample Line. Your Customers Want Them.

THE PREMIER ELECTRIC CO.,

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Insulated Wires and Cables.

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Celebrated Kerite Tape for Insulating Joints.

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ALL SIZES LEAD ENCASED WIRES.

Aerial Use. Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

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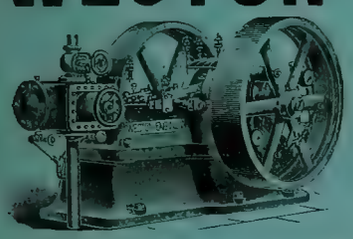

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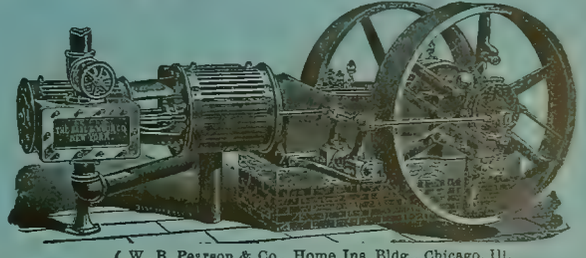

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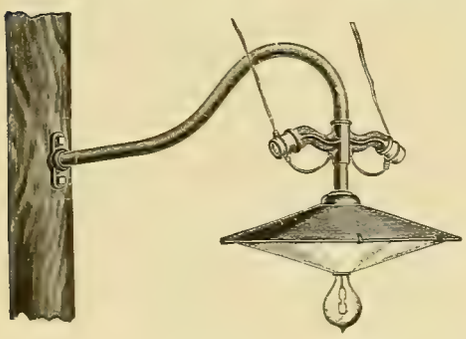

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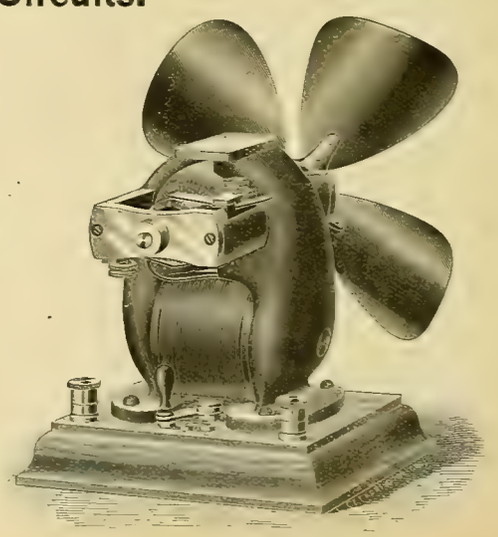

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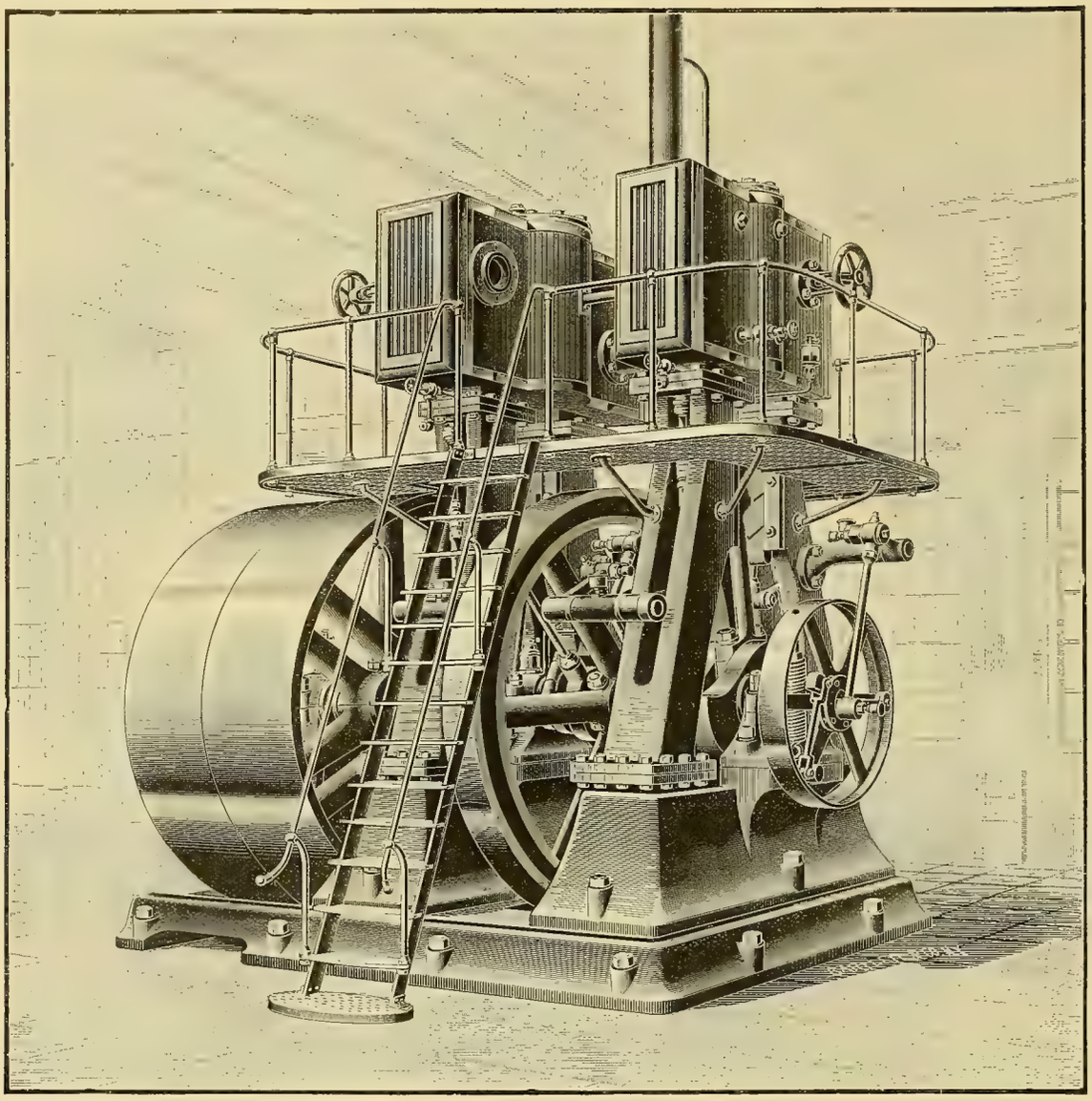

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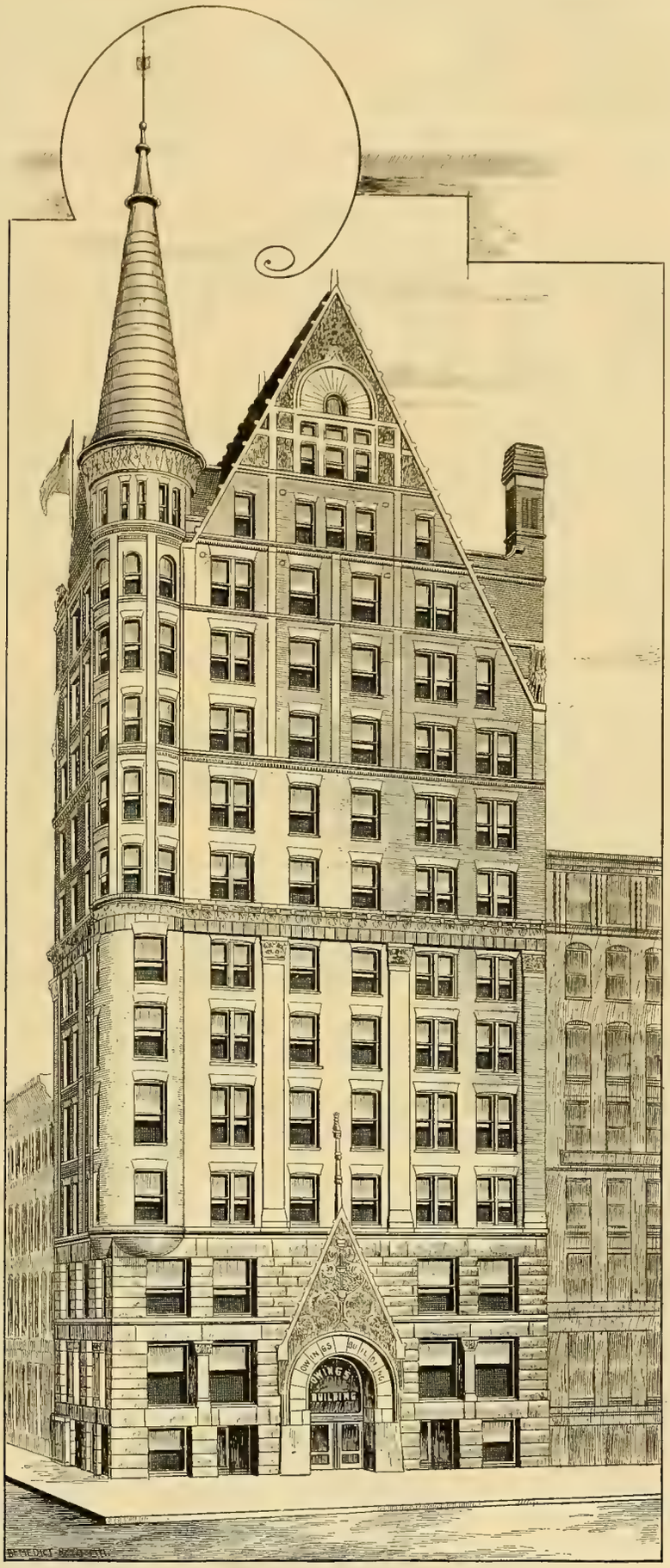

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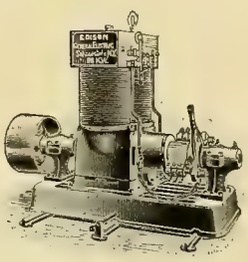

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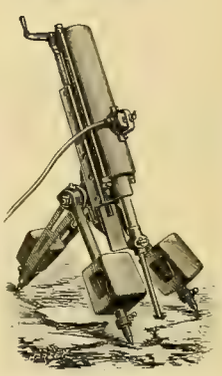

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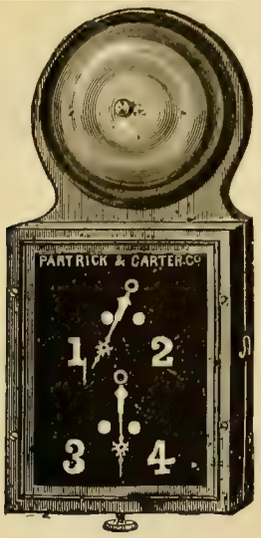

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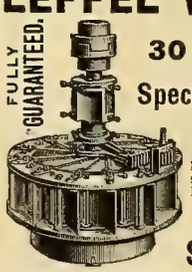

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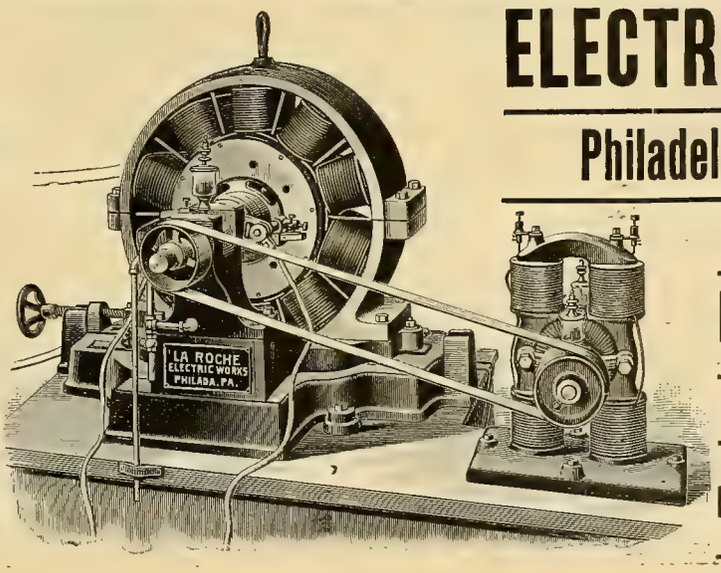

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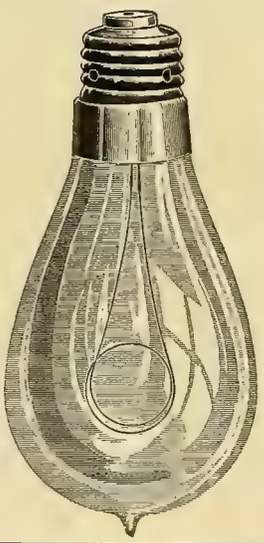

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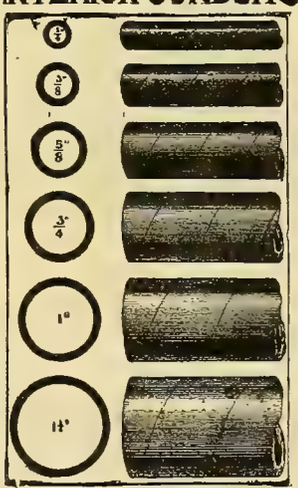

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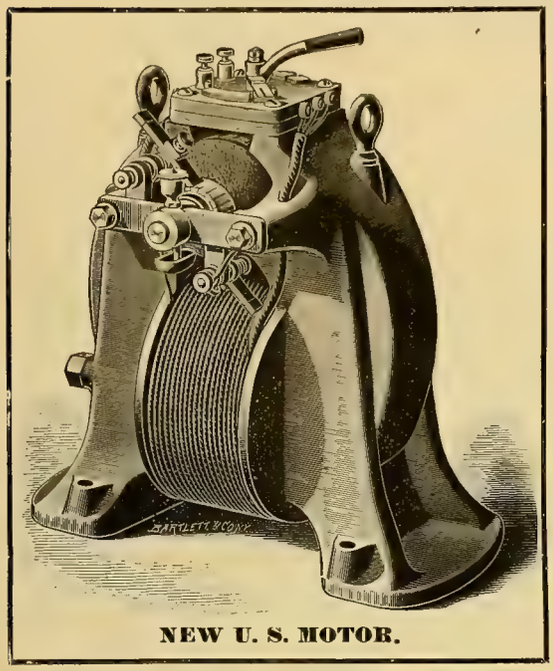

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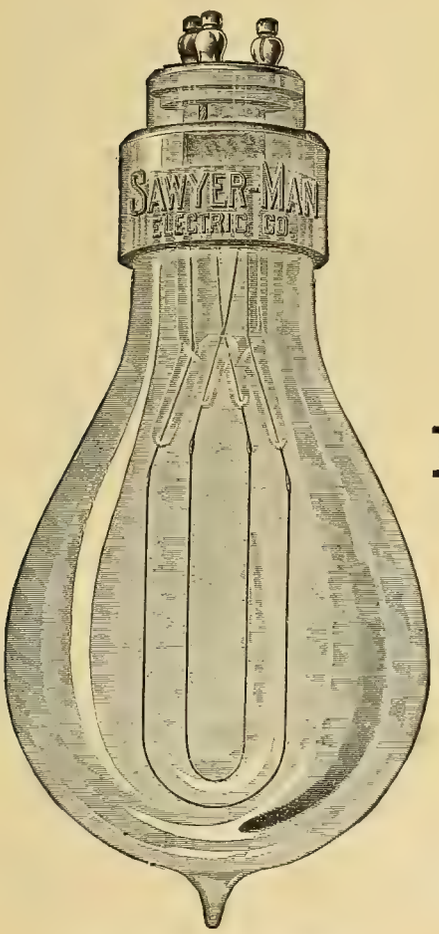

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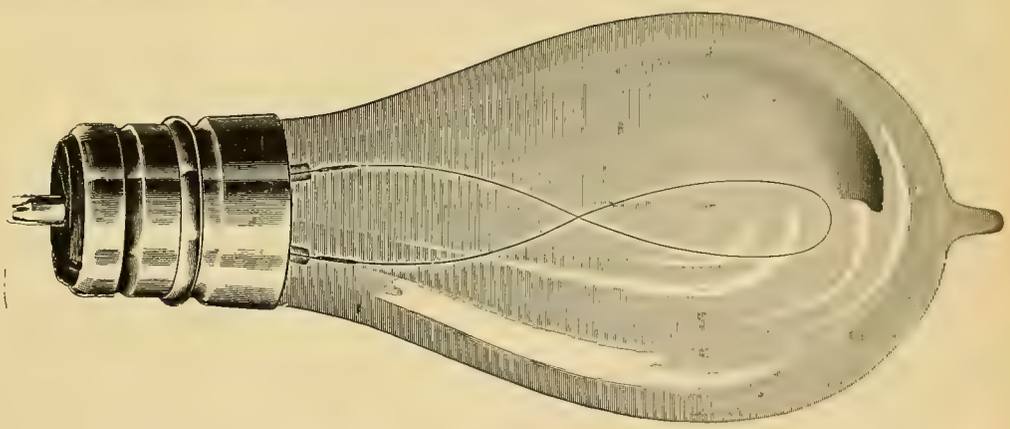

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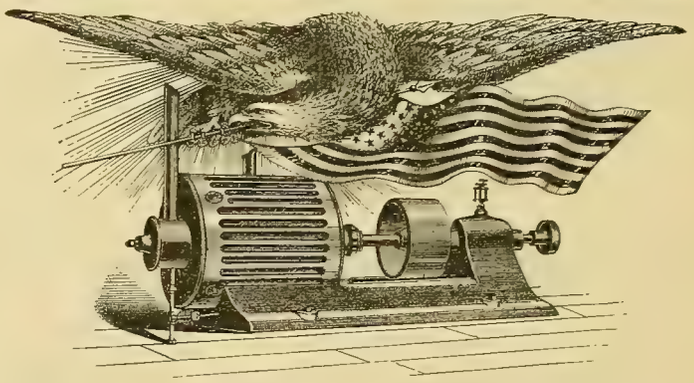

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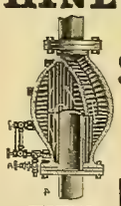

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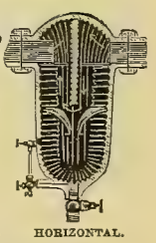

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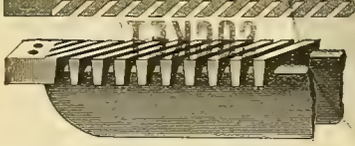

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Vol. X. CHICAGO, APRIL 16, 1892. No. 16

Electric Traveling Cranes at the E. P. Allis Company's Shops, Milwaukee.

The application of electricity to the operation of cranes designed for moving heavy machinery has become quite general during the last few years, and has consequently attracted much attention among manufacturers of all kinds of heavy machinery, as well as electrical engineers. Since the introduction of the electric traveling crane there have, of course, been many improvements, and to-day it is conceded to possess many advantages over the best type of mechanically driven cranes. The difficulties encountered in the construction and operation of these latter machines are pretty generally understood by electrical engineers.

FIG. 1. ELECTRIC TRAVELING CRANES AT THE E. P. ALLIS COMPANY'S SHOPS, MILWAUKEE.

Among the first to appreciate the advantages of electric traveling cranes was the Edward P. Allis company of Milwaukee, which installed probably the first triple motor crane in its foundry. This crane was of the Shaw type. So successful was the first machine that others were ordered, and now there are constantly in use in the Allis shops three large electric traveling cranes built by the Shaw Electric Crane company of Muskegon, Mich. These cranes are used for handling all kinds of heavy machines and castings, carrying them from one part of the shops to another and greatly facilitating the work of the company. The ease and safety attending the operation of these machines, together with the absence of noise, are in striking contrast to the jerky, unsteady and unreliable operation of mechanically driven cranes, with which all builders of heavy machinery are familiar. Another feature of the electric crane which will at once impress those who have had experience in the operation of the old styles is the speed regulation. All mechanically driven cranes have certain pre-determined speed of travel and hoist which cannot be varied, but the electric crane is under such perfect control that any movement may, at the will of the operator, be gradually and smoothly accelerated, retarded or maintained at any desired speed from the highest to the lowest capacity of the motor.

The machine illustrated in Fig. 1 is a fifteen ton crane in use in the Allis shops. This crane has a maximum hoisting speed of 25 feet, a bridge or longitudinal traverse speed of 350 feet and a trolley or transverse traverse speed of 125 feet per minute. The speed of each of these movements may be raised from nearly zero to the maximum by moving the reversing lever. Only one lever is required for each movement, and the manipulation is therefore of the simplest possible character.

The crane is fitted with incandescent lamps of an aggregate of 600 candle power, which brilliantly illuminate the floor below when the crane is used at night. It is fitted with duplex automatic brakes, to which in large part is due the accuracy with which the load can be handled in hoisting and lowering. These brakes not only insure against the accidental dropping of the load from any cause other than breakage of parts, but absolutely prevent any possibility of "racing" in lowering. The brakes are automatic in their operation and do not depend for their action on the skill or vigilance of the operator. One of them the mechanical brake, is applied continuously by the reaction of the load itself, the force with which it is applied being proportional to and increasing with the load, and is released by the pull of the motor. The other is applied by a powerful spring, and is always "on," except when withdrawn by the action of a solenoid in series with the hoisting motor.

Without the mechanical brake the crane would "race" in lowering, as the magnetic brake is then withdrawn by the current which actuates the motor, and as both the motor and load act in the same direction, so without the magnetic brake the load could not be stopped promptly after either hoisting or lowering, on account of the momentum of the armature. Accurate handling would be impossible without the capability of instantly checking the movement of the load, as when the current is thrown off it would always go either a little too far or not far enough. The two brakes acting in combination give great accuracy of control, which, together with the extremely slow speed at which the crane may be run, enables the heaviest loads within the capacity of the crane to be set with absolute accuracy.

All the truck wheels are cast from charcoal iron and the treads are chilled deep and hard and ground true. These wheels are considered by the makers to be better than steel, as the hard surface insures great durability, while the accuracy attained by grinding causes the traverse movements

to be extremely free from vibration. All the shafts are large and bearings are unusually long. Great attention is given to the matter of accessibility, the machinery being so arranged that all important details may be removed and replaced readily without disturbing other parts. Bearings are capped wherever possible. The girders are very rigid, laterally as well as vertically, and have a large margin of safety.

Further details of the construction of this type of crane are shown in Figs. 2, 3, 4 and 5, which are reproduced from *Iron Age*. Fig. 3 is a side elevation of one end of a 60 ton double trolley crane, having a span of 60 feet, Fig. 4

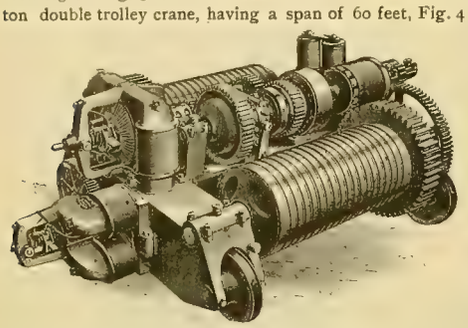


FIG. 2. ELECTRIC TRAVELING CRANES AT THE E. P. ALLIS COMPANY'S SHOPS, MILWAUKEE.

being a cross section through Fig. 3. Fig. 5 is a plan view of a crane trolley of 15 tons capacity. The bridge is moved along its track by means of a motor placed near one end, as shown in Fig. 3, the power of which is transmitted through suitable gearing to the driving wheels at each end. This crane trolley carries two motors, located at one side, as indicated in the perspective view, Fig. 2, one of which is arranged to move the trolley along the bridge while the other is so geared as to operate the hoisting drums.

The electrical features of this crane were fully described and illustrated in the WESTERN ELECTRICIAN, July 5, 1890.

These cranes are built by the Shaw Electric Crane company of Muskegon, Mich., and are handled by Manning, Maxwell & Moore of New York and Chicago.

A Trolley System for Torpedoes.

A correspondent of the New York *Sun* makes a novel suggestion for harbor defense. He proposes to string wire cables over the Narrows of New York bay and drop or lower torpedoes from them to destroy hostile vessels attempting to force an entrance. "By this system," he writes, "two inch or heavier wire rope might be stretched from shore to shore, at such a distance above the water that ships could easily pass beneath, and on this wire torpedoes of various sizes might be run out to and over or against the ships of the enemy and exploded by electricity exactly as wanted. These torpedoes could be lowered to a point below the water line under the side of a ship and set off equally as well as by dropping them on the decks and tearing up the plates, for a thousand pounds of dynamite exerting its force against a deck plate would do an amount of damage hardly calculable."

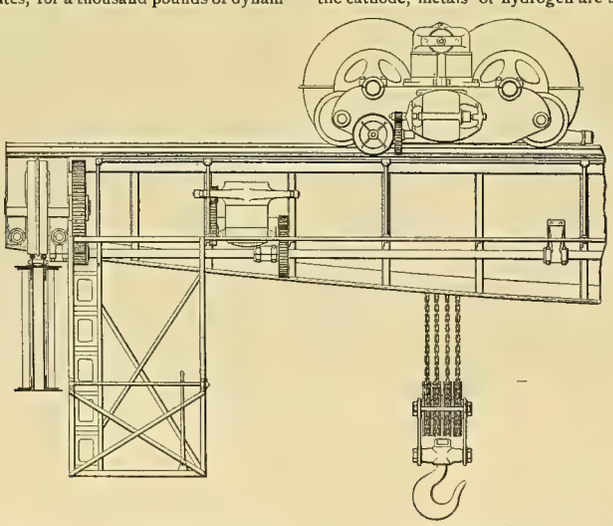


FIG. 3. ELECTRIC TRAVELING CRANES AT THE E. P. ALLIS COMPANY'S SHOPS, MILWAUKEE.

It is stated that a concession has been granted by the government of Nicaragua to Dr. Louis Cruz for the establishment of a complete telephone service in Nicaragua. All the material for the construction of the line will be admitted free of duty, and during the continuance of the concession no other similar privilege will be granted, except that the canal company and the various railroad lines will not be prohibited from enjoying private telephones in the regular course of their own business. The government will be furnished, free of expense, with twenty-five instruments, with the necessary connections with the central office and all the lines of the company.

Which Terminal Shall We Ground in Electric Railway Circuits?

BY CHAS. PROTEUS STEINMETZ.

In most of the electric railway systems the electric circuit is grounded by using the rails as return circuits. It is thus indeed not a true earth return circuit, as employed on telegraph lines, because for such large currents as employed in railway propulsion the carrying capacity of the earth is not sufficient to quickly distribute the current. Therefore a metallic return circuit is always provided by connecting the rails with each other and with a bare underground conductor, which carries the return current, so that the earth forms only a shunt to the return circuit. In this metallic return wire there is a drop of potential also, and consequently there exists only one point where the potential of the wire is the same as that of the earth; at one side of this "neutral point" the wire potential is higher, at the other side lower, than the ground potential, and therefore at the one side of the neutral point the current leaves the return wire, passes through the earth as conductor and enters the return wire again at the other side of the neutral point; that means that a portion of the return current flows through the earth as shunt to the return conductor. But, unfortunately, the earth is not a "metallic" conductor, that is, a conductor which carries the current without change of its chemical or physical constitution (except so far as it is heated by the energy consumed by its electric resistance), but the earth is an electrolytic conductor, that is, a conductor wherein, by the action of the electric current, chemical changes are produced, or rather, which carries the current only because chemical changes—generally dissociation of water—can take place therein. Therefore, for every ampere of current which passes through the ground a rigidly determined amount of chemical action must take place. For instance, thirty cubic inches of hydrogen gas are developed per hour at the point where the current leaves the ground, and at the point of entrance fifteen cubic inches of oxygen, and oxygen in its most destructive modification, either partly or wholly as ariatomic oxygen or ozone, which attacks all the metals but gold and platinum.

Considering the large amount of current always circulating in the return wires of extensive railway systems, and the vast surface of rails and conductors exposed to the earth, we cannot wonder that practice proved rapid destruction of return wires and rail bonds by electrolytic action.

It became customary, therefore, to connect the negative terminal with the return circuit and the positive terminal with the trolley line. The reasoning which led to this custom was about the following: If an electric current passes through an electrolytic conductor at the positive terminal, or the anode, oxygen is developed, which rapidly dissolves all the metals except very few, while at the negative terminal or the cathode, metals or hydrogen are set free, which affords such a thorough protection for the negative terminal that even if it consists of a substance rapidly dissolved by the solution (for instance, zinc in sulphuric acid) it is entirely protected against it as long as the current lasts. Therefore it was thought that by connecting the return circuit to the negative terminal (the zinc or hydrogen pole) it would be protected against electrolytic destruction.

How far that is true we shall consider in the following: Suppose the positive terminal connected with the trolley line, the negative with the return wire, and let us follow the path of the current. Leaving the central station, the current flows over the trolley line through the motors to the rails, from rails to return wire, back to the station, while a shunt current branches off from the return circuit at or near the motor, passes through the ground, and enters the return circuit again in proximity to the power house. Consequently, the rails and return wires at and near the motor will be positive against the earth and

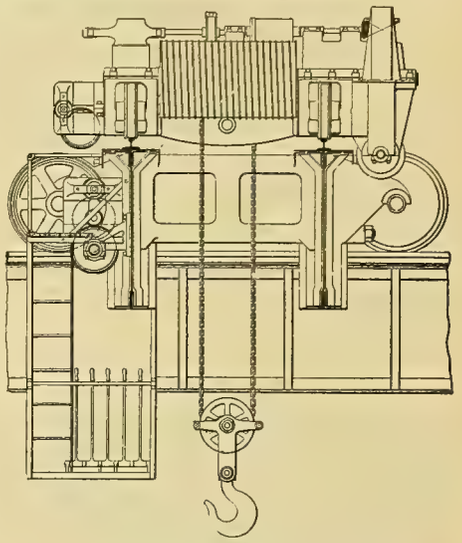


FIG. 4. ELECTRIC TRAVELING CRANES AT THE E. P. ALLIS COMPANY'S SHOPS, MILWAUKEE.

eaten away by electrolytic action, and near the central station rails and wires are negative against the earth and protected from destruction. Consequently a neutral zone exists where the earth potential is the same as the potential of the return circuit; outside of the radius described by the neutral zone electrolytic destruction will take place, inside, protection. But every ampere which enters from the ground into the return inside of the protected circle around the station has left the return outside of the protected circle and done its destructive work, so that we see that by connecting the negative dynamo terminal to the return circuit in a grounded railway system the return circuit is not protected against destruction by electrolytic action.

Let us connect, now, the negative terminal to the trolley line, the positive to the return. Then the whole phenomenon is simply reversed: outside the neutral zone protection is afforded, inside destruction, but again the protected area of the return conductor is the same as the area exposed to electrolytic destruction, and no protection of the system secured either. Only now the other half of the return circuit is endangered.

Changing the line terminals frequently if possible—for instance, every day—would not help either, but only damage the whole system of return wires equally. For, while in an electrolytic bath—for instance, a copper solution—by reversing the current the action is simply inverted, and the copper that before was dissolved at the one

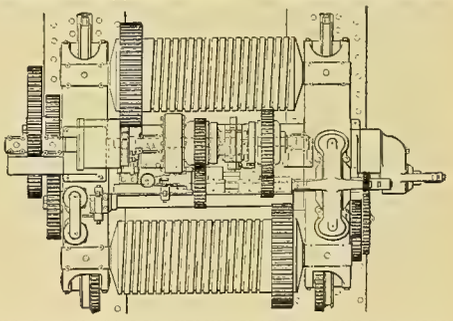


FIG. 5. ELECTRIC TRAVELING CRANES AT THE E. P. ALLIS COMPANY'S SHOPS, MILWAUKEE.

and deposited at the other electrode is now carried back again to the first electrode, in a railway return wire no deposition of metal is to be expected, but before the current has reversed the dissolved metal is dissipated in the earth.

Besides, a change of the line terminals meets with difficulties caused by the necessity of protecting the station against electrostatic discharges from the line, that is, against lightning. This makes it necessary to connect the series coil of the compound generator to the trolley line, so that a disruptive discharge, entering the power station from the line, finds its path obstructed by the heavy self induction of the series coil, and is thereby forced to jump at the lightning arrester, while, in reversing now the terminals, the series coil of the generator field would be between armature and ground, and such an oscillating discharge

would find a free path into the armature, and very likely, not being able to pass from the armature to the ground through the impedance afforded by the series coil, disruptive discharge would destroy the armature.

So we see that there exists no possibility of protecting a grounded return circuit against electrolytic action by connecting either the one or the other dynamo terminal to the return circuit, but in either connection half the circuit is protected, while the other half is exposed to oxidation.

If the central station is provided with a large and extensive ground a slight advantage exists in favor of connecting the positive terminal to the return circuit, because in this case a part of the current enters the earth over the ground in the station, and thereby the neutral zone of zero potential is moved nearer toward the station, and if it were possible to make the ground in the station of such a low resistance that it is equal or superior to the ground afforded by the whole return circuit, which is practically hardly possible, the radius of zero potential would coincide with the limits of the power house, and the whole return circuit be protected by throwing all the destructive action upon the ground in the central station.

Connecting the positive terminal to an extensive ground in the station, and interposing a suitable resistance between the return circuit and the positive terminal would bring the return circuit below the earth potential also, and thereby protect it, indeed, by the expenditure of a certain amount of energy in the resistance.

Besides this integral circuit, local electric circuits are formed between the iron rails and the copper conductor, iron and copper forming a galvanic angle whereby a current is produced which passes from the iron through the ground to the copper wire, eating off the iron, and thereby loosening the electric contact between the iron rail and copper conductor. If the positive dynamo terminal is on ground, the line current flows against this electromotive force, and at least occasionally impedes its obnoxious action, while, by grounding the negative terminal, the live current flows with the local currents through the earth connection between rail and conductor, which is less advisable.

Hence, concluding, we see that neither by connecting the negative nor the positive terminal with the grounded return circuit, the desired protection of this return wire can be secured, but in either case electrolytic action will take place, causing oxidation of the return conductor. But in regard to the local currents between rail and return wire it is even more advisable to connect the positive terminal to the return circuit, which practice is of some advantage, too, if a separate ground in the central station is provided.

Ahearn's Method of Governing Water Wheels in Electric Railway Service.

The Ottawa, Ont., Electric Railway company operates a line consisting of eight miles of double and four miles of single track. The system was constructed in seven weeks, and cars were put into service in the latter part of June last year. The equipment consists of sixteen cars of the vestibuled type, and the electric system employed is that of the Westinghouse Electric & Manufacturing company, single reduction motors of 20 horse power each being used on each car. The dynamo room is located at the famous Chaudiere Falls, where two turbine water wheels drive two 100 horse power Westinghouse compound dynamos, and a third machine is kept in reserve. The difficulty in supplying steady current by water wheels was at first a matter of serious difficulty as, owing to the frequent stopping of all or nearly all the cars at the same instant, the water wheels were liable to race. By an ingenious mechanical arrangement the water-wheel gates are now raised and lowered instantly, and by the introduction of a novel electric device sufficient load is kept on the dynamos at all times to keep down the speed of the water wheels.

As the problem of securing a satisfactory water-wheel controller is just now of much importance to electric railway men, a detailed description of the Ottawa company's apparatus will be of interest.

Speaking generally, this governing device, which was designed by T. Ahearn, of the firm of Ahearn & Soper, the builders of the road and its principal owners, consists of several coils of iron wire, connected in shunt to the trolley circuit, and so arranged that any current from 12 to 72 amperes may be made to flow through it. The wire is kept cool by being immersed in water, which is changed as it becomes warm.

In the station there are two 175 horse power turbines and three 100 horse power compound wound Westinghouse railway generators. The wheels are under 15 feet head of water and the dynamos are belted to a main shaft driven by the turbines.

At first the company tried a water wheel governor that was in very successful operation in its electric light station, but this was found to be practically useless for street railway work. Next man power was substituted at the gate wheel, but even this human regulator failed to keep the wheels reasonably steady. Then a very efficient means of regulation was tried, which is still in use. This last method consists of a right and left hand lever which operates a shifting belt, which in turn operates a gear wheel on each of the water wheel gates, so as to rapidly lift and lower the gates. This apparatus, of course, requires constant watching, but the low cost of the water power permits of this expense. It was found, though, that while the arrangement described solved the problem for ordinary fluctuations, when all the cars were in service, it did not work when a few cars were using current. The water wheels would race, and it was to overcome this difficulty that Mr. Ahearn resorted to the electrical regulator.

At first five non inductively wound coils, immersed in five barrels filled with water, were employed. The resistance did its work very efficiently, but when current was kept continuously in the coils the water in the barrels became overheated, and decomposition began, so it was necessary to devise still another arrangement. A large tank was then constructed with a capacity of 8,000 pounds of water, and in this receptacle five coils of iron wire were immersed. Into this tank a ½-inch stream of water was kept constantly running through fifty feet of hose. The lengthy hose was employed so as to increase the resistance of the stream of water. The wooden tank is set in a drip pan of sheet iron, with a 3 inch rim. The tank is kept a few inches from the sheet iron by porcelain insulators; from the pan a three-inch rubber hose runs to within six feet of the basement of the power house. The water overflows from the top of the tank, falls into the drip pan and is carried away by the rubber hose.

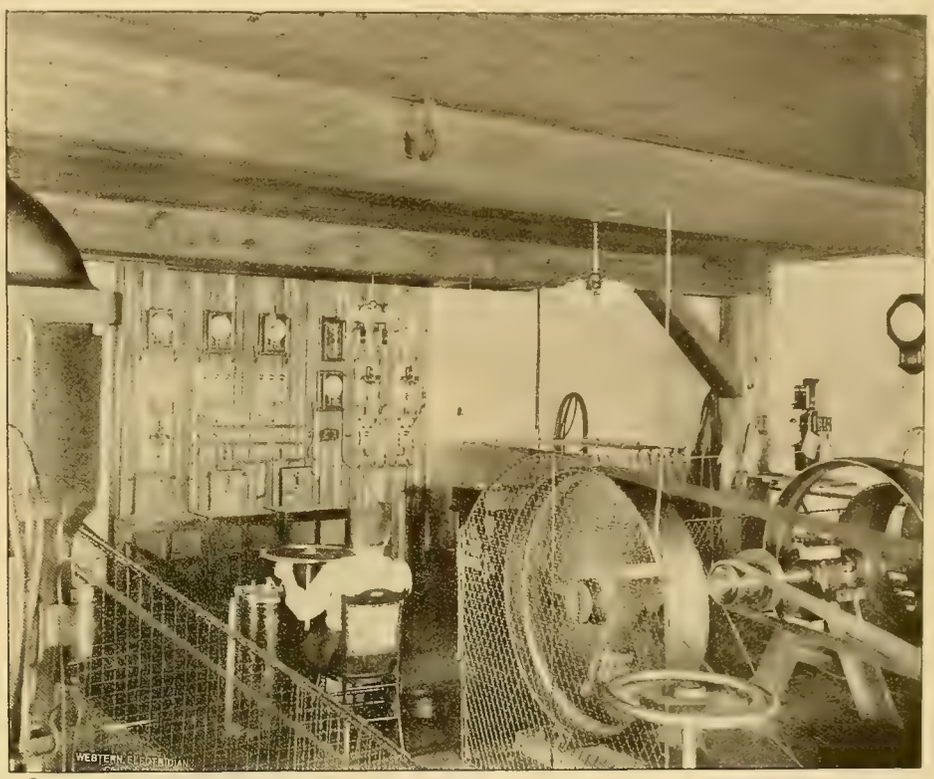
The five coils of iron wire in the tank are connected through an ordinary Westinghouse car controller. The first movement of the controller crank connects the five coils in series with the trolley and the ground of the dynamos; the second step connects the first and second coils in multiple, and the remaining three in series; the third step connects the first, second and third coils in multiple, and the fourth and fifth coils in series; the fourth notch connects the first, second, third and fourth coils in multiple, and the fifth in series; the movement to the fifth and last step of the controller connects all five coils in multiple. As at present wound the quantity of current diverted through the immersed coils is for the five movements respectively, 25, 50, 75, 100 and 125 amperes. The energy consumed, then, with the lever on the last notch at 500 volts is equal to about 84 horse power.

The cut presented herewith shows the Ahearn apparatus as it appears in the Ottawa station. The man on duty has the belt-shifting water-gate controlling lever to the right of his chair, and the current overload controller is at his left. By a coincidence of not infrequent occurrence all or nearly all the cars may cut off current simultaneously, and when this occurs the controller is then employed until the gate lever has lowered the gate sufficiently to make its continued use no longer necessary. During this time the wheels are sufficiently loaded to prevent their racing. Of course the electrical device is only used occasionally, and then it is early in the morning and late at night, when but few cars are moving, and always when the snow sweepers are out.

The man on duty watches the voltmeter and as the voltage drops he moves the lever to raise the gate until the needle stands at zero. If any unusual increase in pressure is indicated the controller at his left brings the coils into service and prevents the pressure from increasing dangerously. As the Ottawa company's power is cheap, as much drop in the mains as efficient work will permit is allowed. The voltmeter is connected with the center of distribution, a mile distant, so that regulation for the center of distribution is secured without regard to drop in the feeders.

It should be mentioned further that there would be an objection to the employment of an automatic device in combination with the electrical arrangement in that practically a constant load would be maintained on the dynamos, and this Mr. Ahearn considers as not desirable, as there would then be no intervals of rest for the generators. If it is desirable, though, in any case, regulation could be accomplished so that current would automatically either go to the trolley wire or through the tank. Mr. Ahearn also states that as regards steadiness of electromotive force the Ottawa system will compare very favorably with steam plants in which power is supplied to an equal number of cars.

This apparatus is not patented.



AHEARN'S METHOD OF GOVERNING WATER WHEELS IN ELECTRIC RAILWAY SERVICE.

Death of Andrew Irvine.

Andrew Irvine of the National Electric company, Eau Claire, Wis., who died suddenly last week, was highly esteemed in electrical circles. The following resolutions were adopted on April 5th by the board of directors of the City of Pekin, Ill, Electric Light & Power company:

Resolved, By the board of directors of the City of Pekin Electric Light & Power company of Pekin, Ill., that we tender our sincere regrets to the National Electric company of Eau Claire, Wis., upon the deplorable loss of its late faithful and efficient agent, Andrew Irvine, whose business relations with us have been of the most pleasant character, and gave every evidence of the deceased being a man of ability and strict integrity. And we further desire to express to the bereaved family of the deceased our deepest sympathy with them in their affliction.

Resolved, That the secretary of this company send a copy of these resolutions to the family of the deceased and to the National Electric company.

Lightning Arrester.

The cuts illustrate a lightning arrester devised by E. G. Miller, Wilkinsburg, Pa. As will be understood from Figs. 1 and 2 the line connection is made to a row of three carbon plates. Beneath these carbon blocks is fixed a helix connected as shown, and provided with a tubular core which projects below the lower end of the spool, and is closed at its lower end by a hollowed out plug. In the tube is placed an armature formed of a bundle of iron wires

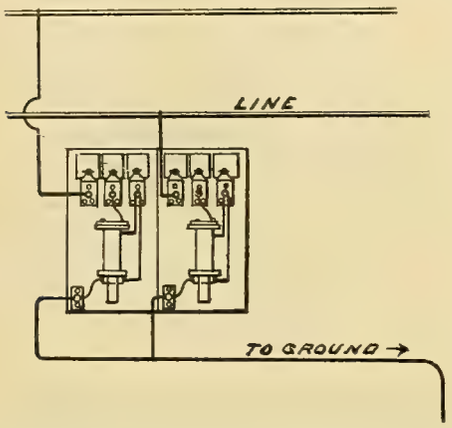


FIG. 2. LIGHTNING ARRESTER.

having spiral wrappings. The bundle is inclosed at its lower end in an insulating tube, and is furnished with collars which loosely fit the tubular core. In diametrically opposite sides of the tubular core are inserted screws, which clamp the ends of the conductors, and in the tube is placed a lot of mercury. The upper end of the helix is furnished with a cap which prevents the armature from being thrown out of the helix, and also excludes dust and moisture.

The designer explains the operation of this arrester as follows: When the current is working normally, the parts of the arrester remain in the condition shown in Fig. 1; but when either branch of the line is struck by lightning the charge escapes by way of the wire marked "line" and the three carbon plates. The lightning. leaping from the first plate to the second, either passes through the helix and thence through the mercury in the lower part of the core to the ground pin, or it may leap the space between the second and third plates, and thence pass to the ground, as before.

If an arc is established between the carbon plates and the dynamo finds a circuit through the arrester and the ground, the helix becomes energized and draws up the armature, thus allowing the mercury to recede from the

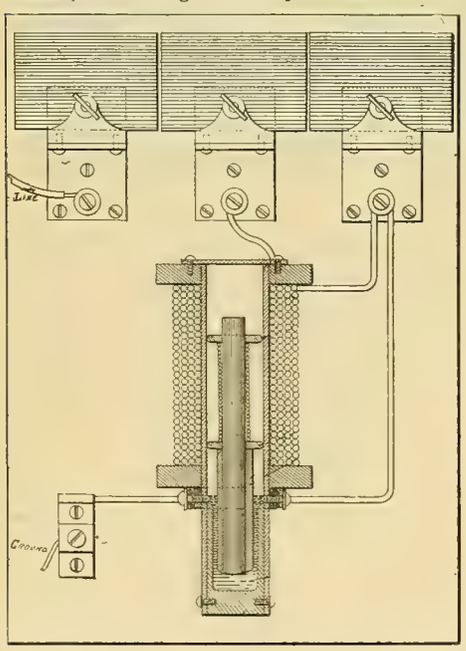


FIG. 1. LIGHTNING ARRESTER.

screws and break the ground connection, thus returning the circuit to its normal condition

The property of Roanoke, Va., Street Railway company has been acquired by a syndicate which has been organized with S. W. Jamison, president. The new owners will proceed at an early date to improve and extend the lines at an outlay of about $150,000. Electricity will be the motive power on all except the Salem dummy line. The company will also, it is understood, control the Crystal Springs Railroad company's lines.

Applications of Electricity in Balloons.

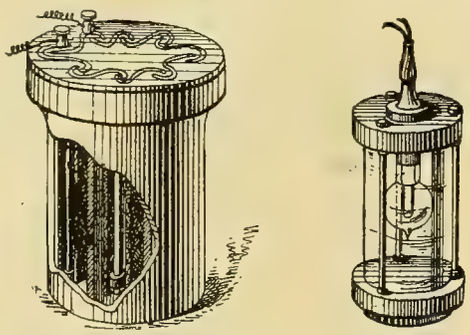
The problem of illuminating a balloon without incurring the danger of setting it on fire has become a fascinating one to aeronauts, especially in France. MM. de Fonvielle and Liepmann used the incandescent light in their ascension on the night of June 27, 1881, even before incandescent lamps with carbon filaments had come into general use. These gentlemen employed a little spiral of platinum inclosed in a glass vial and kept it red hot by current from two Plante accumulators. This means of illumination becoming more common, several aeronauts conceived the idea of establishing a system of optical telegraphy by the aid of luminous balloons.

M. Mangin applied, a bichromate cell Figs. 1 and 2, to the illumination of the interior of little balloons made of gold beaters' cloth, Fig. 3. There was used for this purpose an incandescent safety lamp, Fig. 4, with double glass walls. By means of a manipulator it was possible to reproduce, through flashes of light more or less prolonged, the signs of the Morse alphabet.

MM. de Dion and Dute Poitevin, on their long night journey from Paris to Aarau, in Switzerland, used a pile powerful enough to keep several Swan lamps kindled. In 1885 M. de Graffigny used Geissler tubes, but these did not give as desirable service as the incandescent lamps.

The most important factor in this mode of illumination is, of course, the generator. M. Renard, who, together with M. Krebs, is occupied specially upon problems relating to the direction of balloons, invented a chloro-chromic acid pile, whose specific power is said to be remarkable.

In their ascension, made in the balloon, Figaro, June 26, 1890, MM. Jovis and Mallet employed this battery



FIGS. 1 AND 4. APPLICATIONS OF ELECTRICITY IN BALLOONS.

in a series of experiments in which signals were exchanged with telegraph operators stationed on the third platform of the Eiffel tower. In these tests the idea of rendering the whole balloon luminous by placing in the interior of the envelope an incandescent lamp, was abandoned, as it was thought they would succeed better by concentrating the light into a powerful focus. They therefore used a lamp and reflector. The source of electricity, in this case, was the Renard pile, placed beneath one of the cross seats in the basket, as is shown in Fig. 5.

The balloon, in this instance, was equipped with a number of measuring instruments. There was a compass with a glass dial, which, being illuminated by a strong incandescent lamp placed above it, indicated the angle of the ground in relation to the magnetic meridian. The observers were able, also, to project upon the ground a pencil of rays by means of a lamp with a reflector, suspended by a cord under the basket, Fig. 6.

An apparatus very often used for aerial navigation is the alarm, for ascent and descent. This device, Fig. 7, is a paddle-wheel, movable in one direction or another under the pressure of air, so as to touch one of the contacts *c c*, and close the circuit to one or the other of two different bells.

One other electrical application that forms an important accessory, is the gas heater of M. Doillet, Fig. 8. This apparatus was designed to overcome the injurious effects of noctural condensation by causing the gas to expand under the effect of heat. The arrangement consists of a series of burners fed by hydrogen. The kindling is accomplished by an electric spark, which leaps up at the moment the supply pipe for the gas is opened. The draught is caused by two pipes, one descending into the basket, the other issuing through the valve. As 267 cubic metres of hydrogen expand one cubic metre under the influence of an elevation in temperature of one degree, it is evident that the apparatus constitutes a powerful regulator of the pressure and volume of gas. The cuts are reproduced from *Electricite*.

The mayor of Baltimore has signed an ordinance authorizing the North Baltimore Passenger Railway company to use the overhead electric system.

Electricity at the World's Fair.

No conclusion has yet been reached in the matter of awarding the contracts for the incandescent lighting at the World's Fair. The bids, which were summarized in the last issue of this paper, were referred to the committee on grounds and buildings, and that body turned them over to a sub committee consisting of Col. R. C. Clowry and C. H.

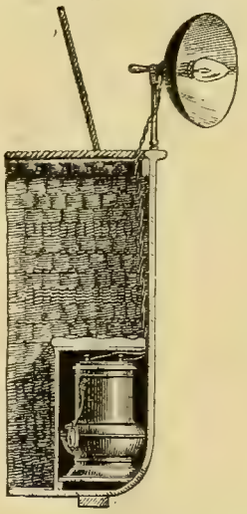


FIG. 5. APPLICATIONS OF ELECTRICITY IN BALLOONS.

Schwab, with instructions to confer with the representatives of the larger companies, whose bids were thought to be very high, to the end of arriving at some agreement whereby these important companies would agree to furnish a portion of the lighting at a moderate price. Several conferences of the sub-committee and representatives of the Thomson-Houston and Edison companies have been held to bring about this result, and negotiations are still in progress. After the bids had been opened and their contents made public the companies named sought and obtained permission to put in amended bids on the ground that they had misunderstood the specifications, thinking that conduits would be required in several places where the mains are to be strung on the elevated railway structure. Offers were then made on behalf of the large companies to do the work at a much lower rate than was proposed in the original bids, after visiting the grounds and conferring with Mr. Sargent, the electrical engineer of the construction department. Other meetings resulted in further reductions, until, by the end of last week, the revised price had diminished to about fifty per cent. of that originally asked. This was still thought to be too high, however, by the directors, and further meetings are in prospect. It is not intended, as the result of these negotiations, to slight the companies that put in the low bids, but the directors desire that all the important companies

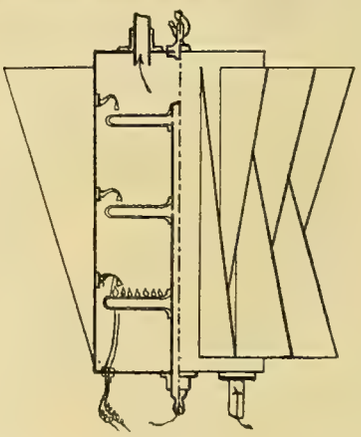


FIG. 8. APPLICATIONS OF ELECTRICITY IN BALLOONS.

shall be represented if a reasonable rate can be secured. Lieut. Spencer of Lynn and S. Dana Greene of New York represented the Thomson-Houston and Edison companies respectively at several of the conferences last week.

There was some difficulty last week with the iron workers employed on the electricity building. The men had trouble with one of the sub-contractors in relation to the manner of receiving their wages, and the places of about a dozen were filled. There was no serious delay. The iron work is now about completed, and the staff covering is being put on the wooden framework of the building.

Chief Barrett of the department of electricity is in New York on business.

Frederick Sargent has finally decided not to go to Europe

as a representative of the construction department—a plan that was for some time under consideration.

Secretary Hornsby was summoned before the congressional investigating committee last week to tell all about the scope, aims and finances of the department of electricity. He was subjected to a searching examination, but

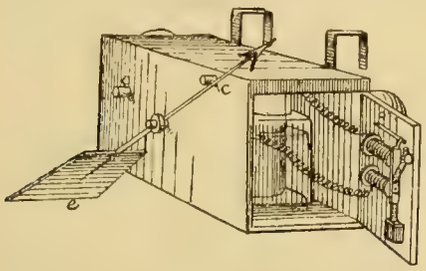


FIG. 7. APPLICATIONS OF ELECTRICITY IN BALLOONS.

the congressmen appeared to be satisfied with the answers that he made to their questions.

Telegraphy in Chicago.

A New York journal devoted to the interests of telegraph operators publishes a communication signed "Chicago Division 42, O. R. T.," intended to warn other operators from seeking employment in Chicago during the World's Fair, on the ground that the field would be greatly overworked, as the supply would many times exceed the demand. This is undoubtedly true, but the letter contains another assertion that has evoked considerable criticism. It is this:

The disastrous cutting of salaries which affected the telegraphers in Philadelphia in 1876 by reason of the Centennial being celebrated there; the same cutting and slashing in New Orleans in 1884, caused by the great influx of operators into that city to attend the World's Exposition, and from which they have never recovered, is now being experienced in Chicago. Large numbers of operators are coming to this city in search of work, in order that they

FIG. 2. APPLICATIONS OF ELECTRICITY IN BALLOONS.

may be here while the World's Fair is in progress. The result is the market is overstocked, and salaries are gradually being reduced.

A gentleman connected with the Western Union company, in conversation with a WESTERN ELECTRICIAN representative, characterized this statement as absurd. "It is sensational and untrue," he continued. "The constant tendency is to raise salaries, and I could mention several recent examples if it were necessary. We are not looking for cheap men, and do not want them. We desire a permanent force of competent and reliable operators, and have no wish to experiment with the 'skippers' who may

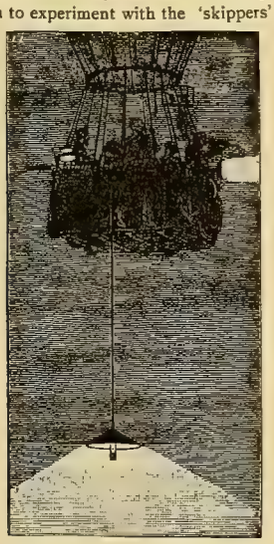


FIG. 6. APPLICATIONS OF ELECTRICITY IN BALLOONS.

be drawn here by the World's Fair. Most of our men are married and are old and valued employes. I can assure you that salaries are not being cut down, and that we do not contemplate such a course."

It may be of interest to add that the Western Union company employs 665 operators in its Chicago offices—an increase of 31 over last year. There are 220 clerks and office boys and nine battery men. The number of circuits operated is 607.

The Western Union company is considering the possibility of erecting a large new building in Chicago. It is at present located in an old building on the corner of LaSalle and Washington streets, but it seems that the lease of the ground has formed the subject of considerable controversy. The project is in the embryonic stage as yet, however, and nothing definite can be announced regarding it.

Chicago Electric Club and Technological Education.

The establishment of an institute of technology in Chicago which was advocated recently in a paper before the Chicago Electric club by Francis W. Parker, and which has since been the subject of much discussion, was considered at a joint meeting of the Western Society of Engineers and the Chicago chapter of the Society of Architects last week. The Chicago Electric club which was invited to attend was well represented, and there were also many prominent business men in the audience. President Harper of the Chicago university had been invited to make an address, and in the course of his remarks he said:

The University of Chicago will undertake a technological work commensurate with the times. An equipment deemed princely a few years ago would be poor at present. The University is taking steps to lay a proper foundation. We will select the best man available, without sparing

FIG. 3. APPLICATIONS OF ELECTRICITY IN BALLOONS.

money. The leading features of this department will be a trade school to give training to workmen, a school for foremen or governing workmen, and a school for manufactures. We will have schools of electricity, of architecture, of mechanical engineering, of mining engineering, of sanitary engineering, etc., one professor in each department, with two assistants. The basis of the departments will be in mathematics, physics, and chemistry. How much will it cost? For a physical laboratory $250,000, and for special laboratories and workshops $200,000. There will be $2,000,000 needed. The citizens will give this to educate the boys of this city. A vast storehouse of apparatus for the various schools might be obtained when the World's Fair is over.

Chicago Electric Club.

The meeting of the Chicago Electric club on Monday evening, April 11th, was devoted to a debate of the question: "Should We Have the Trolley in Chicago." The principals in the debate were Alex. Dow and Frank L. Perry for the affirmative, and E. E. Keller and St. John V. Day for the negative. F. W. Parker acted as judge of the debate, and also presided over the meeting. The question was discussed very thoroughly, and from many standpoints. Among those who spoke were Messrs. A. G. Wheeler, Soden, Sperry, Cutter, Terry, Degenhardt, Grier, Arnold, Horne, Pumpelly, Armstrong, Applegate, and others. Mr. Parker delivered his decision on the arguments presented, to the effect that the trolley system in the residence and outlying districts would be the best but would not do for crowded thoroughfares.

After the literary meeting had adjourned the committee of two, Elmer A. Sperry and B. J. Arnold, appointed at the last meeting to draw up resolutions on the death of Charles J. Van Depoele, presented the following a copy of which will be sent to the relatives of the deceased:

Whereas, The Chicago Electric club learns with sorrow

MODEL ARC LIGHT STATION

and regret of the death of our former member and fellow townsman, Chas. J. Van Depoele; and

Whereas, The electrical fraternity has lost a skillful and energetic engineer, and the club a true and faithful friend; and

Whereas, His work and efforts were always in the line of progress, and the practical development of electrical science along paths hitherto untrodden, and which have led in our own day to results of great utility and benefit to the public; therefore be it

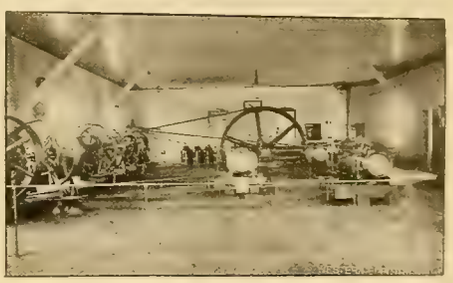
Resolved, That the Electric club of the city of Chicago desires to place on record the testimony of its respect and appreciation for the labors, ability and genius of the deceased, and that it hereby tenders to his family and friends its sincere sympathy in their bereavement and irreparable loss; and be it further

Resolved, That the secretary of the club be instructed to transmit a copy of these resolutions duly engrossed, to the family of the deceased, and spread the same upon the records of this club.

A Model Arc Light Station.

The accompanying illustrations show the power house constructed last fall by Louis Sands of Manistee, Mich., for his electric lighting plant. The house has several excellent features; the most noticeable of these on its exterior is the tall tower which is used as an observatory and a signal station, with the lower part as a wire tower and circuit distributing room. The height of the tower, together with the peculiar topography of the city of Manistee, admits of the superintendent observing whether his street ligh ting circuits are operating properly, almost any street lamp being easily identified from this elevation. The arc lamp on the summit is used to flash signals to linemen and other employes. The arrangement of wires entering the building is obvious. Within the room in the tower there is a crossing-board, in which the wires of each circuit are "crossed" from their position on the line poles to that which they should assume in entering the main switch-board.

In the interior, contrary to the usual practice, the visitor is met by a notice which states in large type that visitors are welcome, but are requested for their own safety not to handle any machinery or wires. There is ample floor space, so a large crowd of visitors causes no interruption to the movements of attendants. The engine is a 300 horse power Allis Corliss. The dynamos are all of the Brush Electric company's manufacture. Four of them are 60 light arc dynamos and the fifth is a 1,000 light direct



MODEL ARC LIGHT STATION.

current incandescent machine of the latest Brush pattern. All the arc lamps are of the new Brush-Adams type.

The growth of this plant has been phenomenally rapid. It was started with ten street lamps on Christmas eve, 1890, prior to which date there were no public arc lights in Manistee. Now all the arc dynamos are fully loaded and the demand for lights is not yet met.

The station is owned by Louis Sands. His superintendent, B. J. Stall, erected the station and installed the machinery, with Alex Dow as consulting electrical engineer.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CONGRESS has been petitioned by the national board of fire underwriters, and the president has been asked to address a message to congress advocating the enactment of a law providing among other things for suitable regulations as to special hazards from electricity, oils and explosives. Just what the president of the United States or congress has to do with these matters does not appear. Such matters come properly before local authorities, and there are already in many states laws covering these subjects.

THERE is great competition for the doubtful honor of being the most rabid city in the Union in opposition to the overhead trolley system, but San Francisco seems clearly entitled to this unenviable position, although closely pushed by New York. As detailed by our San Francisco correspondent, the lot of an electric railway man in that city is far from being a happy one. Even after the necessary franchises have been obtained vexatious litigation marks every step of the work, and all possible obstacles are thrown in the companies' way. And this is in the city where the cable roads have a record of killing one person a month and where the dainty little "cable bumper," recently described in this journal, is developed to its highest point of usefulness! The day is not far distant when the citizens of San Francisco will look back with shame upon the record that they are now making for themselves.

ONE hears, nowadays in Chicago, a great deal for and against electric trolley wires, but the latest suggestion as to the utilization of an overhead trolley comes from the metropolis, where so much opposition to the system has been developed, A correspondent in one of the daily papers makes a suggestion, impracticable, possibly, but nevertheless somewhat startling in its conception, providing that wire cables be strung over the Narrows of New York bay and that from these conductors torpedoes be dropped or lowered on any hostile vessel which, during a war, would attempt to force an entrance to the city.

"WHICH Terminal Shall We Ground in Electric Railway Circuits?" is a question discussed in another column by Chas. P. Steinmetz. Mr. Steinmetz explains very clearly his reasons for concluding that the return wire cannot be protected from electrotytic action by either connecting it with the positive or the negative terminal of the generator. Where the action from local currents is concerned, though, he deems it the best practice to connect the positive terminal to the return circuit.

It would be interesting to hear further from Mr. Steinmetz as to the direction in which might be found a satisfactory method of overcoming this now most vexatious difficulty.

FURTHER evidence of the progress that is being made in the introduction of electric traveling cranes in factories handling heavy machinery, is presented in an illustrated article in this issue. The advantage of this type over the mechanically driven crane with its clumsy, rattling and unsteady action have already become recognized by machine builders. A further advantage of using electricity in this work is here pointed out. In factories where it is desirable to handle heavy machinery at night the electric crane is especially adapted as power and light for the work may be obtained from the same source, as in street car work. The importance of having steady light for work of this kind cannot be over-estimated.

THERE is an interesting rumor afloat to the effect that the Western Union Telegraph company is considering the advisability of erecting a fine new building in Chicago. The project thus far appears to partake more of the nature of a possibility than a probability, and the local officials of the company are not disposed to be communicative regarding it. Outsiders who are familiar with the antiquated structure now used by the company will join in the hope, however, that the report is true. If the company does decide to build, it will undoubtedly put up an edifice that will be a credit to it and form one of the notable buildings of the city. Such a structure would be in marked contrast to the one now occupied, which is not calculated to overawe the visitors to the World's Fair by its magnificence.

THE government steamer Thetis is about to sail from San Francisco for Honolulu to complete the survey for the proposed submarine cable to the Hawaiian islands. The Albatross commenced the work and went so far as to make soundings over and back, when it was decided that she would be more valuable in Behring Sea, and the instruments and apparatus for sounding were transferred to the Thetis—a proceeding that delayed the work considerably, for the Thetis is not a vessel so well fitted for this class of service as the Albatross. The Thetis will follow the same general direction, filling in where it seems to be needed to ascertain more definitely the nature of the bottom of the Pacific. In the final plotting of the survey the lines laid down by the Albatross and the Thetis will be considered in conjunction with the much earlier one laid down by the Tuscarora. The Thetis will start from Point Conception and finish its survey at the Hawaiian end at Hilo. The Thetis is expected to complete its work in about six weeks, and then the Hydrographic office will begin its charts, which will serve as a basis for the recommendation of the navy department for the line which may one day connect this continent with the islands in the Pacific.

WHILE electric signaling on railroads has not been brought into such extensive use in this country as in Europe, it is gratifying to observe that improved systems, into which electricity largely enters, are now being introduced on several of the great American railroads. Electric block signals are to be used on the entire length of the New York, Pennsylvania & Ohio, and Chicago & Erie roads, which form a portion of the Erie system. The departure was only decided upon after a thorough trial of the electric signals on one division of the former line. The results were most satisfactory, and the railroad men were delighted with the operation of the block system. It is now announced that a somewhat similar method of signaling is to be put into service on the great New York Central system. All interested in electrical development, and, indeed, the entire traveling public, will hail the introduction of the improved method with approval.

FRIENDS of the storage battery will find little comfort in the patent litigation in which the manufacturers are still engaged. Conflicting opinions are handed down with a regularity that is astounding, and the companies controlling the patents seem content to exploit their apparatus in court, rather than devote their capital and energy to the development of the business. During the last three years there has been a constant warfare between the several companies, each of which claimed the exclusive right to the manufacture of storage batteries. Several fortunes have been expended in this controversy without advancing materially the prospects of any particular company or improving the storage battery. Moreover it must be admitted that the prolonged litigation has greatly interfered with the development of the storage battery and that it has raised doubts in the minds of many who have been watching the progress of the controversy while others have become discouraged or disgusted with the squabble and, having despaired of securing storage batteries, have taken up some other system. Such proceedings would be considered very poor business policy in ordinary commercial transactions, but many electrical interests have had to struggle through these disputes. It must be admitted that this policy has proven extremely costly to all engaged in storage battery business; in fact it may be said that more money has been expended in the legal controversy than in developing and exploiting the several systems. Despite this fact the companies now engaged in the controversy are in practically the same relative positions that they occupied several years ago. It certainly does not look well to see the electrical companies of Europe installing storage battery plants wherever electric lighting plants are found, while in this country the plants of any consequence do not exceed a dozen in number.

MEMBERS of the New York Electric club were notified last week that the subject of winding up the affairs of the organization was under consideration by the present management, and that the question would be voted upon by the members at a special meeting this week. This decision was reached after considering the report of the president on the financial condition of the club and its prospects. It has been known for some time that the New York Electric club was in a bad way financially and that the officers had been unable to arouse enough enthusiasm among the members to make a serious or determined effort to place the club on a solid financial footing. Such a condition of affairs is deplorable and should not exist under any circumstances. The metropolis of the continent should have a flourishing organization of the character of the Electric club, and that it has not is a reflection on the public spirit of the fraternity in New York. In the electric club it had an institution that was worthy of support, and one that might be made a powerful agency for the advancement of the general interests of the fraternity.

At its inception it possessed every element that was supposed to be requisite to the success of such an organization. With a large membership, commodious quarters, and backed by the most liberal class of manufacturers in the country, it ought certainly to have been a grand success. Such, however, was not the case. Poor management and internal dissensions undoubtedly have done much toward hastening the dissolution.

There is no reason why New York should not support a first class electric club. Chicago has an electric club and supports it in a most creditable manner, yet the Chicago Electric club is much younger than the New York organization, and has not, in some respects, enjoyed the advantages of the eastern club. As a matter of fact the bonds of the New York Electric club were, in one or two instances, bought by western people who withheld their support from the Chicago organization. Yet the latter is successful and the former is contemplating dissolution. This latter course should be avoided if possible. Certainly a feeling of despair should not be encouraged by the management. The president under whose administration the affairs of the New York Electric club will be closed up will certainly have little cause to look with pride upon his official career.

The Gearless Motor.[1]

By S. H. Short.

At first thought it does not seem necessary to place on the market a motor of new design, which involves the abandonment of gear wheels for transmitting the power of the armature to the axle, but when we consider it carefully and examine all the advantages to be gained by so doing, we feel justified. If you recall the history of the steam locomotive, you will remember that in the first machines the power was transmitted from the engine through gear wheels to the axles. This was soon abandoned because of the wear on the gears, the noise, the breakage and the many things which rendered it impracticable, especially

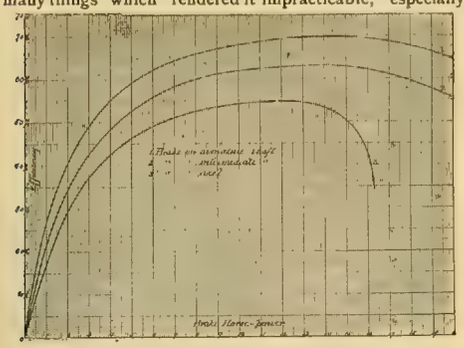


FIG. 1. THE GEARLESS MOTOR.

where high speeds were required. If you will look back over the history of the electric street car motor, you will remember that among the first experiments that were made, the high speed armature was geared down through a long train of gears to the axle. Finally, within the last two years, the practical operation of electric motor cars with two sets of gears of a double reduction has become quite general. It has been found, however, that these gears are a great source of expense in the operation of the electric street car, and it has been the object of the manufacturer to reduce the number of gears in street car practice as far as possible, until we now have all of the well-known electrical manufacturers offering a motor for street car service with but a single reduction, and we have already found in practice that this is immensely superior to the old double reduction type of two years ago. While this single reduction type of motor is undoubtedly eminently successful, I believe that we can go a step farther with great advantage; that we can connect the armature directly to the axle of the car without the intervention of armature, intermediate or other kinds of gears. The abandonment of gears, or a 'gearless" motor, is undoubtedly absolutely necessary where high speed is required for driving trains of cars upon suburban or interurban lines—a thing which we shall undoubtedly be called upon to do within the near future. It will be well for us to inquire into the disadvantages of the spur gear, the form which has finally been adopted as the only successful method of reducing the armature to the axle speed. These gear wheels vary in efficiency of transmission of power, with the load and with the speed. They wear rapidly, especially when placed under a street car in the dirt, grit and mud. This wear of the gears has been a very serious thing for the electric railways during the last three or four years. The repairs upon street car motors have been mostly because of the use of gears, and the cost of maintaining an electric motor car has been due largely to this one thing. With the single reduction motor, of course, much more than half of the difficulty has been removed, but we believe that with the gearless motor, which does not contain any of these wearing parts, and without the armature and intermediate bearings and shafts, bolts and

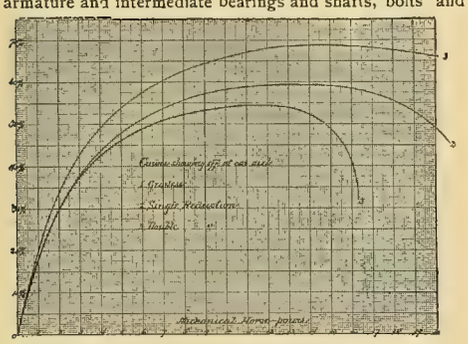


FIG. 2. THE GEARLESS MOTOR.

nuts, etc., we can get rid of all this source of cost in operating the electric street cars.

Those of you who have operated electric street car lines can appreciate what a serious thing it is for a tooth to break out of a gear in a car motor while it is in service. The car is loaded with passengers who have paid their fares. If one tooth breaks, the probability is that more will follow; finally the teeth of the gear do not mesh with the pinion, and it either bends the armature shaft or breaks the motor frame. Probably the wheels become locked and the car is unable to proceed on its journey. The passengers must be removed and the car must be taken from the track or dragged to the car house by another motor. This is calculated to make the patrons of the road dissatisfied with the electrical system and it creates a feeling of distrust in the public mind about the certainty and regularity of the operation of the cars. Nothing could be more serious for a street railway management than a feeling of distrust among the patrons of the road. While this is not now as common an occurrence as it was a year ago, because of the fewer gears in the single reduction motor and the fact that we are making our gears of steel which lasts longer and breaks less frequently, still the trouble is serious.

Again, it is a great source of loss to a street railway company when it is necessary to take a car out of service to replace worn-out gear wheels. A car earns on an average, in a good street car city, about $20 per day. If a car is taken off the road for half a day or a day, we not only lose the cost of the repairs, but we lose the profits of that day's run. The causes which disable cars should be reduced to a minimum, and it is to this end that we are advocating the use of no gears in a street car motor. It is very seldom now that we have trouble with the armature bobbins and field magnet spools burning out. While we had some difficulty of this kind in early days, we have learned how to insulate and protect the motors for street car service, so that electrically they are quite equal to the work they are required to do. We have therefore to look more carefully to the mechanical construction of a street car motor and perfect the parts of the machine. We believe that we should make a street car motor with as few parts as possible and especially should we endeavor to do away with the wearing parts. If we can abandon the gears you can easily understand that we not only do away with them, but also with those wearing parts which accompany a train of gears—fast running shafts and their bearings, box caps, nuts and bolts—all of which need looking after.

We will now take up the matter of the power lost in spur gearing and see what we can gain in that direction by abandoning gears. When we first took up the subject of a gearless motor we set about to see how much could be gained in the efficiency of transmission of power by doing away with the gears. I made a very careful and thorough investigation of the losses between the armature pinion and the intermediate gear and between the intermediate pinion and the axle gear, of a double reduction motor. I first put a double reduction motor in good order, eliminating the armature bearing losses as much as possible by running the motor for a long time, to wear the bearings down to a good surface. I put my power brake for determining the horse power directly on the armature shaft and ran the motor, delivering different horse powers,

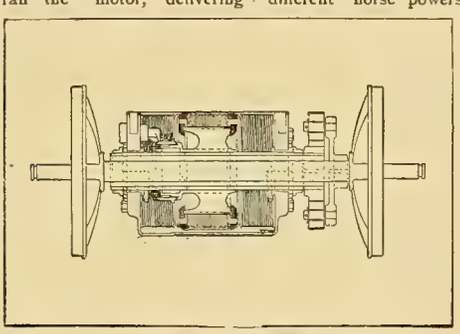


FIG. 3. THE GEARLESS MOTOR.

all the way from no horse power to its full output—20 horse power. At the same time we measured the electrical horse power which was being put into the motor and from this we constructed a curve of efficiency of the motor at different loads, which is reproduced as the upper curve in Fig. 1. The greatest efficiency reached by this motor was about 70 per cent. at a load of from 14 to 16 horse power. The efficiency at small loads, say, at 2 horse power, was something like 50 per cent.; at 4 or 5 horse power, an efficiency of 65 to 70 per cent. We then took the brake from the armature shaft and replaced it with a well-made armature pinion, allowing it to mesh with a well-made intermediate gear, these gears being cut as nicely and as carefully as possible, so that there would be the least possible loss between the two in making this test. Putting the brake on the other end of the intermediate shaft we again secured the number of readings of the horse power delivered after being passed through this one pair of gears, the electrical horse power being indicated carefully at the same time. From the efficiency at different horse powers thus obtained we produced a second curve, which is also shown in Fig. 1, as the middle curve on the diagram, and we find that the efficiency of this arrangement has fallen considerably. We once more remove the brake and place the intermediate pinion on the intermediate shaft, allowing it to mesh with the axle gear. The brake was now placed on the axle itself and another set of measurements—the same as those before made—were secured and a curve of efficiency again plotted, which showed a large loss in these gears, the efficiency at the axle being less than that at the armature by an amount indicated between the two outer curves. The axle results showed that at 14 horse power, delivered by the motor, we obtained an efficiency of 70 per cent. as a maximum when the brake was placed on the armature shaft. When the brake was placed on the intermediate shaft, delivering 14 horse power, the efficiency dropped to about 62 per cent. When placed on the axle, the efficiency dropped to a little less than 55 per cent., showing a loss in the gears of some 15 per cent. when delivering 14 horse power.

You will find in going over these curves that the loads vary considerably with the speed. Making an efficiency curve of the gears alone at different speeds, you will find the efficiency is very low at heavy loads and slow speeds and rises to its highest at medium speeds and medium loads. It again falls when running up to higher speeds. For this reason it is more economical to run a geared motor not too fast nor too slow, but at a medium speed. This fact has been established long since in the use of gears in other classes of machinery and in designing machines where power must be transmitted through gears. The best possible speed at which gears are to be run and the relation between pinion and gear are carefully considered. In the single reduction motor we regain, we might say, more than half of this loss in efficiency because the gears are run at a moderate speed. I think this one feature of gear loss makes it desirable to abandon their use in street car motors if possible. If we can save in practice 15, or more nearly 20, per cent. of the power consumed in operating a street car motor, by using the gearless instead of the double reduction type, it is well worth while, as this means the consumption of less coal and the reduction of first cost in the power plant and accessories.

Fig. 2 represents another set of curves developed in the

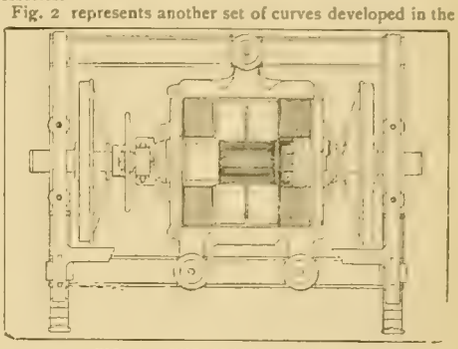


FIG. 4. THE GEARLESS MOTOR.

same way as those shown in Fig. 1. Three motors were used in this test, the double reduction, single reduction and the gearless. In each case the power brake was placed on the car axle. The double reduction motor, showing the efficiency at different horse powers, is practically the same as the lowest curve in Fig. 1. The power brake placed on the axle of the single reduction motor shows the loss in but one pair of gears, and its axle efficiency is greater than that of the double reduction. In the gearless motor, however, there is no loss between the armature and the axle; therefore the curve shows the actual efficiency of the motor itself. In the single reduction motor the relation between the diameter of the pinion and the gear is greater than it is in the double reduction; therefore the loss is somewhat greater. If we had a still slower running motor armature on the single reduction, so that the pinion could be larger and the gear smaller, this loss would not be so great, and the efficiency at the axle would be greater. From these curves it is seen that the efficiency of the gearless motor at the axle when delivering 14 horse power reached very nearly 70 per cent. or very nearly the same efficiency as the double reduction motor at the armature shaft. The single reduction motor when delivering the same power through one pair of gears showed an efficiency of 60 per cent., while the double reduction shows a little over 50 per cent. These practical tests show that with the gearless motor we actually save from 15 to 20 per cent. in the power necessary to be put into the car in order to get the same result at the axle.

We will now give you a description of the construction of our gearless motors. Gearless motors have heretofore, as you well know, been constructed and operated. The armature has been placed directly on the axle, and fairly good results have been obtained. The City and South London railway in London is operating its road with gearless motors to-day. These motors are high speed, making the problem somewhat easier. It is, however, difficult to construct a small motor, not too large to be placed under an ordinary street car, the speed of which shall not be above 105 to 150 revolutions per minute. Because of the light construction of the road bed in street railways it is always necessary to avoid the heavy hammer blow which occurs at the rail joints from a motor partly or entirely car-

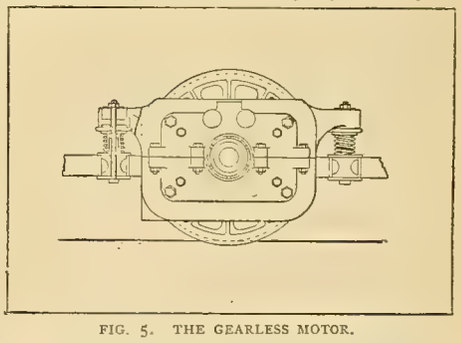


FIG. 5. THE GEARLESS MOTOR.

ried on the axle. When the wheel of the car passes from one rail to another, it falls, striking a very heavy blow. If we have a very heavy weight, directly attached and carried on the axle, without any intervening cushion or spring, we will have a very severe sledge-hammer blow on the rail at every joint. This will soon pound them out and destroy the rails. You are all familiar with the difficulty experienced in keeping up the rail joints on electric lines. The reason for this is apparent, if we think a moment, as it is a new element which has made its appearance since the introduction of the electric motor. All geared motors are supported at one end directly on the axle, by means of axle bearings. At the other end these motors are supported on springs; thus one-half of the weight of a geared motor is carried directly to the car axle without the intervention of any flexible material. Imagine, if you please,

1. Read before the Chicago Electric club, March 28, 1892.

that we could cushion both ends of a geared motor and put a spring between the motor and the car axle at the axle end. We will relieve the heavy blow of the wheels at the joints and the wheels would not do as much harm or as much damage to the track. The actual weight carried by a set of wheels on the rails does not seem to affect the joints materially. Old horse cars, even when carrying heavy loads of passengers, did not affect materially the rail joints. Cable cars do not destroy their tracks, no matter how great their loads. Therefore it must be that this heavy weight of the motor carried solidly on the axle is the thing that is breaking down the rail joints on electric lines. This heavy jarring also crystallizes the axles, and we have complaints from all over the country that axles on motor cars are breaking. When we come to examine these breaks, we find that the iron has crystallized, and the manufacturers are now endeavoring to overcome this by increasing the size of the axles. With the gearless motor, as we now construct it, none of the weight is directly carried on the axle. By referring to Fig. 3, which shows a section through the axle of the gearless motor, it will be seen that the armature is mounted on a hollow shaft which surrounds the axle, leaving an air space of about an inch entirely around the axle. This hollow shaft is really the armature shaft of the motor, and is carried in its own independent bearings in the motor frame. The motor frame consists of a box made in halves. These two halves are fastened together, and contain the field magnets and inclose the whole, protecting it from mud and dust; the only opening in the box being on the upper side, next the car floor. This box, which makes the complete motor when assembled, is provided with three projections at right angles to the armature shaft. These projections are made to receive steel spiral springs, similar to car springs. These springs are supported on the cross

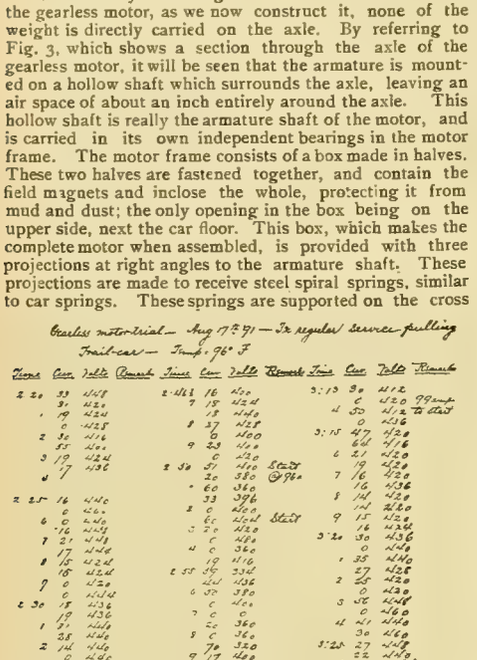


FIG. 6. THE GEARLESS MOTOR.

girders of any ordinary truck, such as is commonly used for motor cars, and support the entire weight of the motor. The axle is passed through this hollow armature shaft and can move freely in any direction within it. At one end of the hollow armature shaft is placed the flexible driving device which communicates the motion of the armature directly to the axle. This driving device can be seen in Figs. 3 and 5; and in Fig. 4 an end elevation of the motor is shown, together with the spring mounting of the motor and a section of the axle in the center of the hollow shaft. Fig. 5 shows a plan of a motor as you would look down through the trap doors in the floor of the car, the field magnets and armature, commutator and brushes all being revealed, and the ease with which you can get at the brushes and all the various parts of the motor is well shown. The axle also has a free end play of two inches through the motor and armature shaft. This is necessary in rounding curves and to insure freedom for the movements of the truck.

When the wheels drop from one end of a rail to another the motor does not immediately follow, its inertia being so great. The wheels, not being very heavy, do not make a heavy blow, but by the time they have reached another portion of the rail, the motor falls down against the springs, distributing, as it were, the blow over a considerable length of the rail, thereby preventing a serious damage to the rail joint.

The question is often asked, " How do you obtain the necessary power or tendency to turn the wheels around, without using an abnormal amount of current in so doing?" It is contended that in a geared motor we have an enormous leverage through the gears. If we had a small armature, the same as is used in the geared motor on the axle, we would not of course be able to start the car, or do the work necessary in moving a loaded car, but we have a large armature placed in a very strong magnetic field, and we have a great many more turns of the same current around the armature, thereby gaining in two ways a greater leverage because of a larger diameter of armature and a greater pull at the end of that lever, because of the increased number of turns of wire on the armature and the stronger magnetic field. It is something analogous to the steam engine. If we replace an electric motor with a steam engine, we can use a small engine under the car, with a small cylinder, and run it at high speed and gear down to the car axle, or we can use a large engine connected directly to the axle, as is common now in locomotive practice, and run it slower and get the same power, with, as has been demonstrated in steam motors, greater economy. You can make a similar comparison between the high speed engines of small size and the large Corliss engines running at slow speed. We have the advantage in the slow running motor of practically doing away with the loss in Foucault currents set up in the armature ring. Air resistance we are liable to, the greater loss in the dead resistance of the motor, but by designing our motor with a very low resistance of the magnetic circuit, we are able to cut down the wire on the machine so that its resistance is quite low, being only about 2½ ohms. There is another advantage in this slow speed motor, which is not small; the wear on the commutator is very slight and but little heat is produced by the friction of the brushes on the commutator making the motor run cool in all its parts. We are obliged, of course, to take advantage of everything that is possible in the construction of the gearless motor, in order to make it small and light enough for street car service. We use the best wrought iron and steel in its construction, because of their superior magnetic qualities. We have to use the best copper, of the highest conductivity, to reduce our resistance losses. This is of course in the end an advantage to the machine, because it makes it stronger and less liable to breakage.

It has been urged by some that the gearless motor is more difficult to repair than a reduction motor, and that it is a serious thing to repair an armature bobbin which has been burned out, because the armature will have to be taken out of the machine, and the wheels pulled off, in order to get at it. By referring to the drawings of the gearless motors it is easy to see that by dropping the lower half of the casting into the pit it leaves the upper half of the motor carried on the truck frame, and by simply raising the car body the armature can be rolled out from under the car without taking it off the axle or removing the wheels. In practice we should have one of these axles and wheels with the armature all ready attached, to roll back into the place of the damaged armature. Replace the lower casing of the machine and the car can be put immediately into service, and the damaged armature bobbin rewound in its place on the axle, there being no need of ever removing the wheel from the axle, except when the wheels are worn out and have to be replaced with new ones. The gearless motor armature can be removed from the car by one man in as short a space of time as a geared motor armature can be removed, and without so much damage to the armature, as it is well protected from abrasion and injury in handling.

To answer the question as to how much current is taken by the gearless motor in operating a car, we have prepared a copy of readings taken from a car in actual service drawing a trail car. The current readings, also the pressure readings, were taken every half a minute and from Fig. 6 a very good idea of the amount of current required can be gained. These readings were taken in August on the East Cleveland railroad, Cleveland, O. On this road the traffic is very heavy, although the grades are light, but by comparing the results with those obtained from single and double reduction, you will find that there is practically little or no difference between the current readings. The average readings, however, in the test run with the gearless motor, will be considerably lower than those with the geared motor, owing to the fact that we have gotten rid of the gear friction. The gearless motor will coast so easily that on very slight down grade a car equipped with gearless motors will run up to speed, without any current being used, and in making stops the current is shut off from a gearless car long before it is in a geared motor car. These intervals of the use of little or no current as compared with the intervals in which there is little or no current used in a geared motor are very considerable, and represent the extra loss in the gears.

We have carefully tested double reduction, single reduction and gearless cars running on the same track, on roads in Cleveland, O., taking at the same time readings of current and pressure, and we have found that in some cases the single reduction would require the least amount of current, sometimes the double reduction, and sometimes the gearless, depending upon the number of passengers hauled, stops made, and other things that might come in to consume more or less power; so it is difficult for us to say that there is any difference in actual power consumption between the three classes of machines.

The gearless motor is capable of starting loads as quickly as a geared motor, and is capable of starting as heavy a load under similar conditions, and we have a curve shown in Fig. 7 which illustrates the actual horizontal pull of a 20 horse power gearless motor, mounted on 33 inch wheels. In examining this curve, it will be seen that the horizontal effort in pounds, when the car is running 20 miles per hour, is about 250. In ordinary street car practice we find that it requires about 20 pounds per ton to move a load on street car rails. This means that with a horizontal pull of 250 pounds, this single motor could move a car weighing 12 tons at the rate of 20 miles per hour, or, as the curve will show, that at 14 miles per hour, the motor has a horizontal pull of 700 pounds, or it will move a load of 35 tons at the rate of 14 miles per hour on a level track. This curve is not falling off rapidly, certainly not as rapidly as it would with a geared motor, because the loss in the gears begins to increase very rapidly with the heavy loads. You can easily figure from this curve what the motor will do under any conditions of load, grade and speed. The tendency in street car practice is to increase the speed of the cars, and the gearless motor lends itself especially to this end, as we have found that with very rapid speed, geared motors wear out the running parts more rapidly and become very much more expensive to maintain. While the gearless motor can operate with as great economy at the slow pace required in crowded streets, it is also capable of running at a much higher speed in suburban traffic without the slightest fear of damage to the machine. In this respect it makes a very much more flexible motor than the geared machines. You can easily understand that this motor now makes it possible for us to develop large electric locomotives to be used in elevated railway service and for pulling suburban trains in and out of large cities.

From calculations and designs which we have made, we find that the size and weight of the motors required for 200 and 400 horse power locomotives is not more than is necessary to produce the required adhesion to the rails needed for the required tractive pull to move these heavy trains. The motors are not large, comparatively, and their economy will be very great. We believe that this branch of electric railroading will develop rapidly, and that within a few years, gearless electric railway motors will be used in places, for purposes, and in numbers unthought of at the present time.

Single Reduction and Gearless Motors in Street Railway Work.

In the WESTERN ELECTRICIAN of April 9th George K. Wheeler's paper before the Chicago Electric club on "Single Reduction Motor" was presented. At the same meeting of the club Sidney H. Short of Cleveland presented his views on the "Gearless Motor." Prof. Short's paper is presented in this issue. The discussion following the reading of these papers contained several interesting points, as will be seen from a perusal of the following report:

C. G. ARMSTRONG: Do you find, Mr. Short, in starting, or when running very slowly, that the gearless motor is as economical as the single or double reduction motors; that is, when your armature speed is very low?

MR. SHORT: If we wind two motors at their normal rate of horse power to run twenty miles an hour, one a geared motor and the other a gearless motor, they would be equally efficient. In either case we require a rheostat or some other device in the circuit.

THOMAS G. GRIER: The distance at which a speed of

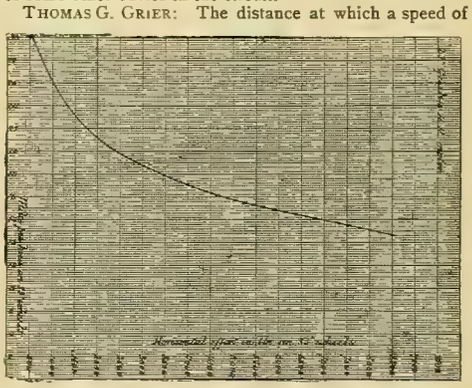


FIG. 7. THE GEARLESS MOTOR.

twenty miles an hour can be obtained from a dead standstill is a vital question on the elevated roads of the present time. They want to obtain the maximum speed in 200 feet, I believe, and it is claimed the only objection that is raised by the elevated railway companies in Chicago against the introduction of electric motors, is their alleged inability to meet this requirement.

MR. SHORT: If you have a motor of 100 horse power capacity on your locomotive you will not obtain speed in as short a time as you would if you had one of 200 horse power. It is simply a matter of railroad engineering. The motors will go quick enough, will do the work well enough, provided they are not overworked in doing it, just like a steam locomotive. If the motor is as powerful as the steam locomotive, it will be under headway just as quick. It is a matter of the power required to accelerate the load. Perhaps the objection raised in Chicago was based on some experiments that have been made in which motors of too small capacity were used in operating elevated trains. I know that the experiments that were made on the New York elevated roads failed entirely because of their not using large enough motors to pull the trains.

We have an advantage in the electric motor which they do not have in the steam locomotive. If the steam were to follow the piston all the way round, not having any dead centers at all, we would have something analogous to what we have in the motor armature. There we have a pull through the whole circumference, the whole revolution of the wheel, which is equal throughout, and that is the reason I believe an electric motor would start a train quicker than a steam motor.

If we would allow the starting current to continue all the time in the operation of the motor, it would overheat the motor; but we can overload temporarily a motor or generator much more easily than a steam locomotive, without any damage. It takes a comparatively long time to overheat a motor or generator.

D. C. JACKSON: The question of getting a slow speed on a motor is, of course, simply the question of getting the product of conductors on an armature into the number of lines of force which those conductors cut as great as possible. The larger your product the slower the speed can be. It may be gained by making a multipolar machine or otherwise. With the gearless motor the weight will be greater than with the single reduction motor. The higher the speed of the machine the more it militates against the gearless for ordinary street car traffic. There are two features to be taken into consideration in selecting motors for street railway service. The first is, what sort of traffic

are we to carry? The second is, how can we carry this most economically, and at the same time attract the largest number of passengers out of the possible traffic?

By the first condition you divide your problem into two parts. One is short distance traffic, short haul traffic, such as you get in many cities, and the other is suburban traffic and long distance work now done by the steam cars. After you have thus divided the problem you can begin to solve the question of economy and the best means of handling it. Now for the short traffic some conditions require a 16-foot car or a 20 foot car with four wheels. Others require a longer car. But in any event it seems to me that in order to attract people who might largely walk two or three blocks to take a car, and get their nickels, it is necessary to make access to the car as easy as possible, for this reason. I think we are making a mistake in getting our cars on 30 or 33-inch wheels, practically putting them up on stilts. I am thoroughly in favor, as motors are now constructed, of having them as high as possible, because it saves largely in repairs; but when it comes to a question of attracting the short haul traffic, I think it will be necessary to put the cars possibly on 26-inch wheels, and bring them as low as possible, as the horse-cars used to be, and in that case I think there is little doubt that a single reduction machine would have to be used.

When we get to the question of long distance work, when your passenger gets into the car and pays to ride 10, 15 or 25 minutes, whether it be a lady or gentleman, it makes no difference if we have two or three steps and even four steps, and we can make our cars as high as we please, placing them on 33 or 36-inch wheels. That gives us an opportunity to use the gearless motor under its best conditions, and secure great efficiency. I think if the manufacturers of gearless motors would cultivate that sort of traffic they need not trouble the short haul men with a gearless motor.

F. L. PERRY: Last week we had a discussion as to the desirability of one or two-motor car equipments. I would like to ask Mr. Short what he would do in a case where he has very heavy work, whether he would use a very large motor—I am speaking generally now—or two motors.

MR. SHORT: Do I understand that this is a four wheel or an eight wheel car?

MR. PERRY: Call it an eight wheel car. I want to get your idea of connecting two gearless motors, whether you would gear them together or not, so as to drive the double wheel base of the moving car.

MR. SHORT: We always put two motors on a car. We find that practice to be the best where we are using four wheels; so as to make them all traction wheels.

MR. PERRY: Do you find that they pull together satisfactorily?

MR. SHORT: Yes, just the same as they do on a double reduction or single reduction motor.

MR. PERRY: That question was agitated last week, and it seemed to be the opinion that sometimes the wheels would move against each other; that is, sometimes one set of wheels would not pull as fast as the other, and therefore they would not work harmoniously.

MR. SHORT: There is a great deal of flexibility of speed in the motors, because when one begins to run a little slower than the other, the counter electromotive force is not so great, and it takes a little more current, and they are finally evened up. They are run entirely independent of each other on the axles.

MR. PERRY: Then you would be in favor of an equipment on each axle?

MR SHORT: Yes, always.

MR. PERRY: Then for very heavy traffic would you advocate one electric locomotive pulling a number of trail cars, as we have on our steam roads, or would you advocate the arrangement that some one has advanced as being an ideal system, that is, the system with a motor on each axle?

MR. SHORT: You mean a motor on each car, on the separate cars?

MR. PERRY: Yes.

MR. SHORT: I think the locomotive would be the best in that case, the simplest and easiest taken care of. It would be run by one man and under the eye of one man.

MR. PERRY: My reason for asking that question is that theorists have advanced the idea that it would be better to have all cars equipped with motors, that is, have a long series of motor cars connected together, each car its own locomotive, as it were. I want to get your ideas on that arrangement.

MR. SHORT: I would say from a practical standpoint that it would be better to have one locomotive, because it makes less complications and consolidates the power.

W. S. ELLIOTT: I think this question of motors is gradually developing itself into one of the survival of the fittest. When a car equipment comes out of the factory, the motors are tested, and two motors that run at the same speed are selected for a car equipment. In case it is necessary to take one of them apart we can never get the same contact exactly that we had before, and consequently the motors will not run at the same speed, and the result is that we will meet with trouble in one direction or another, burning out armatures or fields. It seems to me if we can get a motor that has got as small a number of breaks in the magnetic field as possible, we will eliminate that trouble.

GEO. CUTTER: I don't just see where we are going to draw the line in street railway systems between the short lines in the center of the city, and suburban or interurban lines, where some of the gentlemen claim that the gearless motor would play an important part. But it does seem to me as if the motor cars would be eternally mixed up, and a car motor that will fill nearly all the requirements of a street railroad—and in this I do not include the present system of railroads—is the motor that is wanted. It looks to me as though the tendency would be to fix the gears in boxes carrying oil or grease, and reduce the wear to a minimum.

Famous Electricians and the World's Fair.

BY JOHN E. DAVIES.

It has seemed to me that in your list of "Famous Electricians," etc., published in your issue of February 27th, you ought not to give to Arago the credit of being the discoverer, in 1820, of the magnetic field around a wire carrying a current. Surely, this belongs to Oersted when he announced that "The electric conflict acts in a revolving manner," and so must be the cause of magnetic action surrounding the wire and affecting a needle near it, as his famous experiment showed. Under "Oersted" you assign this latter discovery to him in 1819, and such appears to be the fact. It is hardly correct to assign essentially the same thing to Arago in 1820, especially as Oersted's experiment made a great noise among the scientists of his day, and attracted attention at once.

Moreover, Lagrange, and not Laplace, ought to be credited with the discovery of the function we now call "potential." This is clearly shown (notwithstanding the account given in Todhunter's "History of the Theory of Attraction," wherein the discovery is credited to Laplace) by Prof. A. S. Hathaway of Cornell University, in the bulletin of the N.Y. Math. Society, Vol. I., No. 3, December, 1891. Prof. Hathaway shows that even the great point for which Laplace receives so much credit, viz., the use of some such function for deriving a force by mere differentiation of the function along a line, instead of the more difficult operation of integration over a volume or mass, was really first used by Lagrange in a memoir on "The Libration of the Moon," in 1773, which took the prize of the Paris Academy of Sciences for the year 1774. Three years later Lagrange read a paper devoted wholly to the "Potential and its Applications to the Dynamics of a System of Bodies."

The word "potential," I believe, was first introduced by Green. In the "Introductory Observations" to his famous "Essay on the Application of Mathematical Analysis to the Theories of Electricity and Magnetism" (Nottingham, 1828), Green says: "It is well known that nearly all the attractive and repulsive forces existing in nature are such that, if we consider any material point P, the effect in a given direction, of all the forces acting upon that point, arising from any system of bodies, S, under consideration, will be expressed by a partial differential of a certain function of the co-ordinates which serve to define the point's position in space. * * * In the sequel we shall often have occasion to speak of this function, and will, therefo e, for abridgment, call it the potential function arising from the system S."

Moreover, Cayley (Report on Dynamics, British Association Report, 1862) expressly credits the potential function and its peculiar use to Lagrange's memoir, "*Sur l Equation Seculaire de la Lune*," 1773.

Laplace, like many other mathematicians, deserves a place among electricians, but not for the reason you state. If you turn to Eric Gerard's "*Lecons sur L'Electricite*," for example, Vol. I., p. 133, you will see one of the reasons why he should be there. But so, also, would he be placed among the great of many other branches of physics, as his magnificent genius adorned them all. One has only to think of his "*Mecanique Celeste*," and "*Theorie des Probabilites*," especially the fifth volume of the former, to see that all questions of physics interested him as well as astronomy and mathematics. His contributions to electricity, however, are among the least of these, except as we view him from the ground of his "Spherical Harmonics" and kindred mathematical discussions, which are so vital to all higher theoretical study of this great subject. Even the now celebrated differential operator, called by many the Laplacian, which not only the electrical, but so many other potentials fulfill, seems to have had the independent attention of Lagrange also. The first derivatives of the potential (forces ordinarily) certainly did.

Lighting Effects on the Stage.

The pantomime of "The Forty Thieves," recently presented at the Crystal Palace in London, was distinguished by the effective use of electric lights. The fairy queen, whose wand is more powerful for good than the demon king's machinations are for evil, carried a brilliant lamp above her forehead, the current for which was supplied by a small secondary battery. The demon king was similarly provided, and Cogia had three, one on the crown of her head and two at the termination of her long ringlets. In these cases the batteries were hidden within the folds of the dresses of the performers. Two groups of attendant Amazons in the procession carried spears with decorative colored streamers, and from just below the spear head appeared a twinkling point of fire, as if the spear had a diamond setting. A very brilliant effect was produced. The batteries supplying the current to the spear heads were carried in a small metal pocket on the spear shaft, hidden by the streamers. In the transformation scene a number of camels were depicted, each carrying a lady above whose head was a corona of incandescent lamps. These were fed by means of flexible connections with appropriate terminals on the stage floor and on the camels.

Electricity in Coal Mining.

No other class of men has been so ready to welcome the aid of electricity and so willing to sound its praise as mining engineers. They have found the electrical system of power transmission of peculiar advantage and convenience in their work and have been willing to bear testimony to the fact. The mining papers, too, have encouraged the introduction of electricity as marking a decided advance in mining development. One of the latest contributions to the literature of the subject is by *Black Diamond* of Chicago, which dilates on the use of electricity in coal mining in this strain:

The advent of electricity in the field of coal mining, although not of any great length of time, has met with a wonderful success; and that it will play a most important part in the future there can be but little doubt. It does not necessarily supersede or render obsolete the present system for the generation and transmission of power, but rather creates for itself a new vocation, opens up a new avenue and can be utilized in places and by means that no other agency could be substituted for. This is, indeed, its great peculiarity of value. There is, for instance, mining carried on in Colorado under circumstances that, were it not for the ready facility with which motive power can be transmitted by means of electricity, would be next to impossible. So varied are the conditions that, the greater the number of agencies that can be utilized for dealing with these conditions, the better it is for mining. Hence, electricity does not come as a displacing power, but as one more additional force to wring from Nature the treasures that lie hidden in the earth.

It will be freely accepted that in some mines electricity is an agent of value that can not be exceeded. Especially is this so in regard to the lighting of mines, and if it was never used for any other purpose it would find a wide and useful and profitable career in this one particular department. Every mine owner must be fully alive to the losses which have happened in the past, the destruction of life and property, and the damages accruing to the relatives of the victims of mine disasters, not to welcome with avidity any means that would offer not only a mitigation of prospective trouble on this score, but reduce such a contingency to a minimum. Again, electricity as an illuminator will perform another useful function, none the less valuable to the minor than it is to the mine owner. It will remove from mines the fœtid atmosphere which is a product of bad or low grade oil, and which has such poisonous effect upon those whose lines of labor compel its inhalation. It is injurious to the mule as it is injurious to the man, and, although vast sums may be spent upon the ventilation of the subterranean vaults, they do not completely remove this fatal concomitant of the mine. Many more miners are on the average dying now of lamp-black than was the case a decade or so ago, and the general vitality of the men is naturally abnormally reduced after hours of labor in its atmosphere. Exhausted miners are liable to be much more careless than when in the full possession of all their energies, and many an explosion, presumably the result of careless shots, may have had its origin in the inert condition of the miner. A system of lighting therefore which would practically remove this trouble, improve the health of the miners, and perhaps decrease the expenses of ventilation, and in every way improve the general safety of the mine, is surely one whose points are not only worthy of but merit the closest attention. The Frick company are extensively adopting the use of electricity as a generator of light, and their example is being followed in many other large mines all over the country; and it is a safe prediction to indulge in that the time will come when it will be considered one of the most necessary adjuncts of a well equipped mine.

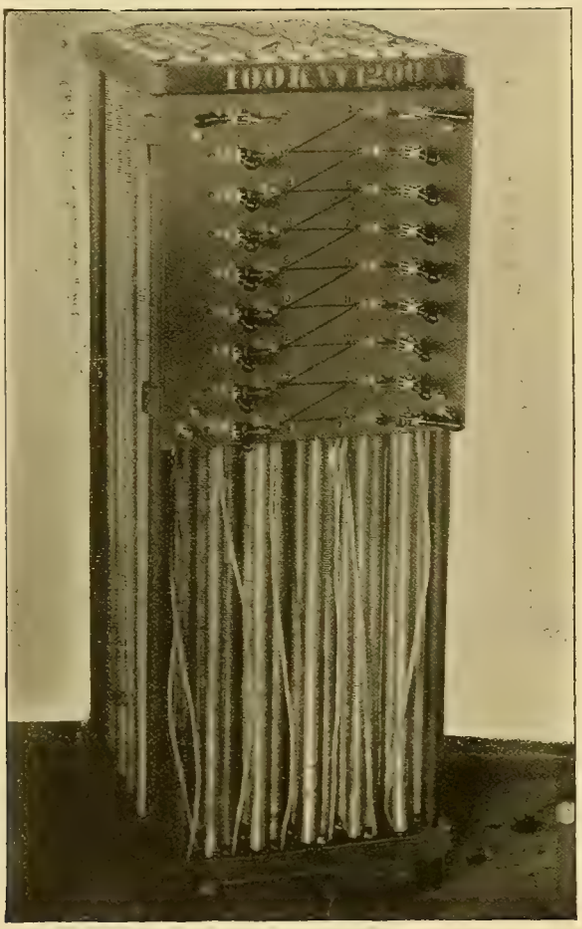
The electric current as a motive power in mine work claims attention on the ground of the facility of its handling. It can be tapped at any point, and run off in a circuit in any direction, and easily and inexpensively shifted. Its application, too, to a system of mine signals is easily appreciated. The instantaneous warning that it is enabed to give of the advent of any trouble might often be the means of alleviating both the loss of property and life. In the electric coal cutter and the electric drill it evidences its value as a motive power of the highest order. The number of electric coal cutters in the market is an indication of its utility in this department and its work is clean, quick and economic. The economy it obtains is as great a feature of its use as the increased productive capacity which it may give to the mine. The greater amount of coal that may be extracted in a given number of hours, the less is the average cost of mining, for clerical and running expenses are just as much in one case as in the other. In these days of competition, the cheaper a miner can mine his coal, the better is his position in the competitive market, and as a result of a realization of this fact the general adoption of machinery and mechanical force of electricity and compressed air as motive powers, becomes a greater and ever increasing necessity. Time is money and machinery saves time and it saves money, and hence the use of machinery of all kinds is advocated in these columns, and the value of electricity, as a new agent, is considered. The coal industry and the science of electricity are closely bound up and interwoven, for some of its most useful triumphs have been in the coal mine, and it is destined to find in that direction a far greater field in the future than it has found in the past.

The trolley system is to be introduced in West Philadelphia, and will serve the southwestern section of the city.

New Edison Rheostat.

The new starting and controlling rheostat for motors running on high voltage currents which has been recently introduced by the Edison General Electric company, is a modification of the standard Edison starting box for motors of large current capacity, which was furnished with an ordinary switch base, fitted with a number of contact blocks and plates and arranged in a semi-circle around the pivot upon which the switch arm turns. The formation of arcs between the contact blocks, resulting in their deterioration and destruction when the rheostats were used on high voltage circuits, constituted a difficulty which it became necessary to eliminate. The arcing could be avoided by employing a larger number of blocks on the board, but this would necessarily increase the cost of manufacture as well as the size of the board.

The modification consists in the substitution of a switchboard with several separate and distinct switches, in place of the ordinary board just mentioned. By the employment of several separate switches it is possible to arrange the coils of the rheostat in multiple with themselves so that



NEW EDISON RHEOSTAT.

if it is required to carry a large current, or remain in circuit constantly for the purpose of reducing the speed of the motor, it is comparatively simple to manipulate the switches according to requirements. The resistance is built up of tinned iron wire wound in spirals and arranged in sections.

The rheostat shown in the cut is designed to start and control the speed of a 100 kilowatt motor, working on a 1,200 volt circuit. The range of resistance is very wide, its greatest resistance being 72 ohms, while with the switches properly arranged it can be reduced to .25 of an ohm; the current carrying capacity for the smaller resistance being increased in the same proportion. The overall dimensions of the box illustrated, which was designed for an electric mining plant, are: height, 5 feet 6 inches; width across switch-board, 28 inches; depth, 26 inches.

Rheostats of this design are said to be absolutely fireproof, strong and substantial in construction,and arranged with a view to securing a high insulation resistance.

The *Boston Beacon* is informed that J. Pierpont Morgan of New York has united with H. M. Whitney to get control of 50,000 shares of the stock of the West End company in Boston, and that these gentlemen have already acquired about 30,000 shares. It is asserted that within a few months the West End railway will be in the hands of Mr. Whitney and his New York friends.

Pilkington-White Electric Meter.

The Electric Construction & Supply company, New York, has just offered to the trade something novel in the way of an electric meter, for which it has the exclusive rights of manufacture and sale. On the outside the meter is similar to a gas meter, there being in view only the dials which register the amount of current used in ampere hours instead of cubic feet, as in a gas meter. The cut shows the inside of the meter case. The principle of this machine is the same as that of a clock; that is to say, when wound it will run for 40 days. The meter shown in the illustration is for ten incandescent lights taking about one-half ampere each or five amperes per hour. In the center of the box there is a drum, as it is termed, with ten pins, the largest about two inches long, and each one a little shorter, until the smallest one is reached, which is about three eighths of an inch. This drum is continually revolving, making one revolution per hour. There is a lever connected to the core of the ampere meter, one end of which is actuated by the drum, the other end being engaged with a toothed wheel. This wheel is connected with a gearing similar to a gas meter. By this means the consumer or central station man can obtain a direct reading of the ampere hours. As each incandescent light is turned on, its current moves the lever into a position where it will strike the same number of pins on each revolution of the drum as there are lights burning.

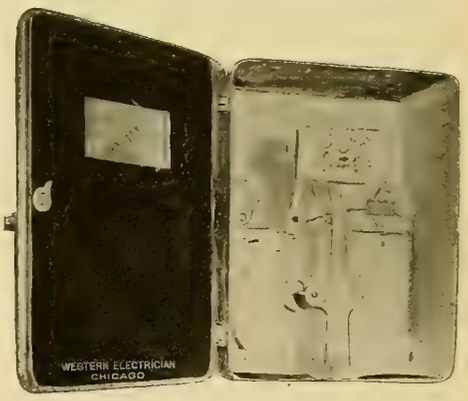
As each light is turned off, the lever is moved to a position whereby it will strike one pin or cog to the left, and so on till all are turned off. When all are off the lever is thrown to a position where it escapes striking the pins as the drum continues on its journey. By this action only the exact number of ampere hours is registered.

Annual Meeting of the Thomson-Houston Company.

The annual meeting of the Thomson-Houston Electric company was held at Middletown, Conn., on April 11th, nearly the entire capital stock being represented in person or by proxy. The directors, through C. A. Coffin, first vice-president, submitted a report, in which this statement occurs:

The opening of the last fiscal year found an essential decrease in our business, particularly in that portion derived from the local lighting organizations operating from central stations. The street railway department of the company suffered to a less degree. From these causes there resulted a decrease for the first half of the year of 40 per cent. This loss was, however, almost wholly recovered during the second half of the year. The unfilled orders in hand at the present time, as compared with the same date of the last year, are more than double in amount. The outlook for the ensuing year is most encouraging.

Benjamin F. Peach, Jr., first assistant treasurer, submitted the financial standing of the company as follows: The Thomson-Houston Electric company has received from its stockholders from time to time $10,500,000 in actual cash from subscriptions to its stock. The last issue of common stock, amounting to $1,500,000 at par, was sold in September, 1890. The surplus net earnings for the fiscal year just closed, after deducting $1,236,366 paid during the year as dividends, are $1,524,414.25, making the total surplus February 1, 1892, $7,564,593.46. Prior to March, 1892, there had been paid to the stockholders in cash dividends a total of $1,731,131.88. In addition to this there had been distributed among the stockholders as a special dividend $1,000,000 of common stock at par, and securities of the value of $2,416,468.27 were placed in the hands of trustees for the benefit of the stockholders. Stockholders have realized as profit from sales of stock in excess of cost to them $775,000. Balance sheets show profits of $2,760,080.25 for the year.



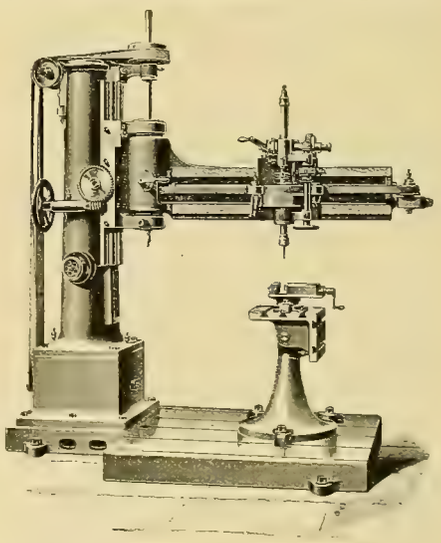
THE PILKINGTON-WHITE ELECTRIC MOTOR.

The following named directors were chosen: H. A. Pevear, C. A. Coffin, B. F. Spilley, G. N. Smith, C. H. Newhall, Eugene Griffin, S. Endicott Peabody, J. Jefferson Coolidge, Jr, C. A. Barton.

German Electrical Drilling Machine.

The accompanying cut shows an electrical drilling press recently brought out in Germany by Collet & Engelhard, of Offenbach-on-the-Main. The pillar of the press contains a 110 volt 1½ horse power motor, which takes the place of the ordinary belt. Collet & Engelhard make electrical cranes and all kinds of electric machine tools.

An English contemporary, *Industries*, from which the cut is reproduced, thinks that the electrical method of driving machine tools directly is not worked out as it ought to be. After calling attention to advantages already thoroughly understood by electrical engineers, the journal in question says, in speaking of motors:



GERMAN ELECTRICAL DRILLING MACHINE.

They need not be large. It is surprising to many to find what a little power will drive a large tool. The motors will, no doubt, cost more than the usual speed pulleys and countershafts, but not much more. It is questionable whether the whole cost of the motors and conductors would be as great as that of the shafting and belting now used. Speed cones are unnecessary, as the motor can be mounted as part of the machine, and if direct currents are used it can be fed

under different pressures, or, if alternating motors are employed, circuits of various frequencies can be employed. The advantages of such an electrical system are that the forest of belting, with its attendant turmoil, is done away with, and a clear space is allowed for overhead cranes. A great part of the shaking and jarring is due to belting, so that with motors the machinery will run smoothly and noiselessly. The attention needed will be much smaller, as the whole of the overhead gear is done away with, and the motors are within reach of the machine attendant. If multiple current motors are employed, no commutators are necessary, and the motors thus add no working surfaces to the machines.

Industries adds, very sensibly, that "it is scarcely to be expected that works managers will remove their belts and countershaftings to replace them by motors in existing shops; but before making any further extensions it would be wise to consider the motor and lighting question carefully, and this, we feel sure, will result in adopting motors, and eventually in the gradual replacing of belts throughout the works."

CORRESPONDENCE.

New York Notes.

NEW YORK, April 9.—Rapid transit once more assumes importance in this city, in view of the legal victory gained by the commissioners. On Thursday the General Term of the Supreme Court decided in favor of the appointment of commissioners to determine whether the rapid transit railroads shall be constructed in accordance with the general plan of the Rapid Transit Commission, to which the consent of the local authorities was obtained last fall. The law requires the report of the commissioners to be made within sixty days after their appointment, unless the time shall be extended by the court, and, if favorable to the construction and operation of the road and confirmed by the General Term, it is to be taken in lieu of the consent of property owners along the line. As is well known, the commission failed in its effort to obtain the consent of the required proportion of property owners, and some of these have contested the application for the appointment of commissioners. While it is not clear that the property owners, after refusing their consent, had any right to contest the appointment of commissioners on the ground that the law had not been complied with, it is well that the question has been raised thus early and disposed of by the court. The report of the Rapid Transit Commission, submitted last October and approved by the Board of Aldermen, with its maps and exhibits, showed where the routes were to be and how the road was to be constructed with sufficient clearness to enable any one to judge of its general effect. It is now at least a year since the Rapid Transit Commission began active work and it is to be hoped that the public will soon have some returns for its forbearance.

The employment of an electric battery for the punishment of the incorrigible boys among the three hundred in the City Home at Verona will likely provoke investigation. An electrode with a thin wet sponge is applied at the base of the skull and a brush-like appendage, with bits of wire at the end, is touched to the boy's exposed flesh when the current is turned on.

The work of applying the block system of signals to the entire New York Central railroad between this city and Buffalo is practically under way. The company's chief engineer has been authorized to contract for the erection of seventy-three iron bridges, spanning the four track road from Albany to Buffalo. These bridges, which will be light structures, will carry the signals and the operator's cabin. There are to be ninety-three block signal stations between Albany and Buffalo, and all but twenty of them will be elevated.

It is reported that a consolidation between the Jersey City and Newark railroad companies is possible. The electric road stretching across the meadows between Jersey City and Newark is to be the connecting link. It is to be in active competition with the Newark and New-York railroad and to carry Newark passengers to New York for ten cents.

An electric railroad is shortly to be built between Red Bank and Long Branch. The railroad company is made up mostly of New York capitalists, and is known as the Seashore Electric Railway company. The road will run by the way of Eatontown. The company has made a call for money, which is to be paid in by May 1st. It is thought that the work of constructing the road will be commenced early in May.

There was a meeting of the committee of the Telephone Subscribers' association and the Board of Trade and Transportation yesterday in the rooms of the latter organization, to consider what was to be done after the defeat of the Telephone Commission bill, for which both bodies worked hard. It was decided to contest the re-election of all members of the Legislature who opposed the bill, following the plan adopted in the gas fight several years ago.

W. F. O.

Denver, Colo.

DENVER, April 9.—A thirty mile electric road to Castlewood dam is the latest project of the Denver Land & Water Storage company. Manager W. E. Alexander, with President Charles E. Dustin and Vice-president Charles E. Jackson of the company, have been at Castlewood dam looking over the work and planning new improvements, one of the most important being the building of the electric road. This will probably be completed within a year. It is proposed to carry passengers and handle light freight. This would give the gardeners and fruit growers of the valley excellent facilities for placing their products in the Denver markets.

Recently the Denver Tramway company filed suit in the district court against the Denver & Berkeley Park Rapid Transit company to recover $62,372.47 on a promissory note. Judge Bentley gave a judgment for $62,736.31, this including interest and court costs. The enforcing of the judgment will necessitate an execution, and the Tramway company will probably become the purchaser.

Breckenridge was illuminated by electricity on March 25th. Three hundred lights were used and 400 more will be put in. Irving Hale of Denver is the manager of the Beckenridge Electric company, Al Sayers and Horace M. Hale, also of Denver, being associated with him in the enterprise.

Representatives of the electric light company recently met members of the council and discussed the matter of rearranging the location of lights throughout the city. A committee was appointed to make a thorough investigation and report at a later meeting.

E. C. D.

San Francisco, Cal.

SAN FRANCISCO, April 7.—The old ten-conductor telephone cable now connecting San Francisco with Oakland and many interior cities is soon to be supplanted by a new thirty-conductor Okonite cable. Evidence that this is a fact was adduced last week upon the arrival at Oakland of a specially built flat car carrying the first section of the cable. It weighed 70,000 pounds, and was on one reel. This cable is to extend from San Francisco to Goat Island, about midway to Oakland, and over which aerial copper wires are being run. The Sunset Telephone & Telegraph company is stringing copper wires on all its long-distance lines, and is making every effort to give metallic circuit service as soon as possible. As contracts for 10,000 new poles and 4,000 miles of copper wire have been closed, there is no doubt but that the present service over galvanized iron wire and grounded circuits will soon show a marked improvement.

The Consolidated Piedmont Cable company of Oakland has at last, after months of deliberation, determined to adopt electricity on existing horse car lines, instead of the cable, in re-equipment. The company operates the cable system through two or three miles of level Oakland streets, and continues on up into the suburban hills to Piedmont Springs and Blair's Park. Its horse car lines, which serve as feeders to the cable system, run out to Mountain View cemetery and also on Market, Fourteenth, Adeline and Wood streets. Owing to a proposed extension of the Mountain View line up into the hills and to the manner in which it connects with the cable system, it is proposed to convert it into a cable road, but all the other lines will be operated by electricity. The generating station will be located in the present cable power house, as ample power is there available, and for once, it is hoped, the electric and cable systems will be in harmony.

The city of Oakland has given the Sunset Telephone & Telegraph company a fifty year franchise to erect telegraph and telephone wires in that city, provided that the work of laying underground conduits and wires shall be commenced within six months, and that not less than $10,000 shall be expended in the system each year until finished.

The people of Grass Valley, Nevada county, Cal., where they have plenty of cheap water at a great pressure, appreciate a good thing when they see it, as the following from the *Grass Valley Union* will show: "The electric plant that has been put up at Mitchell Bros.' market, Mill street, attracts much attention. The dynamo was one of the Keith type, manufactured by the Electrical Engineering company of San Francisco, capable of maintaining forty-five incandescent lamps of 16 candle power. The dynamo was driven by a Pelton wheel eighteen inches in diameter, which received its water pressure from the town pipes. The wheel and dynamo worked perfectly, and the lights burned without a perceptible fluctuation. It was easily to be seen from the workings of the little plant how easily electric lighting can be secured for residences, public buildings and stores, where a cheap water power can be obtained, as is the case in Grass Valley."

The Walla Walla, Wash., Gas & Electric Light company is to place a generating plant at an available water power five miles away, and transmit by electricity 225 horse power into the city.

The street railway company that tries to build an electric road in San Francisco or that endeavors to change its equipment from horses to electricity has a rocky row to hoe. This has been the experience of the companies that have undertaken improvements in this line. First came the San Francisco & San Mateo Electric Railway company, and only by hiring an army of men at a dollar an hour to work Sunday and two nights between court hours was it able to get its poles up, but the poles are placed now, the trolley, guard and feeder wires are strung, and as the road is about ready for operation the company's troubles are over. Then came the Metropolitan Railway company, which proposed to build—and is now endeavoring to build—electric lines to the Golden Gate park, Cliff house and the old Ocean house. A strong prejudice against overhead electric railway wires had by this time arisen among the supervisors, but, if the report of the last grand jury is to be believed, a little poultice of $30,000 applied by the company to the itching palms of the solid majority of the supervisors was sufficiently soothing to allay this prejudice, and the company got its franchise, trolley wires and all. Meanwhile a new board of supervisors came into office, and among its first acts was one prohibiting the erection of poles or trolley circuits within prescribed limits, and last week, while the Metropolitan company was erecting poles within this limit, the city and county began suit against it and filed an injunction forbidding the further erection of poles. The matter will come up for argument next week. Meanwhile tracklaying is progressing, but all overhead construction has been stopped.

Finally the North Beach & Mission Railroad company decided to change its entire equipment from horses to electricity nearly a year ago, but the city refused to amend its franchise accordingly except for such portions of the system as are off the business streets. Suits and counter suits were talked of, if not actually brought, but differences were finally adjusted, and the company began erecting its pole line down Folsom street, intending to turn up East street, which forms the water front to the ferries. East street is under the control of the State Board of Harbor Commissioners, and it was not believed that the state officers would oppose the project, but last week the petition of the company to run electric cars for three blocks on East street was granted, provided it would lay a third rail parallel to the tracks of the Omnibus cable line, and provided further that the overhead trolley system was not used. How the company will overcome the prejudice of the harbor commission remains to be seen. It seems to be a watchword in San Francisco that "cables may come and cables may go, but the electric railroad—never!"

Apropos of cable roads, during the last month a hundred or so San Franciscans were treated to a bit of recreation compared to which tobogganing is tame and insipid. Two heavily loaded cable cars, one at the top of the Washington street hill (maximum grade 31 per cent) and the other at Powell street on the California street hill (maximum grade 27 per cent.) became unmanageable, the first from losing the rope, and the second from the breaking of the grip, and shot down the hills for three and four blocks respectively like rockets. A number who jumped from the cars were considerably bruised. Women fainted, screams and yells filled the air, but miraculously no one was seriously injured. Even the gripman of one of the cars was so badly frightened that he forgot to put on the slot brake. These things, together with statistics now going the rounds showing that nearly one person per month has been killed by the cable cars of San Francisco during the last year or two, form doleful reading for those who harp on the perils of the "deadly trolley," yet who fail to prove either its perils or its deadliness. Should they attempt to do so they will find but cold comfort by making reference to the cable roads of San Francisco.

S.

Milwaukee, Wis.

MILWAUKEE, April 9.—From Ashland comes word of a project to build an electric railway around Chequamegon Bay, connecting Washburn, Bayfield and Ashland. Such a system would comprise fifty miles of track. There is a great deal of travel between those points and it is said that eastern capitalists are considering the advisability of engaging in the enterprise. It is proposed to open up considerable suburban property by building a boulevard between the same points.

Henry Jane, who was appointed receiver of the Milwaukee Power and Lighting company, has filed a bond in the

sum of $15,000 with George Hiles, the petitioner, and John Johnston as sureties. He became president and general manager of the company a few months ago, when Dr. Earles retired. The stockholders are still hopeful of raising the sum of $28,000 necessary to pay the Hiles claim and take the business out of the hands of the receiver.

North Greenfield citizens have received two propositions for street railways to that point. Henry C. Payne, representing the Villard syndicate, has offered to extend the National avenue line to North Greenfield if the people will give an annual guarantee of $4,000 for a term of five years, any excess of receipts over expenses to be deducted from the guarantee. The Milwaukee & Wauwatosa Motor Line company has offered to extend its line from Wauwatosa to North Greenfield if the citizens will take stock in the company to the amount of $20,000. The company states, however, that of this sum Fred J. Johnson, an interested property owner, has offered to raise $15,000. A committee has been appointed to see what subscriptions can be secured.

The Milwaukee Street Railway company has been putting up poles on First avenue, where rails were laid last season from the viaduct to National avenue. It is proposed to connect this line with the Farwell avenue line at Third and Sycamore streets. It will give still another line to the South Side. The work of equipping the rest of the Villard lines with electricity will be commenced very soon.

An opposition electric railway may be built at Superior before a great while. The ordinance was defeated when first presented, but the fight has been renewed with every prospect of success. The ordinance provides for iron poles and the construction of lines on any streets named within one year if ordered by the council. There is a provision against consolidation with the present company and another provision for the purchase of the plant by the city, at the termination of the franchise, at the appraised valuation. The franchise is to expire in twenty-eight years, its life being just as long as that of the present company. There is another provision that the city shall receive a progressive proportion of the earnings and a progressive tax on the mileage operated. It is further provided that five miles of road shall be constructed and operated within one year.

Cars will begin running on the Milwaukee & Wauwatosa Rapid Transit company's line by May 15th. The work of completing the electrical equipment is in progress. New machinery is on the ground at the Wauwatosa electric light plant, which will furnish power for the road, and the poles, etc., have been ordered. The cars will run without change from some point on Grand avenue and Wisconsin street.

Postmaster Nowell has secured one of the new canceling machines, such as are in use at Boston, New York and Philadelphia, for his office. The machine does the work of a number of men. The clerk simply "faces up" the letters and feeds them to the machine. The machine will be operated by an electric motor and the power furnished by the Edison Lighting company.

The Board of Public Works is preparing plans for the equipment of East Water street, Martin street and West Water street bridges with electric motors for swinging them. The Milwaukee Street Railway company will furnish the necessary power. Electric motors for swinging bridges, the city officials state, are just as efficient and much cheaper than steam motors.

In the superior court Charles F. Pfister and August Vogel have begun a suit for the appointment of a receiver for the Milwaukee Electric Railway company. The defendants, besides the company, are Francis E. Hinckley and John A. Hinsey of Chicago; the Merchants' Exchange Bank of Milwaukee, and the Northern Trust company. Mr. Pfister's suit is founded on the loan of $125,000 which he made to the company some time ago and which was not paid when it became due. The complaint gives some unpublished facts about the loan. The company was organized with a capital stock of $500,000, divided into 5,000 shares of $100 each, and the company issued five hundred bonds of $1,000 each. Of the bonds 100 were given to the Wisconsin Marine & Fire Insurance company bank to secure a loan of $50,000. When Pfister loaned the company $125,000, the money due the bank was paid, and he took those bonds, as well as 150 more and 2,502 shares of stock as security for his loan. Of the stock given as collateral security Mr. Hinckley, who held 2,998 shares, deposited 1,501, and Mr. Hinsey, who held 1,998 shares, deposited 1,001 with Mr. Pfister. The bonds were secured by a first mortgage on the road. When the note became due and was not paid, Mr Pfister had 100 of the bonds and all of the stock sold to the highest bidder. The bonds were sold for $50,000 and the stock for $5,000. August Vogel bought both. Mr. Hinckley brought injunctional proceedings, claiming that the issue of the bonds was illegal, and the sale void. Mr. Pfister was prohibited from foreclosing the mortgage, but was permitted to bring suit to have his loan made a lien on the road, which is the object of the present proceeding. In the superior court a decision favorable to Pfister was rendered some time ago, but an appeal to the supreme court was taken, and a modified injunction is still in force. Mr. Pfister states that he has paid taxes and for machinery and wants his claims made liens on the line.

Vice-President Payne of the Milwaukee Street Railway company, announces that the operation of the North Avenue Electric line will commence on May 1st. Tracks, poles and wires are all complete and to run cars it will only be necessary to clean off the rails and turn on the current. By June 1st, Mr. Payne states, the Bay View line will be in operation. There is about a mile of road on Clinton and East Water streets to be built. Horse cars will continue to run on the Forest Home and Brady street lines for awhile, but between Pleasant street and Mitchell street they will be run as trailers to the electric cars. The repairs on State street bridge, it is expected, will be completed by June 1st, when the Chestnut street and Broadway electric cars will run on the East Side and to the Northwestern depot.

The Kinnickinnie avenue barns of the Milwaukee Street Railway company are being converted into an extensive machine and car shop. The shop will be supplied with all the machinery and facilities for building and remodeling cars and for making curves, switches and other special work, as well as for repairing motors. The building will be 300 feet square and two stories high. The Farwell avenue barns are also being remodeled.

Manager Lynn, of the Milwaukee system, is elated over his success in rebuilding an old car. The car was 14 feet long and now it is 30 feet long. It is 22 feet long inside and at a pinch can carry 100 people. It has two roomy platforms and is neat and symmetrical in appearance. A remarkable fact is that the car is mounted on short trucks. Many thought these trucks would not answer the purpose, but they do, as a trial trip satisfactorily demonstrated. It will be run on the National avenue line. Five or six other cars are being similarly rebuilt here and will be used on the same line. Manager Lynn has concluded that it is cheaper to rebuild the cars here than to send them away for that purpose, which involves an outlay for freight.

C.

PERSONAL.

Charles W. Price, editor of the *Electrical Review*, spent a few days in Chicago last week.

Gilbert Donaldson of the D. & D. Electric Manufacturing company, St. Paul, was in Chicago last week.

Col. George L. Beetle, of the Western Electric company, Chicago, was in New York last week.

C. O. Baker, Jr., of the firm of Baker & Co., of Newark, N. J., returned home last week after an extended trip through the West.

Electrical Inspector Alfred E. Braddell, of the Underwriters' Association of the Middle Department, Philadelphia, was in New York last week.

President A. L. Riker, of the Riker Electric Motor company, Brooklyn, N. Y., returned last week to the office after an attack of scarlet fever which kept him at home for six weeks.

Prof. A. J. Rogers of Milwaukee, was in Chicago Monday. Prof. Rogers was recently appointed principal of the high school of Milwaukee, but he will continue to give personal attention to the electrical course in that institution.

W. L. B. Allen, representing the Short Electric Railway company in St. Louis and the Southwest, has been sick for a month or more with pneumonia. For some days his life was despaired of, but he is now considered to be nearly if not quite out of danger.

Word comes from Little Rock, Ark., to the effect that City Electrician Gerald E. Fish, formerly electrical superintendent for the Chicago Arc Light & Power company, recently met with a serious accident by being thrown from his buggy. Although the physicians stated that Mr. Fish was injured internally it is understood that he is now improving.

NEW INCORPORATIONS.

Buffalo & Hamburg Railway company, Hamburg, N. Y; capital stock, $150,000; electric railroad.

Interior Wiring & Fixture company, New York City, N. Y.; capital stock, $20,000; to wire and equip for electric lighting, etc.

Fulton & Montgomery County Electric Railroad company, Johnstown, N. Y.; capital stock, $75,000; electric surface railroad of standard gauge.

Waldron Electrical company, Berwick, Me.; capital stock, $50,000; to manufacture and deal in all kinds of electrical machinery; Harry V. Moore, Berwick, Me.

Citizens Electric company, Green Bay, Wis.; capital stock, $25,000; generating electricity for light, heat, power, etc.; J. C. & A. C. Neville, Green Bay, Wis.

Gallatin Light, Power & Railway company, Bozeman, Mont.; capital stock, $150,000; generating and using electricity for any purpose to which it is adapted or may be applied in the present state of the science; constructing canals and utilizing water powers.

Independent Plumbing & Electrical company, San Antonio, Texas; capital stock, $10,000; to purchase and sell electrical fixtures; Erhard R. Guenther, San Antonio, Texas.

Eastern Compound Wire company, Jersey City, N. J.; capital stock, $100,000; to manufacture and sell electrical conductors of all sorts, etc.; Dickinson & Thompson, Jersey City, N. J.

Mifflintown Electric Light company, Mifflintown, Pa.; capital stock, $2,500; supplying light by means of electricity to the borough of Mifflintown, etc.; B. F. Burchfield, Mifflintown, Pa.

Patterson Electric Light company, Mifflintown, Pa; capital stock, $3,500; supplying light by means of electricity to the borough of Patterson, Pa., etc.; B. F. Burchfield, Mifflintown, Pa.

Marseilles Electric Street Railway company, Marseilles, Ill.; capital stock, $12,000; to build and operate an electric street railway in Marseilles, La Salle county, Ill.; Frank Montgomery, Marseilles, Ill.

Electrical Advertising & Display Manufacturing company, Camden, N. J.; capital stock, $500,000; to manufacture and construct electrical machinery, etc.; S. K. Robbins, 211½ Market street, Camden, N. J.

Rocky Mountain Electric & Power company, Pueblo, Colo.; capital stock, $500,000; to furnish electricity for light and other purposes to the city of Pueblo and other towns and cities in Colorado and elsewhere.

Denver Electric company, Denver, Colo; capital stock, $500,000; to generate, produce and distribute electricity for light, power and heat and all other purposes which may be applied in the city of Denver and additions thereto.

Pittsburg, Neville Island & Coraopolis Railway company, Pittsburg, Pa.; capital stock, $50,000; operating an electric railway from Coraopolis to Neville Island and McKeese Rocks borough in Allegheny county; W. T. Tredway, 96 Diamond street, Pittsburg, Pa.

Lawrenceville & Schenly Park Street Railway company, Pittsburg, Pa.; capital stock, $100,000; operating an electric railway from Butler street, Pittsburg, over and along several other streets to Schenly Park, Pittsburgh, Pa.; G. C. Lewis, 110 Diamond street, Pittsburg, Pa.

Hart & Cooley Manufacturing company, Chicago, Ill; capital stock, $40,000; manufacture, buy and sell pickled and cold rolled steel, cabinet, builders' and domestic hardware, iron and steel, and do annealing and electro plating; David T. Corbin, 1108 Chamber Commerce building, Chicago, Ill.

Columbian Underground Electric Traction company, East St. Louis, Ill; capital stock, $1,000,000; to acquire patents to manufacture, use, sell and deal in electric appliances, underground and otherwise; build, construct and manufacture electric railways, etc.; Jas. P. Kerr, 509 Olive street, St. Louis, Mo.

ELECTRIC LIGHTING.

It is possible that the city of Cambridge, Md., may erect an electric light plant.

The Carlisle, Ky., Electric Light company will install a new electric light plant.

A bill to charter the Electric Light & Railroad company of Baltimore county, Md., has been introduced in the legislature.

According to the *Manufacturers' Record*, 36 electric light plants have been established in the South during the first three months of 1892.

The Morgantown, W. Va., Electric Light & Power company has contracted with the Edison General Electric company for an arc and incandescent electric light plant.

The Platteville, Wis., Electric company has decided to enlarge its plant by the addition of a 125 horse power Corliss engine. It is also considering the advisability of purchasing an incandescent dynamo and a power generator.

A Pittsburg paper says: The Westinghouse Electric & Manufacturing company is building two large alternating current dynamos which will have a capacity of 8,500 lights apiece. These are the second pair of dynamos of this capacity built in this country, all previous machines having a capacity of 3,000 lights at the most. The machines are all ready to be put together and need only the armatures. One of the dynamos will go to the Allegheny County Electric Light company, and the other is to be used by the United States Electric Light company of New York.

ELECTRIC RAILWAYS.

The Palatka & Heights Street Railway company of Palatka, Fla., contemplates changing to the electric system.

The Louisville City Railway company will, it is said, equip six additional lines with electricity at a cost of $500,000.

J. P. Bryan and others have chartered the Bryan Heights Railway company of Quintana, Tex. The capital stock is $25,000.

The ordinance granting permission to the Jacksonville,

Fla., Street Railway company to use electricity as a motive power has passed the city council.

The purchasers of 600 acres of land near Atlanta, Ga., contemplate, it is stated, the construction of an electric railroad. Hon. John Sherman of Mansfield, Ohio, and James R. Lewis are said to be interested.

Amos Shinkle, Homer Hudson, Robert Dulaney and others propose building an electric railroad from Covington, Ky., via Erlanger, to Florence, at an estimated cost of $100,000.

C. L. Dignowitz and others of San Antonio, Texas, are perfecting plans for the construction of an electrical railroad to be operated outside the city limits. The road is to be about eight miles long.

Sing Sing is to have an electric surface railroad through its principal streets. The trolley system will be used. The main line runs from the railroad station to the Sing Sing camp meeting grounds. Another branch runs down Spring street to the boundary line.

The Hamilton, Ont., street railway will be equipped with electricity. The contract for thirty cars and three multipolar generators with a capacity of 750 horse power has been awarded to Ahearn & Soper of Ottawa, Canadian representatives of the "Westinghouse system."

All the cars running between Harvard Square, Cambridge, Park Square and City Point, South Boston, via Dover street, are now propelled by electricity. The running time between Harvard Square and City Point under the new time table, is ten minutes less than heretofore, and the decrease in time between Park Square and City Point is eight minutes. Eight-wheeled cars have been placed on the route, and the innovation is said to be giving extreme satisfaction to patrons of the West End company, who have to use the lines in that section of Boston.

It is proposed to build an electric road from Redlands to Bear Valley, Cal. Bear Valley is in the mountains in the southern part of the state, at an altitude of 6,000 feet, and produces vast quantities of ice, which is now going to waste. All the ice used in shipping fruit East is brought from Northern California at great expense. There is a project to build an electric road from Redlands to Bear Valley, making the former place an ice depot for the entire southern country and sending out spurs of the road to Riverside, San Bernardino, Morena and Alessandro. It is proposed to utilize the water of the Santa Ana river to generate electricity for the car motors.

TELEGRAPH.

The telegraph is being extended in Persia, according to the English papers. The line to Daragez has been completed; but the line to Birjand, which would be of great service, has not yet been commenced.

The trial of the case of the Call Publishing company against the Western Union Telegraph company was begun in the district court of Lincoln, Neb., recently. The plaintiff claims, that it has the privilege of printing the afternoon Associated Press dispatches in Lincoln. Its contract calls for not to exceed 1,500 words per day, for which service it pays the telegraph company $75 a month. The plaintiff further claims, that the defendant is a carrier, amenable to the laws of Nebraska, and, therefore, not allowed to discriminate. It charges that the Western Union company has discriminated, in that it furnishes the *Journal* dispatches at a lower rate; that fixed for the evening paper is $5 per month for 100 words, while the *Journal* only pays $1.50 per 100 words a month. This makes an excess of $19.62, for which the plaintiff asks judgment. To this the telegraph company answers that it is not charging an unjust or excessive rate; that it is amenable only to the general government, because its business is interstate, that the State cannot regulate its charges, and that the court really has no jurisdiction to try the case. The plaintiff, on the other hand, contends that as Congress has never made any attempt to regulate interstate charges, the right to do so remains with each State; that it is not questioning whether the rate is a reasonable one, but charges that it has been discriminated against.

MISCELLANEOUS.

It is estimated that $5,000 a year would be a low estimate of the loss suffered by the Thomson-Houston company by petty thefts of material by employes at the factory in Lynn.

A French paper reports that the microphone has been successfully used in St. Petersburg in a case of suspended animation, where the patient was given up for dead. As a last resort the physician applied a microphone to the region of the heart, and was enabled by this instrument to hear a faint beating, which proved that life was not extinct. Everything was done to resuscitate the patient, who shortly afterward recovered consciousness.

It is proposed to disinfect ships by sending an electrical discharge through a tank of sea water. The effect of this is to liberate nascent oxygen, which, with the water, is conveyed by pipes through the vessel, and liberated by taps at the places where required. Bilge water, it is thought, can be disinfected in the same way, and as all large steamers are beginning to be fitted with dynamos there will be little difficulty in adding this cheap and apparently effectual mode of pumping oxygen into the evil-smelling spots of a ship.

A Philadelphian has perfected an electrical ice harvester. The cutters upon the machine revolve, and the only weight of any consequence to the whole apparatus is a small electric motor, which is geared to the wheels and cutters. The machine is especially desirable in cutting ice that will not sustain the weight of a team and plow. The machine also removes the snow, and does the corrugating. The current that propels the motor is communicated therewith by means of either a reel of wire, or light, movable trolley; thus the same current may be applied to the housing of the ice and the lighting of the place where the work is going on.

The influence of steam on magnets is the subject of discussion in a Swiss paper, and reference is made to the researches of Strouhal and Barus, who have shown that, with long continued heating in steam, magnets lose from 28 to 67 per cent. of their power. If, after this, the magnets are re-magnetized, and again exposed to the action of steam, only a very slight loss of magnetic power is found to take place. In view of this, repeated steaming and magnetizing is recommended as a good means of securing permanent magnetism in pieces of hard steel.

A farmer near Tahlequah, I. T., was struck by lightning recently, and was instantly killed. A press dispatch says that the unfortunate man was thrown several feet out of a wagon in which he had been riding and his clothing torn in shreds and set on fire and the shoes torn from his feet. The horses fell dead in their tracks and the wagon was torn to pieces. The work of the lightning was witnessed by the family of a neighbor, who ran out to extinguish the fragments of clothing on the body, and found the victim black in the face and badly scratched and mutilated.

An electro amalgamating process has recently been given what is stated to be a successful working test at the Southern Cross company's works, near the Anaconda mine. The Butte *Inter-Mountain* says that the process is the invention of four Butte mining men. The process may be briefly described thus: First, dissolving the gold contained in the ore, and thus getting it into solution; second, precipitating it by means of electricity into a body of quicksilver at the bottom of the pan—for it is a pan process. Quite extensive experiments have already been made upon Southern Cross ore with the process, a though not upon what might be properly termed a working scale, and very satisfactory results have been shown. A 10 stamp mill has been equipped to give the process a thoroughly practical demonstration.

TRADE NEWS.

Ziegler Bros. of Boston are now at work upon a line of special electrical apparatus for the Chicago University.

The Redding Electric company of Boston has recently enlarged its factory and made a new department for its "watchman's register."

The Newton Rubber company, Boston, is now offering a new line of strong and durable battery cells which commend themselves to the trade.

The Riker Electric Motor company of Brooklyn, N. Y., received from Philadelphia last week 58,000 pounds of sheet iron for armature cores.

The Eastern Electric Cable company, Boston, is enlarging its factory and office building, and has also in view a number of other important changes.

General manager P. G. Fiedler of the Boston Braid Manufacturing company reports an unusually good demand for his company's lamp filaments.

Inasmuch as the Imperial hotel, New York, has become the headquarters for so many of the electrical fraternity, it has been suggested that the name be changed to "Hotel Electric."

The Sampson Cordage works, Boston, are extending their offices on Congress street through to Federal street. These increased facilities will allow this firm to meet the growing demands for its goods.

Wm. Becker, with Julius Andrae, Milwaukee, has just returned from Los Angeles, Cal., where he has, for the last four months, been superintending the electrical construction in T. D. Stimson's residence.

One of the most unique as well as useful novelties in the way of advertising, is a blotter made in the form of an incandescent lamp, which the Beacon Vacuum Pump & Electrical company of Boston, Mass., is distributing to the trade.

The D. & D. Electric Motor company of St. Paul is preparing to enlarge the capacity of its factory. It is now making a specialty of mining work and will hereafter give special attention to the development of this line. The company will open an office in Chicago.

Whitmore & Robinson, the well-known electrical engineers of Boston, are very busy in preparing estimates for new work, which will be commenced as soon as the weather will permit. This concern has recently added to its clerical force to meet its growing business.

The new electric specialties offered by the Eastern Electric Supply company of Boston, are meeting with great favor. This company's trolley insulator and "section bell" fill a long felt want in this direction. The company states that the general outlook for trade is better than last year at this time.

H. N. Bates & Co. of Boston are at present at work upon two large contracts for the new "L. P. & D." system of driving dynamos, manufactured by Perry & Demerritt, Montpelier, Vt. The "L. P. & D." transmission system was recently illustrated in the WESTERN ELECTRICIAN.

The Gould & Watson Co. of Boston has taken the general agency for the Whitney electrical instruments, and the report comes in that it is now having large sales, especially through the western agency at Chicago, which is receiving many flattering letters and testimonials as to the accuracy of these instruments.

The Partrick & Carter company of Philadelphia say that the "King" annunciator is one of the most successful specialties it has ever introduced. This device fills the requirements of a low priced and perfect working annunciator and is just the thing for contract work where the finely finished instruments are not demanded.

The St. Louis Electrical Supply company has its new salesroom fitted up with probably the largest and most complete stock of electric supplies ever carried in St. Louis. The company has removed its business office to the second floor, over the salesroom, where additional facilities are also offered for the transaction of business.

The Wagner Electric Manufacturing company, St. Louis, is pushing the sale of the Wagner alternating current fan motor of one-tenth horse power, and is meeting with gratifying success. These motors are of most compact and substantial design, having but few moving parts, and require but little attention in operating.

The Columbia Incandescent Lamp company is having an unusual demand for its lamp at this season of the year, the sales far exceeding all expectations. New machinery has been added and the factory has been run night and day for more than six months, and still the demand has largely exceeded the supply. Prices have been well sustained and the outlook for a prosperous year is most promising.

A. M. Morse of A. M. Morse & Co., St. Louis agents for the Buckeye engine, the Falls Rivet & Machine company and other leading lines of machinery, has several bids out for heavy plants and anticipates a large sale of the Buckeye engine during the coming season. This company has about twenty first-class installations in St. Louis alone, making a very good foundation for future work.

The Pond Engineering company, St. Louis, reports an unprecedented amount of new work in sight, indicating a growth in the different lines of electric work—lighting, mining, traction, etc.—for the coming season, unequaled in any previous year. Several fine installations of high-speed engine plants have just been completed, and bids are out for several more, some of which will undoubtedly be secured.

The Ansonia Brass & Copper company, sole manufacturers of the well known Tobin bronze, is sending to its customers and the trade generally a neat little pamphlet describing the many uses to which this very superior metal can be applied. The company gives also a number of tests made with Tobin bronze and about forty testimonials from some of the largest iron works and engine builders in the country.

Arthur S. Partridge, for some years with T. C. White & Co., has rented an office in the Bank of Commerce building, corner Fifth and Olive streets, St. Louis, where he will engage as a broker in the sale of electric railway supplies, including rails, poles, ties, wire, etc. Mr. Partridge has already established a reputation for business capacity and energy, and will undoubtedly meet with success in this new undertaking.

The Perkins Electric Lamp company of Boston, Mass., is presenting its friends an elegant Russia leather memorandum book combining a card and stamp case. The little volume contains a very useful table for calculating incandescent wiring. A few facts are also given in relation to the Perkins incandescent lamps, and a number of tests to which the lamp has been subjected are referred to in a manner that will be appreciated by the company's many customers.

The quarters of the New York office of the Short Electric Railway company have been changed. The somewhat limited offices in the *World* building were found to be altogether inadequate for the rapidly increasing business. In the new office, Mills building, 35 Wall street, will be found hereafter the same genial and gentlemanly representatives of the company. Edward E. Wessels, manager of the office, and C. C. Curtiss, confidential agent of the company, are rapidly making themselves a power in the street railway fraternity of New York and New England, and the new quarters will do much toward aiding them in their work.

The Toronto Construction and Electrical Supply company, Toronto, Can., has just issued its first catalogue, and has done itself credit by the production. In addition to the goods catalogued this company carries in stock a wide range of specialties in fixtures, shades, test instruments, school apparatus, etc., and can fill orders promptly for almost any electrical article. The Toronto company has adopted the policy of selling goods on close a margin of profit, and of keeping on hand a very large stock in order that it may be able to fill almost any order the same day that it is received. This policy has thus far proved eminently successful, and, as customers are aware, the company's travelers carry as fine and as extensive lines of samples as have ever been shown in Canada.

The Freeman-Holland company of Boston, Mass, recently closed a contract with the Hull Electric Light & Power company for the installation of a complete lighting and power plant consisting of two 150 and one 125 horse power engines, four 100 horse power tubular boilers, two 1,500 light alternating current dynamos, 4,000 lights' capacity of transformers and lamps, and two power generators of 50,000 watts capacity each, and about twenty-five miles of wire and pole construction. This is the first plant this company has undertaken, although Walter K. Freeman has long been well known in the electrical field, especially in the line of alternating work. The Freeman-Holland company was organized in January of the present year, and it has fitted up a factory at 514 to 530 Harrison avenue, with offices at 53 State street, Boston, Mass. This company is equipped to manufacture 5,000 incandescent lamps per

day, and to build alternating and direct current dynamos, transformers and other apparatus pertaining to central station lighting.

The American Electrical Manufacturing company, 2011 to 2017 Pine street, St. Louis, is manufacturing a high grade lamp, on which satisfaction is guaranteed, as to life efficiency and rated candle power. Attention is called to a special railway lamp, the use of which, it is claimed, has met with most gratifying success. The filament is prepared by a special process which is adapted to withstand sudden variations of potential and being "anchored" is not susceptible to the constant vibration and strain incident to street car service. This company says: "We want your business and we want to gain it and hold it by prompt, correct and honorable business methods, and by selling you the best goods at the lowest price that is consistent with their merit." The capacity of the factory has been increased several times until it is thought to be sufficient to supply the active demand anticipated during the coming season.

The Emerson Electric Manufacturing company, St. Louis, announces a perceptible increase over any previous year in the number of inquiries received for the Meston fan motor, indicating not only an increase in the demand for a fan for ventilating purposes, but particularly for a fan that will work successfully with an alternating current. The Meston fan was put on the market last season and was sold over a wide territory, apparently giving entire satisfaction. The 1892 model will have among other improvements a regulating and reversing attachment that will make it possible to run the fan at any speed desired, the amount of current used being in direct proportion to the speed. This is accomplished by means of a commutator, the position of which is changed by means of a short lever. Brushes are provided that will run an entire season, the brush holders being arranged to carry two carbons of special composition 2⅛ inches long and of large cross section for contact and wear. The fan is provided with self-oiling bearings and mechanically and theoretically is believed to be nearly perfect. An alternating motor of three horse power is now well in hand and will soon be ready for the trade.

The Hoppes Manufacturing company of Springfield, O., has issued a circular denying the statements made in a pamphlet issued by the Stilwell & Bierce company referred to in the last number of the WESTERN ELECTRICIAN. The Hoppes company denies that its purifier is an infringement on the patent controlled by the Stilwell & Bierce company and in support of this statement quotes from the judge's decision in the litigation, in which he says: "It is obvious from this description that the change from the vertical position of the purifier to the longitudinal is not material, and it is conceded that the purifier, as it came from the manufacturer and as it was first set up for use by the defendant, was not an infringement of the complainant's." The Hoppes company explains that a suit was instituted in the United States court by the Stilwell & Bierce Manufacturing company against a user of the Hoppes purifier, for the use of a certain arrangement of piping in connection with that purifier. This suit does not in any way involve the Hoppes purifier, according to its makers, but only the pipe connection, which it is claimed is not absolutely necessary to the success of the purifier. The Hoppes company thinks that it had a right to use the pipe arrangement which caused the litigation, and it will accordingly appeal the case.

BUSINESS.

The Canadian agency of the Partrick & Carter company has been discontinued, and the company will hereafter supply the trade direct. Catalogues and special trade discounts will be cheerfully sent on application.

The Hoppes Manufacturing company of Springfield, O., is building new factories and office buildings. The company has recently purchased three acres of ground in Springfield, and has already got its buildings well under way.

The National Electric Manufacturing company through its agent, W. E. Bailey, St. Louis, Mo., has closed a contract with W. L. Hockaday & Co. of Farmington, Mo., for one 135 horse power multipolar generator. This generator will be used for power on the Farmington electric railway, running from Farmington to the Iron Mountain railway and the M. & B. T. Railway Crossing road, about four miles.

H. T. Paiste, manufacturer and patentee of the Paiste switch and other specialties, has sold to the Bryant Electric company of Bridgeport, Conn., his patents on the Paiste single pole switch, together with the business on this specialty. The transfer took place April 1st. Mr. Paiste continues in the specialty line, and will introduce shortly to the electrical trade a number of new devices that he thinks will be appreciated by all.

General Sales Agent F. Day Voorhees of the Norwich Insulated Wire company, New York, has returned from an extended trip through the West and South. Mr. Voorhees reports trade as being unusually good, having secured a contract from the United States Electric Light company of Washington, D. C., for over thirty-five miles of wire. He also closed a number of contracts in Chicago and vicinity, several of which were duplicate orders. Much credit must be given Mr. Voorhees for the position in the trade that he has given the Norwich wire.

Pepper & Register, electrical and mechanical engineers, Provident building, Chestnut and Fourth streets, Philadelphia, have secured the order to build and equip the Delaware Bay & Cape May electric railway, a 6½ mile road, with ten car equipments, generator to be 150 horse power, and cars to be equipped with 30 horse power single reduction motors, all of the Westinghouse company's manufacture. A Ball engine will be used, with Coatsville boiler and stack, Schieren's belts, Morris-Tasker company's brackets for pole construction and Washburn & Moen's trolley wire. The road, it is expected, will be in operation by the first day of June. This same firm has also secured the order to build the municipal electric lighting plant for Doylestown, Pa., and several isolated plants.

The Fitchburg Steam Engine company of Fitchburg, Mass., announces its removal into new quarters. For several years there has been an increasing demand for Fitchburg engines, and lately the company has been unable to keep up with its contracts, although running nights for some time. The new factory is fitted throughout with all the best modern tools and facilities for handling large work, such as traveling cranes, etc., and is more than twice the size of the old plant. The facilities for shipping are the best, as machines can now be loaded directly from the erecting room on to the cars. The company is now in a position to fill all orders promptly, for large or small, vertical or horizontal, high speed, slow speed or compound condensing engines.

Julius Andrae, Milwaukee, has just made the following sales: One 6 horse power Mather motor to the lithographing establishment of the Jacob Knauber Litho and Engraving company; one 3 horse power motor to the Binner Engraving company; one 1 horse power motor to the city of Milwaukee to drive a 40-inch fan in the Municipal Court room; one 1 horse power motor for John Clark, harness manufacturer; one 2 horse power motor for L. Lowe & Sons' grinding and cutlery shop. Mr. Andrae has also installed the electric light and bell work in Wm. H. Bradley's hotel at Tomahawk, Wis. For this installation feeder wires had to be run 1,800 feet on poles, from a saw mill where the dynamos were located, to the hotel. Besides this he is carrying out a number of wiring contracts for incandescent lights in private residences, etc.

The constantly increasing demand for the Beacon incandescent lamp, manufactured by the Beacon Vacuum Pump & Electrical company of Boston, Mass., has compelled this concern to enlarge its manufacturing facilities. The extraordinary growth of business may be attributed to the excellent quality of the company's product due to the great advance which has been made in its methods of manufacture. A special improvement is in the company's new process of exhausting lamps. This is accomplished by means of a metallic vacuum pump, without the aid of mercury. By this machine Beacon lamps are produced free from mercurial vapor, and the injurious effects of such vapor on the filament are thus of course avoided. In addition there is obtained in the lamps a uniformly high vacuum. A large number can be exhausted simultaneously and a perfect control of the vacuum system can be maintained. The consumer will readily appreciate that the possession of such a system as that of the Beacon company places it in a position to make a very superior lamp, and, since the company's method of exhaustion is so perfect and of such great capacity, it is especially equipped to manufacture economically lamps of large size.

ELECTRICAL STOCK MARKET.

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, April 9th, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	98½	99
Edison Illuminating company of New York	81½	82
" " " Brooklyn	76	80
" " " Boston	110	112
" " " Chicago	130	140
Edison Ore Milling company	15	20
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomson-Houston Electric company	58	59
" " " Preferred	28	29
Westinghouse Electric company	18	10
North American Phonograph company	5	8
New York " "	2½	5
Automatic Exhibition company	3	5

ELECTRICAL PATENTS.

Issued April 5, 1892.

472,026. Galvanometer. Sigmund Bergmann and George A. Scott, New York, N. Y.

This invention consists of the combination of a magnet, a metal strip longitudinally curved and gradually widened from one end to the other and supported adjacent to the pole of said magnet, and a weight or its equivalent for moving the strip in the reverse direction to that in which it would be moved by the magnet.

472,027. Switch and Switch Box. Sigmund Bergmann, New York, N. Y.

472,035. Fare Register. Calvin B. Cushman and Horace G. Canfield, Akron, O.

472,037. Thermo Electric Element. Edward N. Dickerson, New York, N. Y.

This invention consists in a series of parallel plates of different metals held firmly in contact with each other, and adapted to be heated at one end.

472,055. Carbon Holder. Henry Howard, Halesowen, near Birmingham, England.

472,062. Rheostat. James R. Masury, Providence, R. I.

472,064. Electric Arc Lamp. John A. Mosher, Chicago, Ill.

472,084. Safety Cut-out. Mandeville Thum, Louisville, Ky.

472,124. Electric Recording Device for Compasses. Charles L. Jaeger, New York, N. Y.

472,135. Lightning Arrester. Edward G. Miller, Wilkinsburg, Pa.

472,169. Toll Collecting Apparatus for Telephones. Jesse J. Kato and Thomas H. Rhodes, Los Angeles, Cal.

Claim nine reads:
"In combination with a telephone a toll collecting apparatus connected therewith, double circuits connecting said telephone through said collecting apparatus, coin controlled devices for breaking one of said circuits, and clock mechanism for breaking the other circuit."

472,193. System of Electrical Distribution. William Marshall, New York, N. Y.

472,220. Hanger for Electric Wires. Henry H. Luscomb, Boston, Mass.

472,237. Unison Apparatus for Printing Telegraphs. Henry Van Hoevenbergh, New York, N. Y.

Claim one is given:
"In a printing telegraph, the combination, with a main line circuit, of a step by-step transmitter organized to drop or intermit one of a series of breaks or impulses and a receiving instrument organized to supply the break or impulse omitted by the transmitter."

472,243. Telephone Transmitter. Edward G. Acheson, Pittsburg, Pa.

The last claim reads:
"The combination with a plate, of blocks of conducting material secured on each side of the plate, a bar of conducting material resting on each set of blocks, and a thread or cord connecting said bars, the said thread being at right angles to the plate."

472,261. Thermo Electric Battery. Robert J. Guelcher, Berlin, Germany.

472,265. Electrical Meter. John F. Kelly, New York, N. Y.

Claim one reads:
"A coulomb meter consisting in the combination, with a motor having a constant field, of a shunt or path of low resistance around the terminals of the motor whereby the difference of potential at the terminals will be determined by the shunt, a load consisting of such a device as a fan, and means for indicating or registering the revolutions of the shaft."

472,274. Electric Arc Lamp. Samuel W. Rushmore, Brooklyn, N. Y.

It is the main object of this invention to provide a lamp adapted for use on a constant potential circuit—such as the usual incandescent circuits—in which the feeding of the carbon shall not depend entirely on the strength of a shunt coil or magnet, but shall depend also on the operation of a coil or magnet in series with the arc.

Of the five claims the fourth reads:
"The combination, in an arc lamp, of a movable carbon, feeding mechanism therefor, and a shunt-coil to control said mechanism, said coil being connected to a contact upon the carbon-rod or carbon, whereby the shunt circuit is interrupted when the carbon or carbon-rod passes said contact."

472,283. Switch Box for Electric Motors. Parvin Wright, Denver, Colo.

The seventh claim is given:
"An electric motor having its field magnets and armature in independent or derived circuits in combination with a switch and a second or independent armature circuit including a variable resistance, said switch having connections for changing the current through the two armature circuits at will."

472,329. Electric Wheel Locking Device. George W. Blanchard, Waterville, Me.

472,336. Cash Recorder. Charlie H. Coles, Owosso, Mich.

472,346. System of Arc Lighting. Horatio A. Foster, New York, N. Y.

472,352. Compound for Insulating Electric Wires. Louis Hill, Waterbury, Conn.

472,359. Electric Indicator for Railroad Blocks. Robert W. Jaggard, Philadelphia, Pa.

472,379. Production and Distribution of Electricity, William Marshall, New York, N. Y.

The main object of this invention is to distribute electrical energy intermittently with such rapidity as to cause the effects in the line to appear continuous and to provide special apparatus for this purpose.

The first claim reads:
"The method of distributing electrical energy from an electric source, which consists in alternately charging an electrical condenser from the said electric source and throwing into the line beyond the condenser the currents of both the condenser and the electric source, these acts being performed with such rapidity as to make the effects in the line appear continuous."

472,435. Brush Holder. John R. Coffman, Detroit, Mich.

472,439. Annunciator. William C. Dillman, Brooklyn, N. Y.

472,440. Annunciator. William C. Dillman, Brooklyn, N. Y.

472,444. Electric Mining Pick and Drill. John Fish, South Bend, Ind.

472,447. Inclosed Supply System for Electric Railways.

This invention is specially designed for use in connection with the multiple arc system of electric railroading. Its principal object is to provide improved means for supplying current to the motors on the moving cars without exposing the conductors or contacts.

572,461. Electro Magnetic Valve Controller. Olof E. Lundstedt, Brooklyn, N. Y.

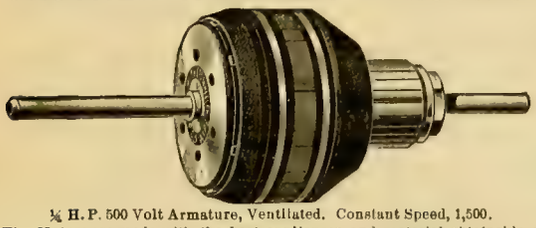
472,466. Rotary Transmitting Dynamometer. Franklin Van Winkle, Paterson, N. J.

472,480. Adjustable Armature for Electro Magnets. Emil Hofmann, Ballard Vale, Mass.

472,494. Automatic Electric Lamp Lighter and Extinguisher. John H. Caughy, Baltimore, Md.

472,500. Electrical Indicator. John W. Henderson, Philadelphia, Pa.

CROCKER-WHEELER ELECTRIC COMPANY,



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¼ H. P. 500 Volt Armature, Ventilated. Constant Speed, 1,500.

The Motors are made with the best appliances and material obtainable, and embody every improvement of merit, with the intention that they shall be the Standard of their class.

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Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

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The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

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ENGINEERS AND CONTRACTORS.
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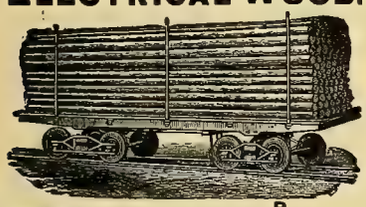

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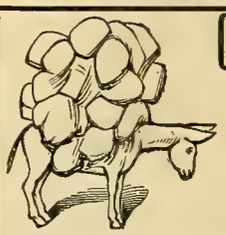

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WHY?

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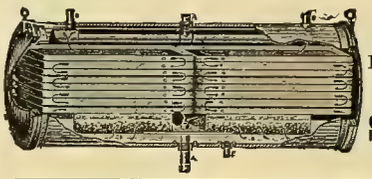

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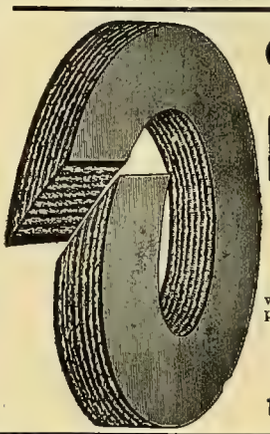

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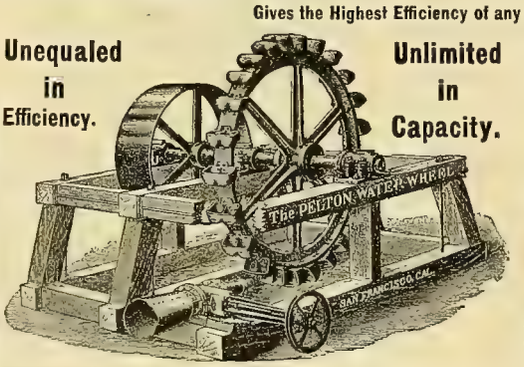

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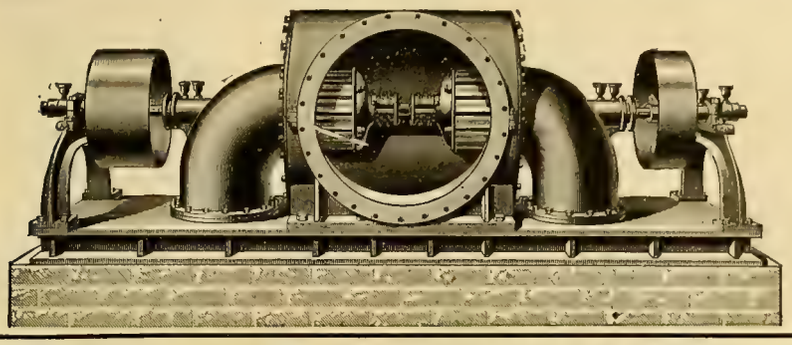

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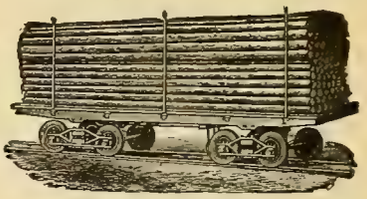

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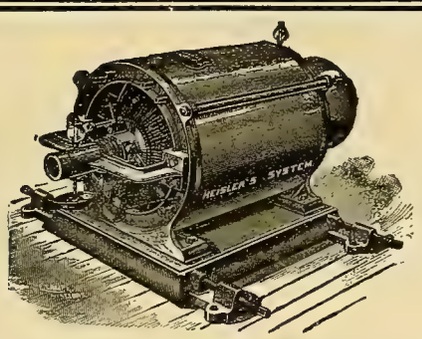

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Noted for Brilliancy of Light and Great Efficiency.

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Series Sockets and Lamps for Arc Light Circuits.

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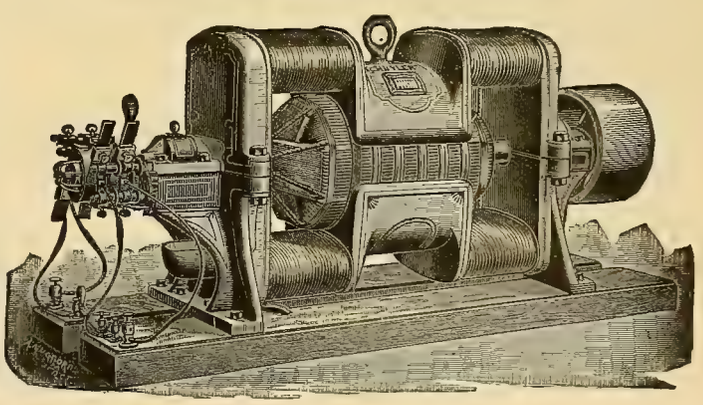

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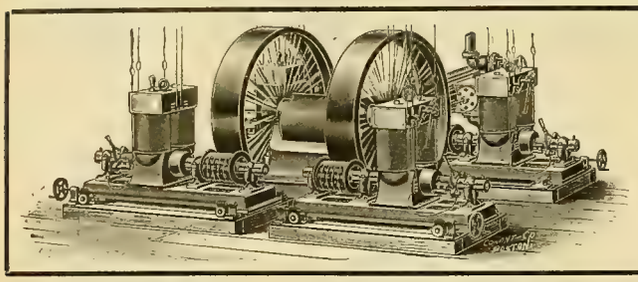

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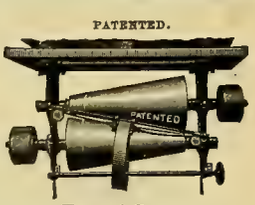

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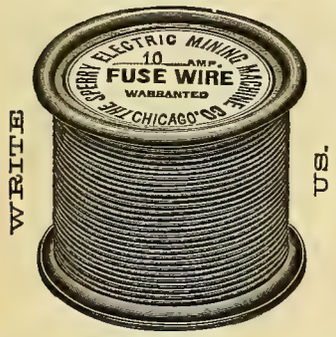

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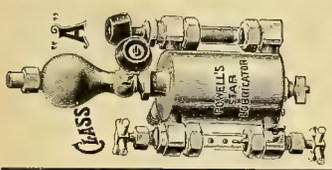

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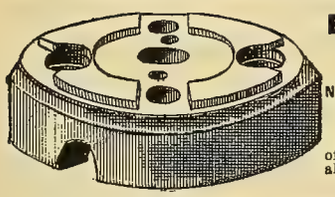

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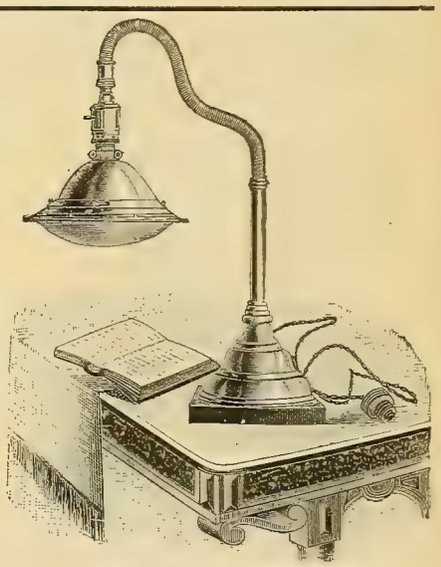

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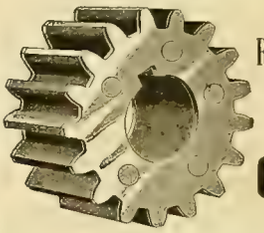

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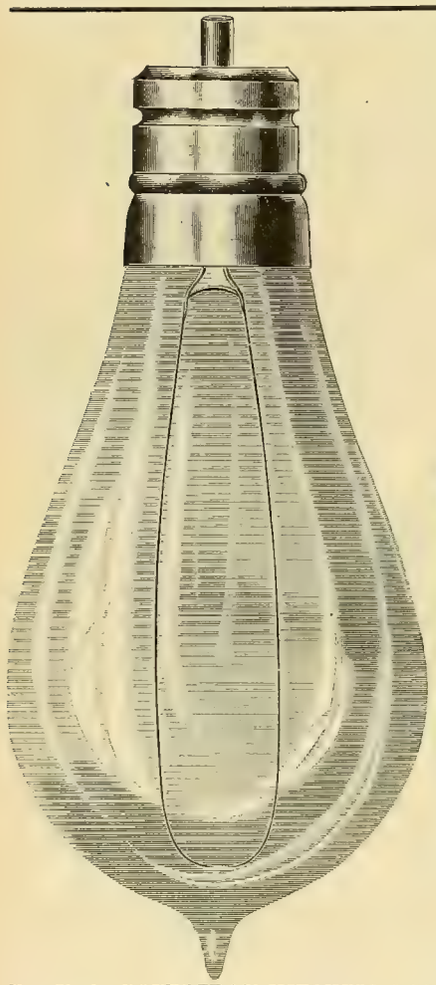

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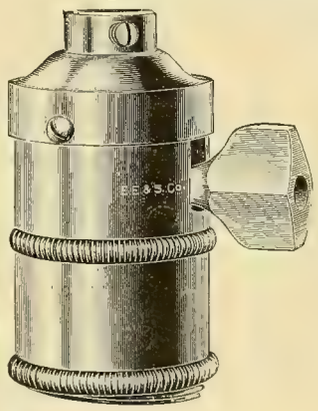

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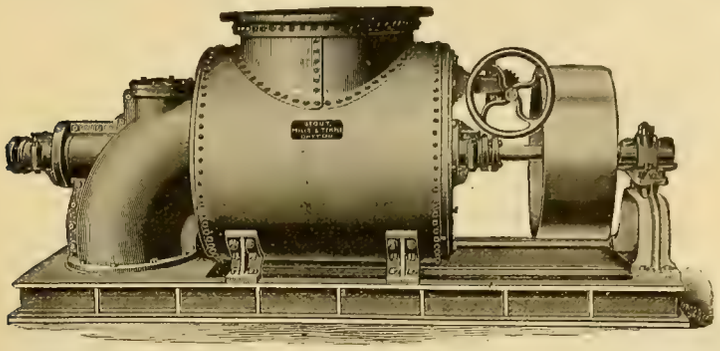

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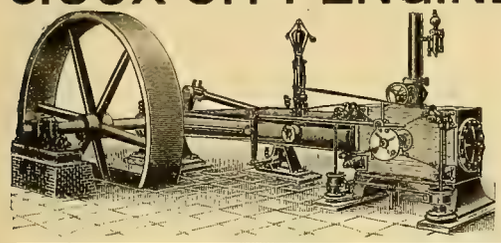

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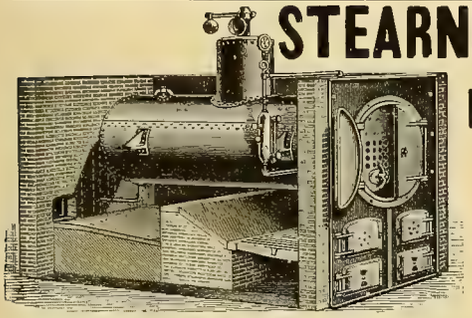

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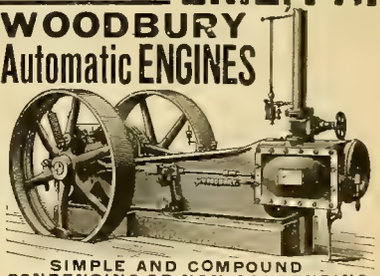

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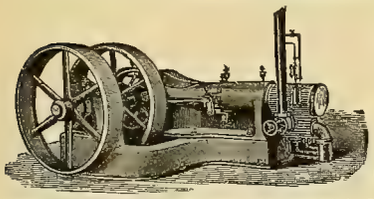

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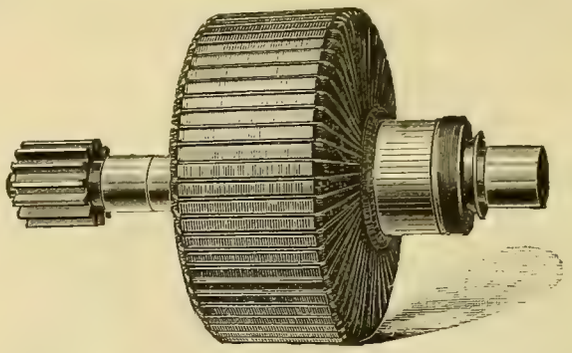

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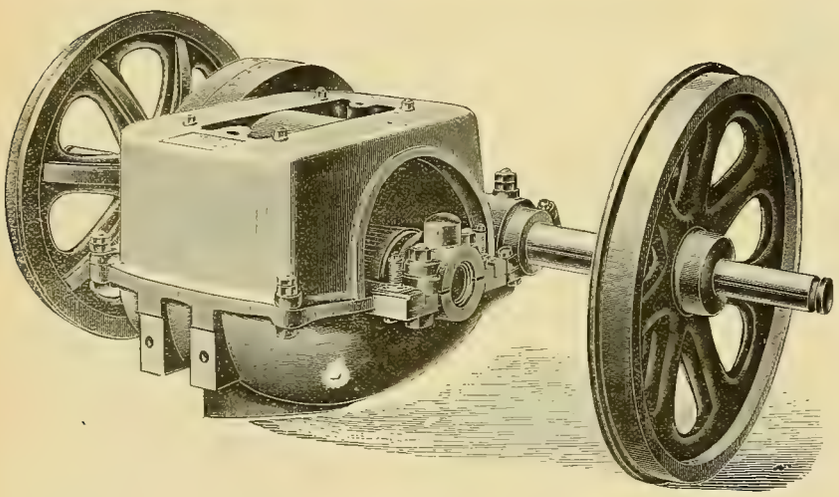

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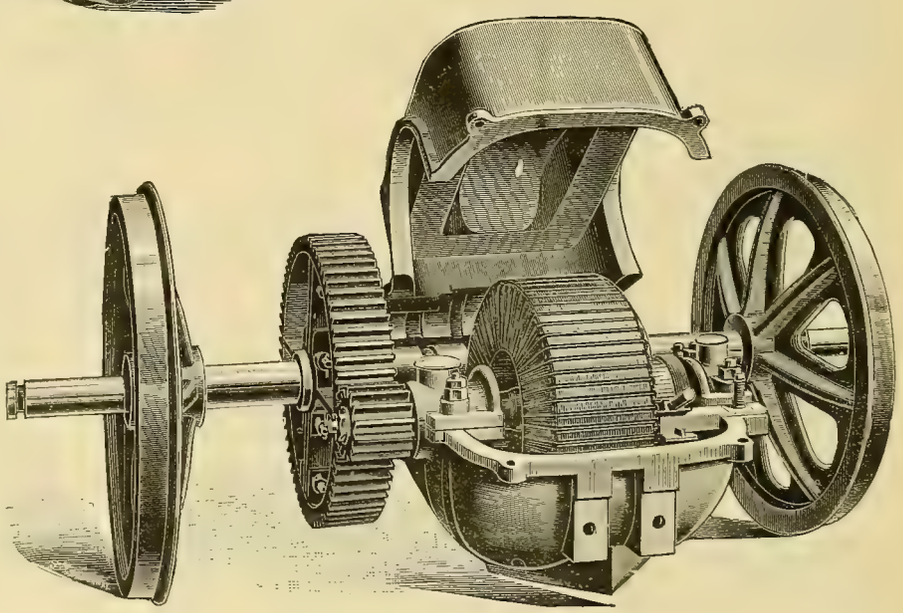

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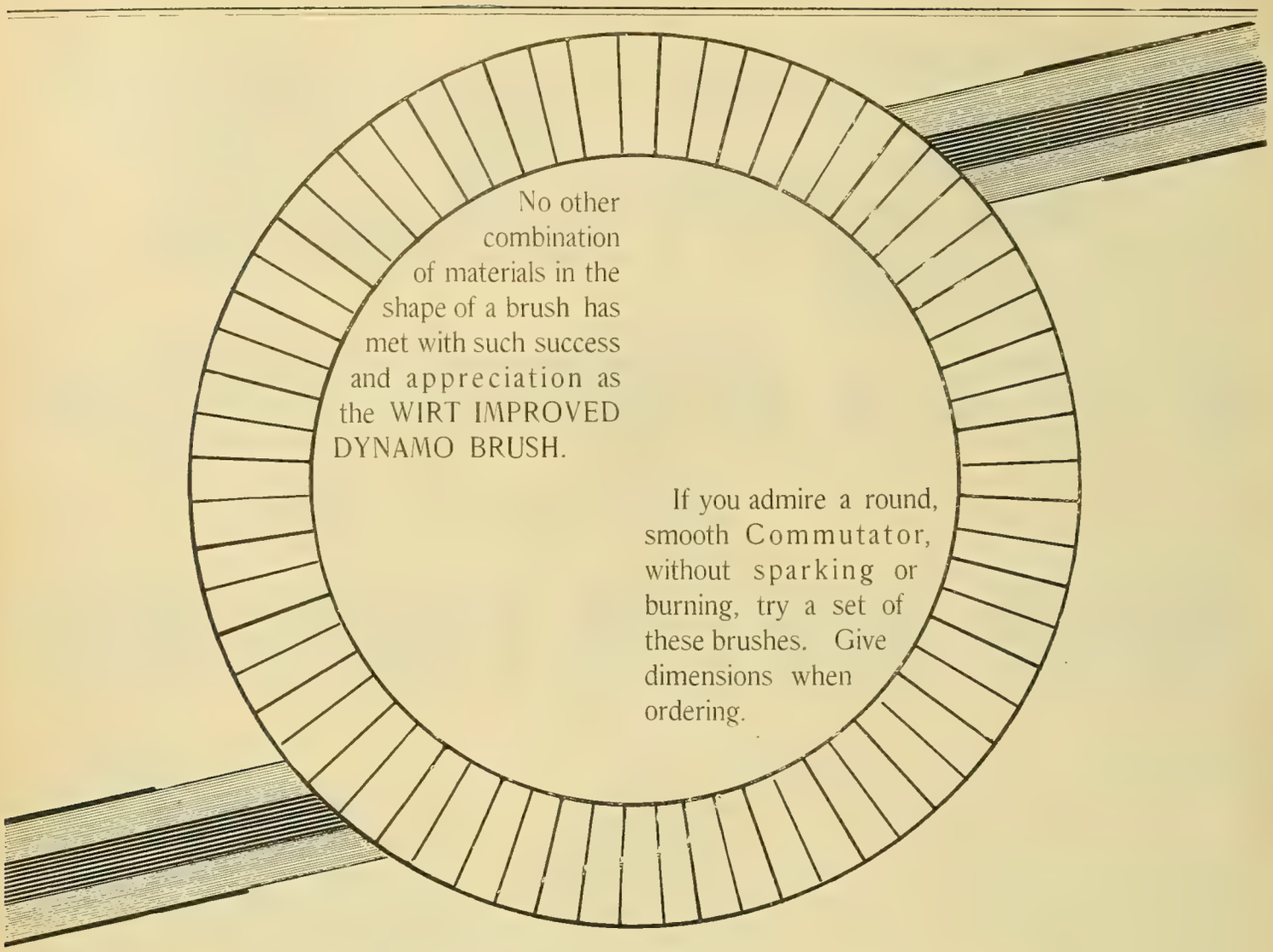

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GENTLEMEN:—We have been using four No. 32 Wirt Dynamo Brushes for about a month. We find that they do not spark at all and cause but little wear on the commutator, keeping the surface of the latter smooth. The Wirt Brush is entirely satisfactory, and superior to any we have used. Yours truly,

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Respectfully, GEO. CARSON.

THE ELECTRICAL SUPPLY CO., CHICAGO, Aug. 22, 1891.
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GENTLEMEN:—We have used a set of your Wirt Brushes on our dynamo, and have had no sparking, and scarcely any attention required during that time. The brushes furnished by the makers of the same dynamo were always more or less troublesome, and required frequent resetting and dressing of the commutator. I would now consider it a hardship to be obliged to use the old brushes.

Yours truly, (Signed) R. C. PAGE,
Engineer Libby Prison Museum.

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GENTLEMEN:—We have been running your brushes on our Edison Dynamo for two months and find they are a decided improvement.

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DEAR SIRS:—The brushes came in good order, and after giving them a trial I find them to be the best brushes we ever used, as they run smooth and do not cut the commutator, or spark. We will order more. Very truly, R. TURNER,
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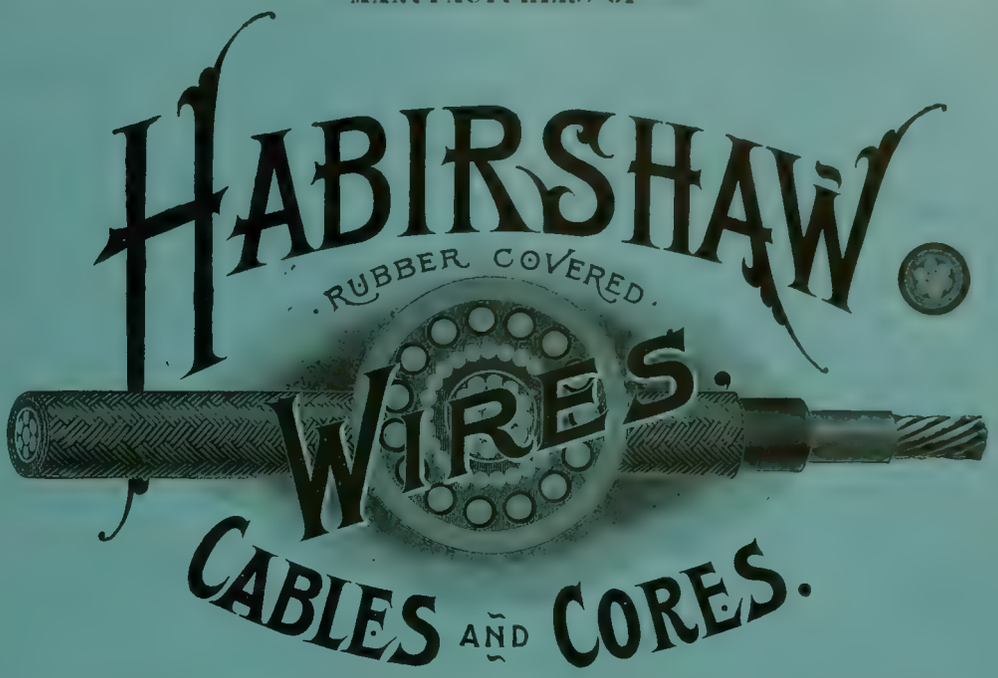

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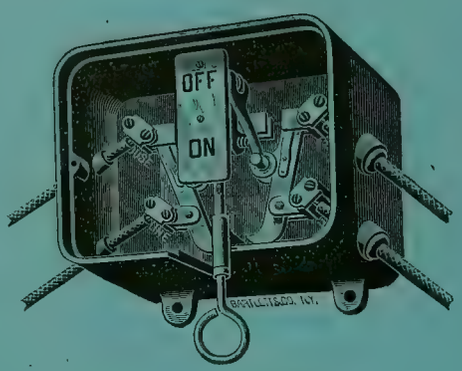

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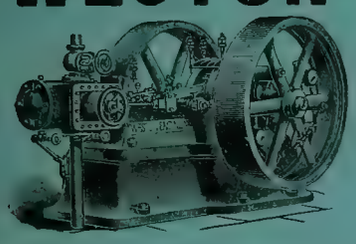

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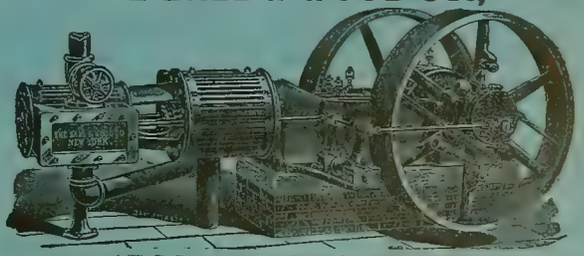

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The more you see of the "Ward" lamp the more you become interested. Mechanical and electrical perfection. It is all that. Are you aware that we are combining these features with a line of ornamental lamps that surpass in beauty of finish and design any arc lamp ever offered to the trade, and equal to the handsomest electrical fixtures manufactured?

You need such lamps for interior lighting and decoration. They increase the output of your station, and delight the consumer. How about prosperity? Of course you're through with experiments. Why need you injure your business and add personal worry by the purchase of any other style of lamps, which are so imperfect that they will have to be changed over every month, and brought out as a "New Lamp"?

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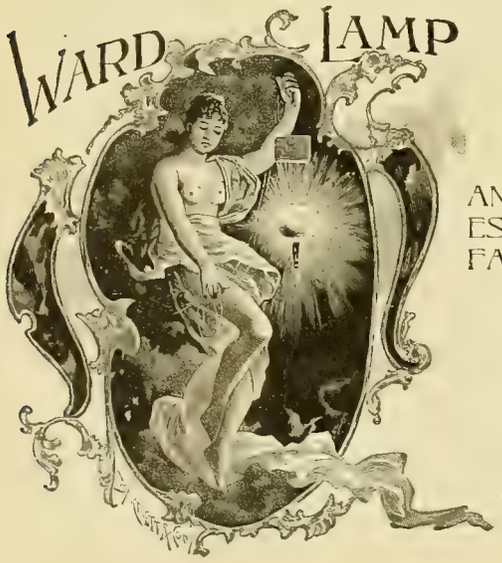

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EACH ONE LEADS IN ITS CLASS.

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By method of exclusion, the Bryant all porcelain sockets and switches stand alone.

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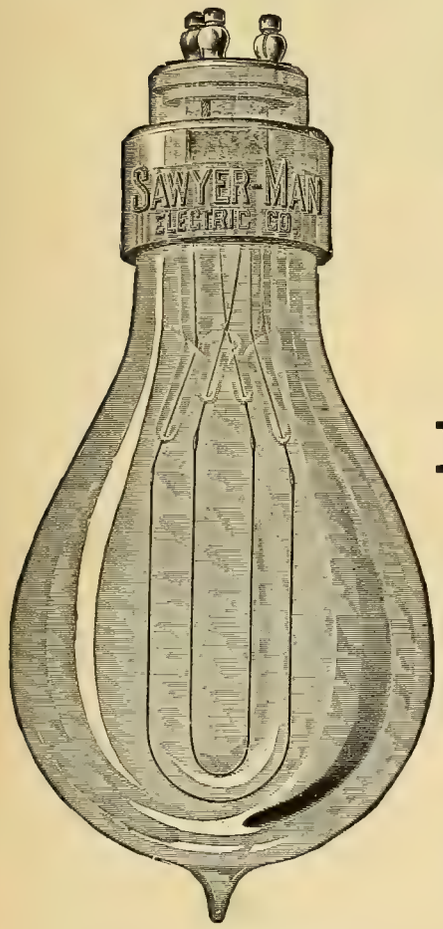

(SHOWING LAMP HALF SIZE.)
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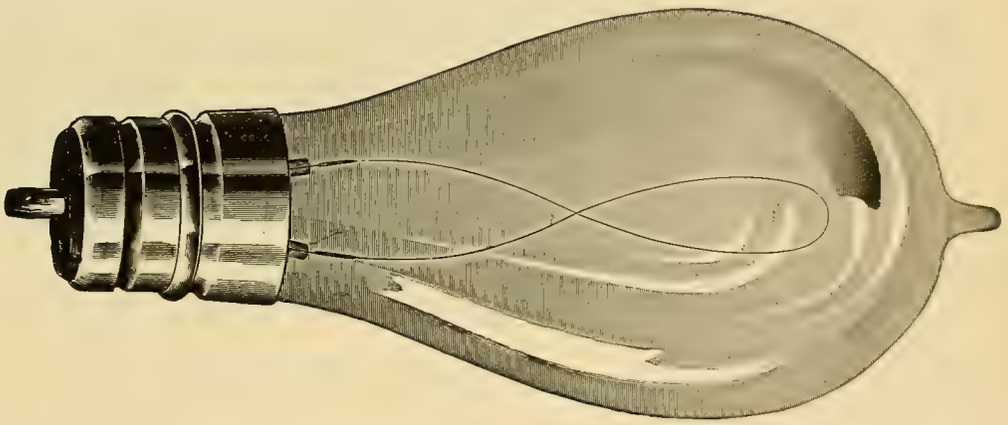

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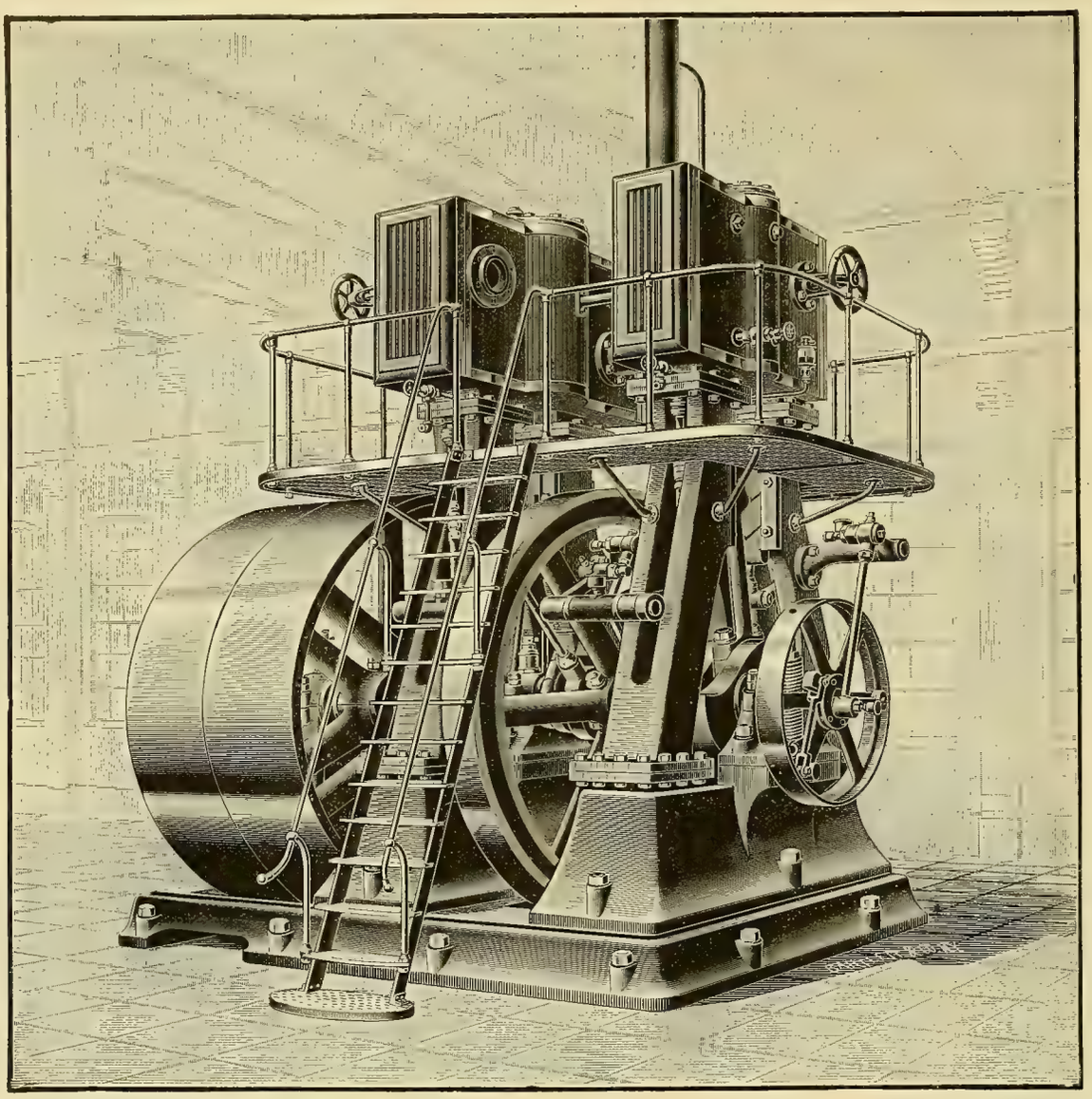

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FIRE DEPARTMENT.

* CITY TELEGRAPH. *

Chicago, Mar 21st., 1887.

C. B. Hotchkiss. Esq.

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I send herewith a piece of Kerite Wire cut out of service on account of construction of manhole. The wire, two pieces of about 3000 feet each, was placed in one inch common gas pipe and buried beneath the pavement about thirty inches, on Cass Street from Chicago Avenue to Erie street, thence to Pine street. This work was done in the summer of 1877 and the wire has been in continuous, and is now in service, without interruption of any kind. I see no perceptible change in the material and congratulate you upon the record.

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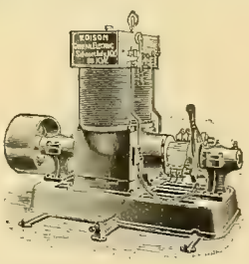

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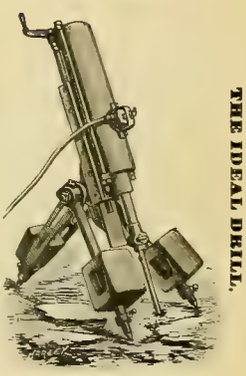

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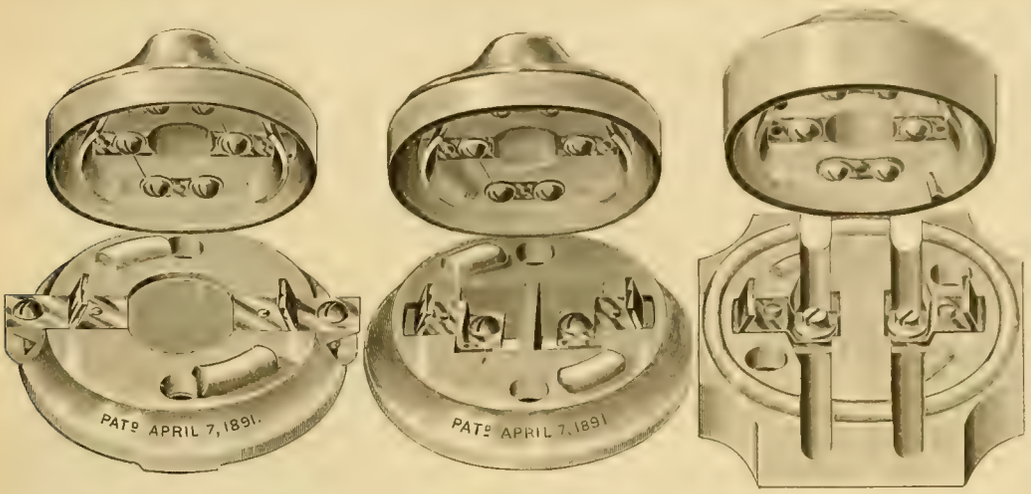

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Geology, three courses.
Engineering, three courses, viz.: Topographical Surveying; Railway Surveying; Electrical Engineering; Mechanical Drawing.
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Circulars descriptive of these courses and other information may be obtained on application to the *Secretary of Harvard University, Cambridge, Mass.*

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In general these courses are adapted to the needs of those who intend to be teachers in the several subjects. Several of the more elementary, however, are intended to meet the needs of beginners and may be taken by students in lieu of the corresponding courses in the College and the Lawrence Scientific School, and may be counted towards a degree.

During the session of the schools the College Library will be open from 9 A. M. till 5 P. M. The Museum of Comparative Zoology, the Peabody Museum, and the Mineralogical Collection are also accessible to students during the summer vacation.

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Board and lodging may be obtained in Cambridge during the summer vacation at a cost of from $5 to $10 per week.

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This school, which is under the control of the Faculty of Arts and Sciences of Harvard University, offers seven courses of study leading to the degree of Bachelor of Science, viz;

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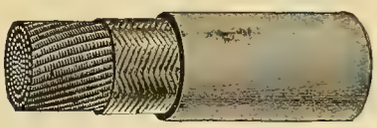

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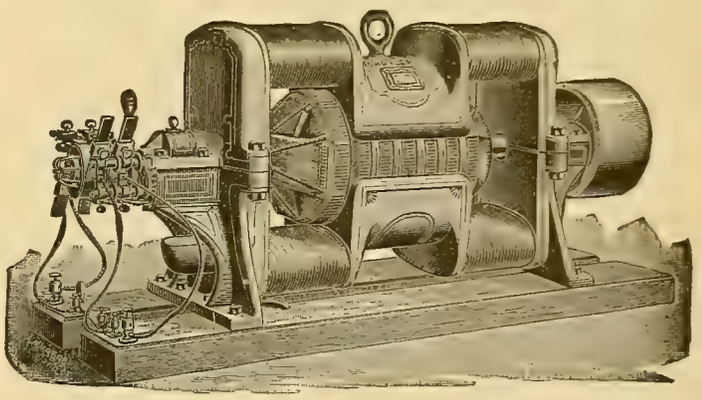

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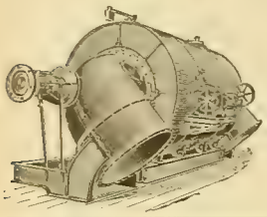

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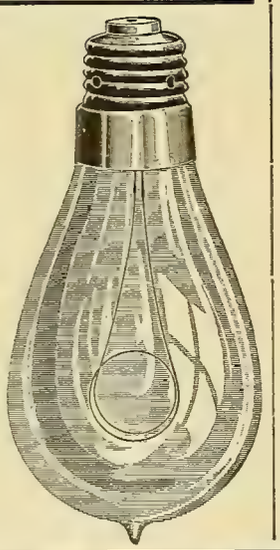

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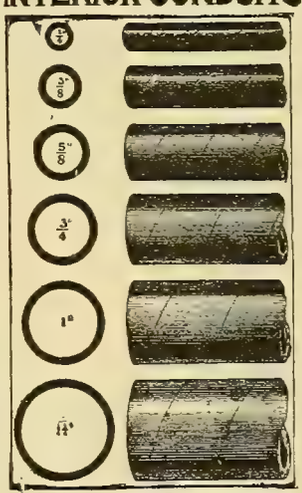

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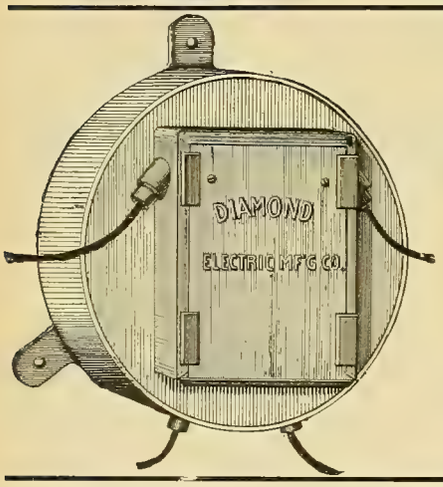

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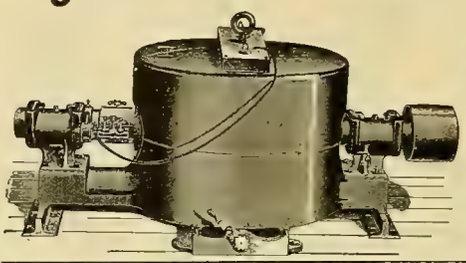

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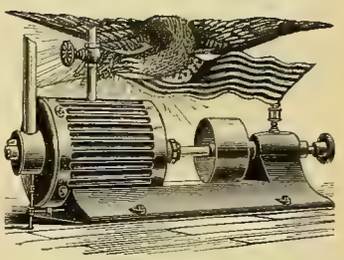

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Western Electrician.

EVERY SATURDAY.

Vol. X. CHICAGO, APRIL 23, 1892. No. 17

Wisconsin Telephone Exchange.

The Wisconsin Telephone company is now comfortably settled in its new building in Milwaukee. The elegant structure, which the company erected at an expense of about $80,000, possesses characteristics both of a palace and a huge fire-proof vault. It is very handsome indeed on the outside, as will be readily seen by glancing at the view shown in Fig. 3, and its interior finish is something that the terms tasteful, elegant and beautiful only partially describe. As to fire it is pronounced absolutely safe. A fire on the inside could not possibly grow to dangerous proportions, and on the outside flames might sweep over the building without doing serious damage. The structure was built, as Secretary J. D. McLeod has aptly remarked, "to stand everything except earthquakes, and Milwaukee is altogether too conservative for earthquakes." The building, in a word, is as safe as it is artistic.

The new exchange stands on Broadway, between Mason and Wisconsin streets. Its location is within a block of the present postoffice and two blocks from the new government building site and the Chamber of Commerce. It is about midway between the two principal hotels—the Pfister and the Plankinton. It has a west front, is twenty feet wide and five stories high. The front is of terra cotta, both handsome and novel in appearance. The interior is of solid brick and steel. There is a winding stairway, which runs from top to bottom in such a way as to form a court, which really divides the building. Light has been secured and space saved by combining the stairway and court. In front of the court, overlooking Broadway, are the principal offices, and back of it the storage rooms, operating department, etc.

On the first floor, with an entrance on Broadway, is the office of Superintendent Cottrill. In this office quartered sycamore has been used for finishing with fine effect. Adjoining is the office of W. H. Hyde, superintendent of equipment, which is equally fine. The rear of the first floor is given over to the inspector and storekeeper.

A trip through the upper stories, which can be reached by an elevator as well as by climbing the ornate spiral stairway, reveals new beauties. On the second floor, with a street front, is the office of President Payne. It has a mosaic floor, a handsome fireplace and is finished in mahogany. Adjoining it is the directors' room. It is finished in birdseye maple and affords a pleasing contrast to the president's office. In the rear is a suite of rooms occupied by Auditor D. E. Roberts and his clerks.

Secretary McLeod reigns supreme on the third floor. He has the whole front part of the building. His private office is large and airy and well lighted. It, as well as the rest of the building, is finished in quartered oak. Two smaller rooms adjoin Mr. McLeod's office. One is used by his stenographer and the other is an ante-room. In the rear is a number of rooms devoted to the use of the custodian of the building.

The lady operators are on the top floor. In the rear, securing its light from the alley, the court and a skylight, is the operating room, shown in Fig. 1. It is a long, narrow apartment, with a high ceiling. In the front part of the building is a large parlor, finely finished in oak and richly and tastefully furnished, for the use of the operators. It is provided with lockers, closets washrooms, etc. There the girls eat their lunch and at night those that are "off duty" temporarily may lie down and obtain a little sleep. The girls are happy and contented despite the occasional and inevitable "kicking" which they hear over the lines.

The fourth floor is used for storing stationery. In the basement is the cable house, shown in Fig 2. The cables are properly arranged and numbered, and are so placed that one can be taken out without disturbing any other. There is room in the basement for seventy-two cables, but less than half of that number are in use at present. The cables are all protected by a current arrester. It is a Milwaukee invention, owned by Messrs. McLeod, Parker and McManman.

The most improved multiple switch-board is used. It has a capacity of 2,400 subscribers, which may be increased to 4,000. The subscribers number 6,280, of whom 2,450 are in the city and the balance, 3,370, scattered throughout the state. The number of the company's employes is 410. Milwaukee is the headquarters for the whole state.

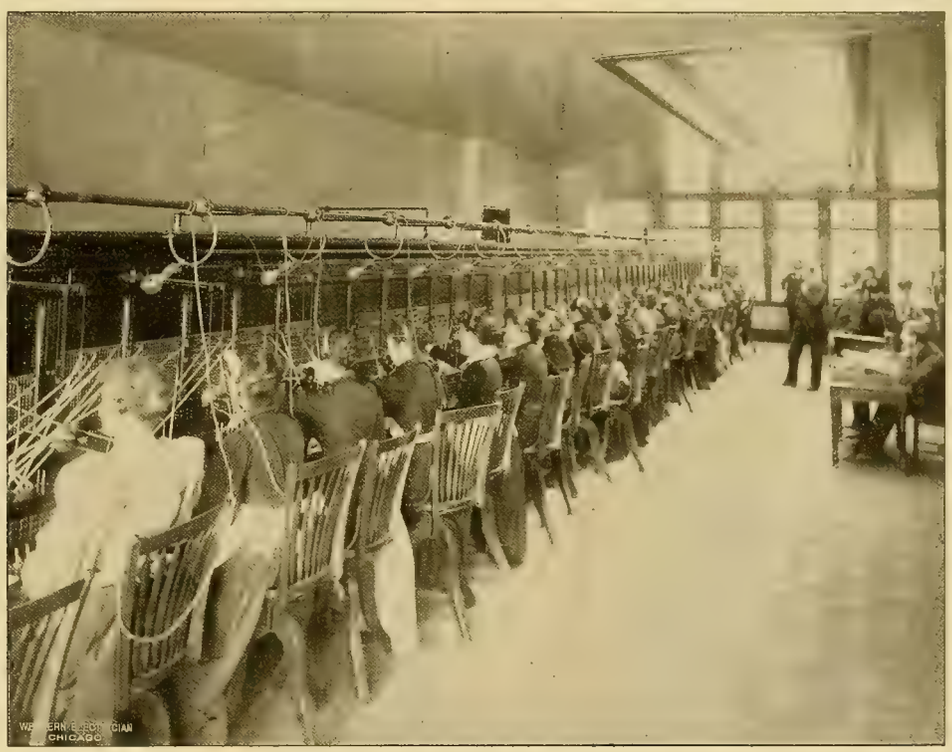

FIG. 1. WISCONSIN TELEPHONE EXCHANGE.

The arc light wires and electric railway wires played havoc with the company's toll and local service from the start. The company has been busy perfecting a long-distance service and burying its wires in Milwaukee. In the long-distance system the complete metallic circuit is used. A year ago the system was first introduced between Milwaukee and Waukesha. It has since been extended to Racine and Appleton, and the people of those and intermediate points, as well as of Milwaukee, have connection with the Chicago long-distance line. They will be connected with New York, Boston, Philadelphia and other principal Eastern points as soon as the long-distance system, which is being built westward, reaches Chicago. By that time, moreover, the long-distance service in the state will probably be materially extended. The system involves an expenditure of $400 a mile.

By next fall the company expects to complete the work of burying its wires in the city. During 1890 the district bounded by Mason street on the north, the lake on the east and the river on the south and west was completed. Last year a great deal of work was done. On the East Side the system will extend to the northwestern part of the city, the line ending on Farwell avenue. On the West Side it will extend on Third street to Walnut, on Chestnut to Winnebago, on Wells to the city limits and out a short distance on Clybourn street. On the South Side one subway will extend on Clinton street to National avenue and west to Grove street and another on Reed to Washington street. Outside of the underground district the lines will be rebuilt and the two-wire system used. The cost of the improved service in the city will be about $400,000. The new service, of course, is proving more expensive to subscribers, but the company continues to furnish the old and cheaper system where it is desired.

The conduits are of vitrified clay, ten inches square, with a carrying capacity of six cables, each cable containing 100 wires. The conduits are buried in the street about two feet and have a manhole at the end of each block. Near each manhole is a pole for carrying the wires to subscribers in the immediate neighborhood.

Henry C. Payne is president of the company; Frank G. Bigelow is vice-president and treasurer; John D. McLeod, secretary and general manager; E. B. Cottrill superintendent; W. H. Hyde, superintendent of equipment, and D. E. Roberts auditor. In the state the company has 80 exchanges and 190 toll stations. The miles of wire in use aggregate 10,000. Nearly 200,000 toll messages are transmitted annually.

Chicago Edison Company's New Building.

For some time the Chicago Edison company has been casting about for a site for a new station, as the present quarters on Adams street are inadequate to the company's large and increasing business. The property, too, is situated in the heart of the business district, and is considered too valuable for central station purposes. A site for the new building has now been purchased. It is located on the west side of the Chicago river, at Harrison street, and has the following frontages: Harrison street, 219 feet; Charles street, 231 feet; river, 208 feet; north line, 274 feet. The water frontage is considered of especial advantage, as reducing the cost of the transportation of fuel. The property is now partly taken up by a dry dock which was formerly owned by the Chicago Dredging company. The plans for the new station are not sufficiently advanced to warrant description, but it is the intention of the company to erect one of the largest central station plants in the country. A meeting of the stockholders has been called for May 4th to vote on the question of increasing the capital stock from $1,000,000 to $3,000,000. It is believed that the greater part of the money thus raised is to be devoted to the erection of the new plant.

An English exchange says: The city council of St. Etienne, France, has decided to apply electric power to all the hand looms in the city, and contracts have been made with an electric company for the necessary plant. The dynamos are to be driven by water from the city reservoirs. There is practically an unlimited supply of water, with a fall of upward of one hundred feet. The bulk of the enormous output of ribbons (£4,500,000 a year) is the product of house industry. The weavers for the most part own their own looms, and operate them by hand in their own houses. There are 18,000 looms which are thus distributed among the homes of the weavers, while the number of looms driven by steam in the few ribbon factories of the town is only 5 000. The 18,000 looms of the independent weavers are valued in the aggregate at £900,000.

Wire Tappers in Cincinnati.

Schemes for stealing or falsifying telegraphic returns appear to have suddenly become epidemic all over the country. A bare-faced swindle of this sort, as perpetrated in a Chicago bucket shop, was recently illustrated in this paper, and somewhat similar schemes have lately been detected in New York and elsewhere. Cincinnati was the scene of one of the latest operations of this character, which appears to have been elaborately worked out A correspondent of the *St. Louis Globe-Democrat* gives the following account in a dispatch from Cincinnati:

A discovery was made in the vicinity of Red Bank, near this city, of a scheme to beat the proprietors of pool rooms. The New York wire had been tapped near Red Bank, three-fourths of a mile from the station of any road, and all necessary preparations were made to falsify returns from the East announcing the results of the races. There were forty-eight cells in position, and a well-equipped telegraph station had sprung up in the woods. The conspirators located the Western Union New York wire, avoiding the railroad wire. A more secluded spot could not be secured, as there is a stretch of a mile and a half from Red Bank to Batavia Junction that is almost uninhabited. It was between these points that the wire was tapped.

It is supposed that the wire tappers reached the point by the river from Columbia, where they could land within fifty yards. There was mud on the telegraph pole where the wire was tapped. The operators tapped two wires and had a mile of covered wire leading off into the woods. Three batteries and a lot of cells were turned up. One of the wires tapped had been used for race matters, but there has been so much of this sort of work going on lately that the business was switched around every day, and no one knows until the time for sending arrives just which wire is to be used.

Supt. Miller of the Western Union said to-day that the members of the gang of wire-tappers were very well known, and if those who had discovered the plant had not been quite so zealous in breaking it up, the telegraph officials might have caused the arrest of the law-breakers. The laws of the state are very stringent now, and discovery means a term in the penitentiary.

A Wooden Map for Fire Alarm Purposes.

F. W. Swenie, son of Chief Swenie of the Chicago fire department, is proudly displaying a new and very useful map at the office of the city telegraph department in the city hall. It is painted on wood and represents the city of Chicago, the parks, principal streets, etc., being shown. On the map is correctly located every one of the 68 engine and hook-and-ladder houses in the city. The former are represented by round and the latter by square plugs. When an alarm comes in the plugs representing the companies sent out are withdrawn from their holes, and, if it is a big fire, plugs are transferred to the denuded district to represent companies sent in from other houses to protect the territory. The operator is thus enabled to see at a glance just what companies are at the fire and what are transferred to houses other than their own. Then if an order comes in from the chief for twenty additional engines the man at the map can determine at once what companies can best be spared without leaving the outside territory entirely unprotected. He rapidly calls off the numbers, and the necessary orders are telegraphed as he speaks. Without the map it would take much more time and trouble to place the engines.

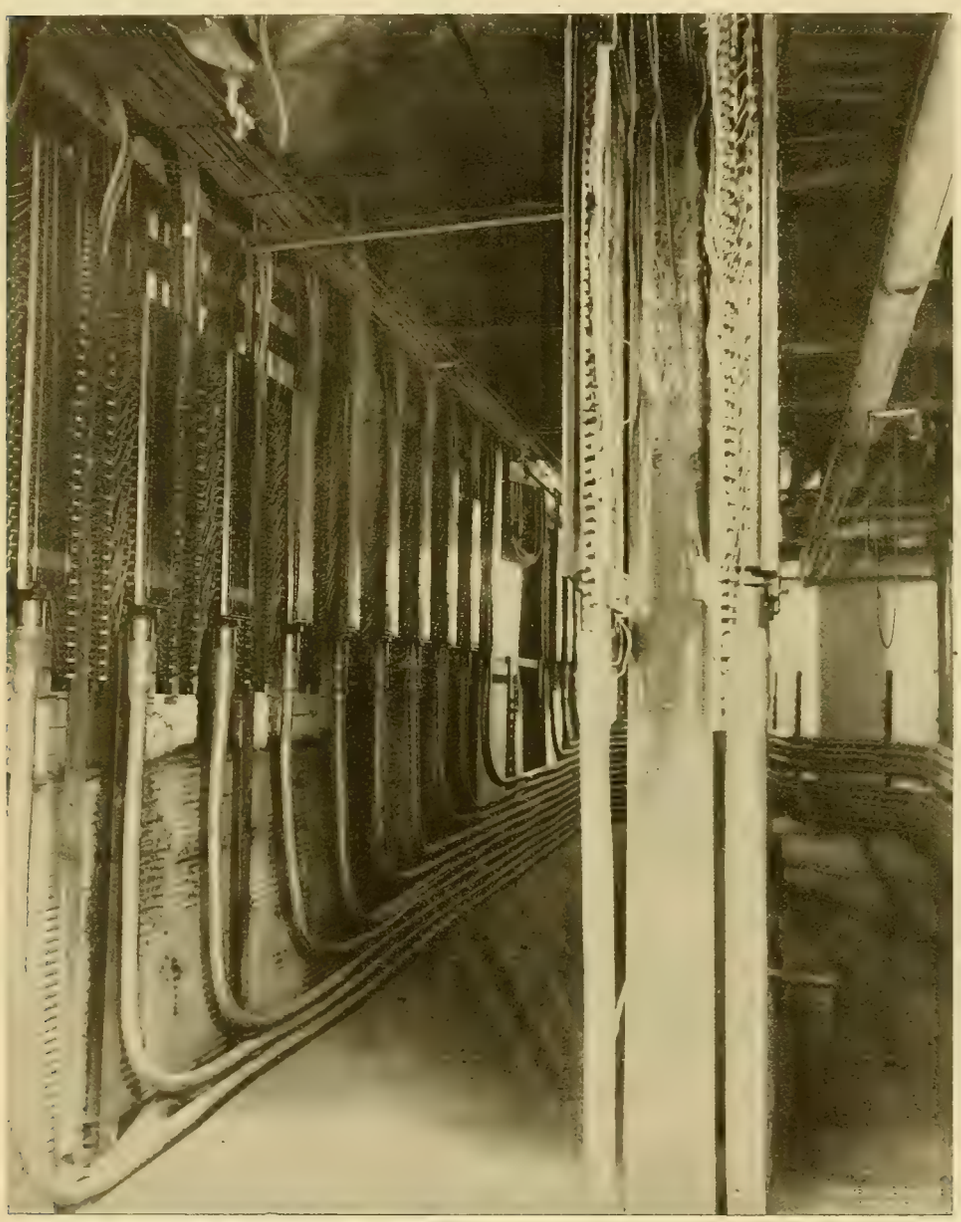

FIG. 2. WISCONSIN TELEPHONE EXCHANGE.

Bids for the construction of the Edmondson Avenue, Catonsville & Ellicott City electric railway, of Baltimore, Md., have been invited.

The Baltimore, Canton & Point Breeze Railway company has applied to the county commissioners of Baltimore for the right of way over certain county streets.

Electricity at the World's Fair.

After nearly two weeks' deliberation the World's Columbian Exposition, acting on the recommendation of Directors R. C. Clowry and Charles H. Schwab and Electrical Engineer Sargent of the construction department, has decided to award the contract for furnishing the 93,044 incandescent lights needed for the World's Fair to the Edison General Electric company at the flat rate of $5.95 per lamp for the period of time named in the specifications. This period varies in the case of the different buildings, as in several the lamps must be capable of being burned for some time after the fair has closed. In the case of most of the groups of lights the plant must be capable of operation for about six months. The price named includes everything—dynamos, station apparatus, mains, inside wiring, sockets, lamps and renewals. The Edison company's original price for this work was $18 49 per lamp. At the rate agreed upon the contract will amount to $553,611.80. The arc lighting will cost about $120,000.

In conversation with a representative of the WESTERN ELECTRICIAN, Frederick Sargent, the electrical engineer for the construction department, gave the following account of the manner in which the agreement was reached: "The committee first rejected all bids, as, of course, it had a perfect right to do. Then the Edison company put in new bids at a much lower rate. There are practically only two companies in the country that could undertake to carry out such a large contract—the Edison-Thomson-Houston and Westinghouse companies. Mr. Westinghouse came to Chicago and also put in new bids. Yesterday (April 14th) he made the company two offers, but the last bid of the Edison company was lower than either, and we decided to close with it. Mr. Westinghouse urged us to re-advertise for bids and thought that the Exposition company could save money by doing so. After carefully considering the matter, however, we decided not to do so, although the committee fully appreciated the assistance that Mr. Westinghouse had rendered it. We decided not to re-advertise, first, because the matter would ultimately come down to the Edison and Westinghouse companies, anyhow, and both had every opportunity to put in their lowest figures, and, second, because we had reason to fear, from the reported relations of these great corporations, that changes might be brought about in their attitude toward each other by which the World's Fair would be unfavorably affected, or that this contract might be made the subject of negotiations between the two companies. So we concluded to close the matter up at once. The by-laws make provision for the letting of contracts without advertising by the president or vice-president of the board and the chairman or vice-chairman of the committee on grounds and buildings in case of an emergency. We thought that this was a case justifying such action. It will be asked why we passed over the bids of other companies that offered to perform certain portions of the work at rates considerably lower than that finally agreed upon. If you will examine these bids carefully, you will notice that they are for the buildings nearest the generating plant, such as machinery hall and the administration building. It is apparent, of course, that the conductors for these buildings will cost very much less than those needed for the buildings situated thousands of feet away, like the art gallery and Illinois State building, for instance. Figuring on the rate asked for the advantageously located buildings, it will be seen that the general price agreed upon is less than we would have to pay if the rates in the bids apparently so low were proportionately carried out for all the buildings. The offer of the Western Electric company—to furnish generating capacity for 2,500 lamps for $1—will be accepted."

It may be added that it is now generally understood that the South Side Machine and Metal Works of Chicago, which originally put in the lowest bid for the entire work, was backed by the Westinghouse company—that is, this concern had an understanding with the latter company by which, if successful, it agreed to obtain the larger part of the electrical equipment needed from the Pittsburg company.

The World's Fair people generally are rejoicing that terms so advantageous have been obtained, especially in view of the size of the bids at first put in by the companies in the consolidation. In speaking on the result Director Schwab is reported to have said: "Altogether, I think we have done the wisest thing. We caught those people when we could. If we had postponed the matter a week or ten days, the Westinghouse company might have joined the combination and placed the figure at $10 or $12 per lamp. I have devoted more time to this question in the last ten days than I have to my private business. The same is true, I think, of Col. Clowry. There is no use talking, the so-called trust has the facilities and the improved machinery. Besides, we are getting the lights at $2 less

than our lowest estimate." Lyman J. Gage, a member of the committee on grounds and buildings and ex-president of the board of directors, said: "I don't doubt there will be something of a howl about this matter. But we couldn't deal in uncertainties with a matter of such importance as this."

The plans for the lighting and power service in the electrical building are entirely different from those adopted for the other buildings of the exposition. Chief Barrett has offered to take the light and power supply for his building entirely off the hands of the exposition, so far as the cost is concerned, and proposes to apportion the work out

FIG. 3. WISCONSIN TELEPHONE EXCHANGE.

among exhibitors, and ask them to do it at their own expense as a part of their exhibits. The proposition has been submitted to several exhibitors, and enough have agreed to it to insure the entire success of the project. The general plan is this: The Exposition company is to furnish steam power for the operation of the generators of exhibitors; the building is to be divided up into sections and each company will be assigned a section; the wiring and all other necessary work to be done by exhibitors. Manufacturers of ornamental posts, brackets, globes and all sorts of arc lamps have offered their goods for service, largely in excess of the need, and such donations will be accepted as far as use can be made of them. In this way the equipment and operation of the electric system for the building can be secured for barely the cost of the steam. Prof. Barrett proposes to go farther than this, however, and secure a return to the exposition of an amount covering the cost of all special lighting, beyond the necessary illumination of the building. For instance, 422 arc lamps will be used for general lighting, but in addition to this many exhibitors will require special arc lamps and they will have to pay for them at the regular price, whatever that may be. Then it is estimated that about 5,000 additional incandescent lamps will be required by exhibitors; for these they will have to pay. In this way brilliant effects may be had, practically without cost to the exposition, if indeed there may not be a revenue. As soon as Mr. Burnham has leisure, after the rush incident to the letting of the contracts for the general lighting, the electrical building will be taken up and the details of the plan finally agreed on.

Assignments of space have been made in the electrical building to fourteen foreign countries—England, Germany, France, Austria, Belgium, Holland, Denmark, Sweden, Norway, Russia, Switzerland, Spain, Italy and Mexico. The allotments range from 20,000 square feet of space, made to Germany and England each, down to 500 square feet made to Mexico. Nearly all of these assignments have been accepted, and in nearly every instance the space has been applied for to the commissioners of the various countries. The total assigned pace to foreign countries is 54,571 square feet. The total net space in the building is 207,000 square feet. This leaves available for American manufacturers 152,429 square feet. The department of electricity has on hand formal applications for 161,399 square feet, or more space than is available. These figures do not include preliminary applications, where exhibitors are holding off temporarily until the light and power contracts have been disposed of. This last class includes some of the largest companies, the Edison and Thomson-Houston being among them.

Chief Barrett wrote a letter last week on the subject of the government exhibit of electrical apparatus. It seems that the patent office is to make an exhibit of patent models in all the departments, and that the officials have no electrical models, as the rule allowing the granting of patents on drawings alone went into effect in 1876, or before nine-tenths of American electrical inventions were patented. In order to overcome the meagerness of the electrical exhibit the officials have written to inventors and manufacturers asking them to make models of their patented apparatus, as a part of the patent office exhibit. Prof. Barrett takes the ground that the government has no right to incorporate in its patent office exhibit any article not a matter of record in connection with a patent. He has written, therefore, requesting inventors and manufacturers who have now, or are willing to build, models, to exhibit them on their own account, or place them at the disposition of the electrical department, where they will be properly accredited and conspicuously arranged rather than allow them to be swallowed up in a great mass of patent office exhibits.

A Chicago afternoon paper recently printed a story to the effect that Chief Barrett had been offered a position in New York at a startling salary and would resign from the World's Fair. The report is denied at the headquarters of the department of electricity.

The Columbian Launch company of Chicago expects to

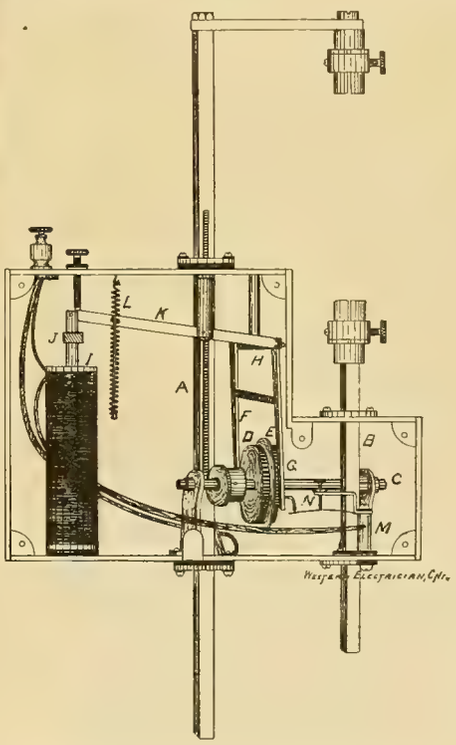

FIG. 2. MEISSNER'S POSITIVE FEED ARC LAMP.

have an electric launch in operation on the lagoons of Jackson Park by May 1st. A new storage battery invented by William Morrison of Des Moines, Iowa, will be used.

The city council of Toronto has decided upon the adoption of a system of electric street railways, and a deputation of the members was selected to inquire into the working of the different systems in the United States. The deputation started on April 13th and will visit Detroit, Cleveland, Philadelphia, Boston, New York, Washington, Cincinnati, Pittsburg and other places. The committee's report will govern the system to be used in Toronto.

Meissner's Positive Feed Arc Lamp.

The arc lamp represented in the accompanying illustrations is designed primarily for use as a focusing lamp in theaters where it is desirable, for lighting effects, to have a lamp that will burn in any position, the feed of the carbons being independent of the action of gravity. The utility of such a lamp for search lights and in decorative arc lighting is also obvious. As yet, however, the lamp, which is the invention of W. O. Meissner, the electrician at the Knapp Electrical Works, Chicago, has only been used for theatrical lighting. Two are in service in Chicago—one at the Columbia theater and the other at the Madison Street opera house. In Fig. 1 the lamp is shown on the stage, fitted with a lens box and a holder for colored glass. It is also used with a simple reflector, and with an "Olivette" box. The latter is a large box provided with a

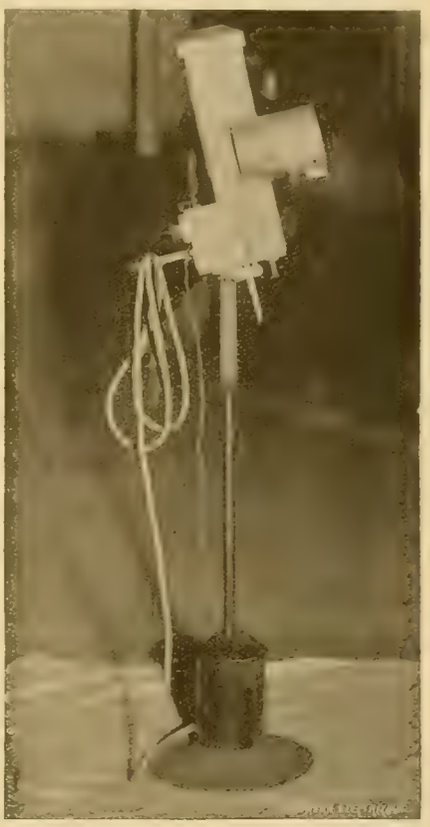

FIG. 1. MEISSNER'S POSITIVE FEED ARC LAMP.

ground glass front and supplied with means for quickly changing the color of the light. The lamp is highly praised at both theaters for the simplicity and thoroughness of its operation.

The mechanism by which a direct motion is given to both carbons is represented in Fig. 2, which shows a side view of the lamp, with the cover removed. *A* and *B* are the carbon rods. *C* is a shaft with pinions to connect the two carbon rods. *D* and *E* are ratchet wheels of different direction, mounted on shaft *C*. *F* and *G* are pawls to engage in ratchet wheels *D* and *E*, and are pivoted at the ends of rocker *H*. *I* is a solenoid connected in shunt with the lamp circuit, and *J* is its armature. *K* is a connecting bar for *J* and rocker *H*. *L* is a spring, the power of which is utilized to engage pawl *F* into ratchet wheel *D*, thus separating the carbons. *M* is an insulated post and spring, and is connected in the shunt circuit of the lamp.

The operation of the lamp is easily understood. In trimming the carbon rods are separated and may be left separated. When the current is turned on the shunt solenoid *I* will attract the armature *J*, thus engaging pawl *G* into ratchet wheel *E*, rotating the shaft *C*, and moving the carbon rods to approximate the carbons. At the same time the shunt circuit will be interrupted at *N*, causing the armature to vibrate and rotating shaft *C* until the carbons are in contact, closing the main circuit of the lamp and diminishing the current in the shunt circuit. This allows the spring *L* to operate the lever *K*, pulling it away from the solenoid *I*, at the same time engaging the pawl *F* in the ratchet wheel *D*. This separates the carbons and establishes the arc. When the arc grows longer the resistance is increased in the main circuit and the current is increased in the shunt circuit, and will repeat the operation described.

Mr. Meissner has filed an application for a patent for his invention.

The Trolley System for Chicago.[1]

By Frank L. Perry.

While it is very reasonable now to assume that visitors to Chicago during the coming exposition who may locate in the southwestern part of the city will ride to the fair grounds in electric motor cars, still the street railway company has not yet purchased its electrical equipment, nor are the wires strung in the streets; and until all this is accomplished the electrical fraternity cannot spend too much time in the legitimate effort of making clear to the general public the merits of a system that we know to be most efficient, reliable and eminently suited to the needs of the street railway company that has just decided upon its adoption.

Such action is particularly desirable at the present time in view of the unreasonable antagonism of certain of the daily papers. For instance, under the bold heading, "No Trolleys for Chicago," the *Chicago Herald* of March 3d editorially designates the overhead method as "the cheap, clumsy, untrustworthy and unsightly trolley electric system" that "is without exception the least reliable and the most dangerous of all surface means of transportation."

The *Herald* fires off this volley of adjectives with the somewhat amusing explanation that the system is "practically heavy cars suspended from wires that must be run all over the town, and have only the guarantee derivable from experience that they will put surface transportation out of order oftener and longer than any other system yet devised by baffled ingenuity." The same paper closes its tirade against the system with the surprising assertion that "no brake has yet been manufactured that can be relied on always to stop an electric car, and runaways with fatal consequences are among the noted achievements of trolley electric systems."

Mention should be made, too, that the Baltimore *Sun* in a recent issue attempted to enlighten its readers by telling them in all seriousness that "the difficulty of the trolley system is that the entire series of cars is dependent on the same wires, and any obstruction or break in the latter stops all the cars until the defect is remedied. It is the same with the cable system," says the *Sun*, "but with respect to the latter the trouble is obviated wherever a double set of cables is used, so that if one cable breaks the grip can be shifted to the other."

With all these misleading and consequently damaging statements before us, and with a knowledge that "a lie will travel a league while the truth is getting its boots on," it is certainly time to make at least a feeble effort to convince the plain everyday citizen, who wants facts which he can understand, that great big mountains have been made out of very little molehills.

In attempting such a discussion as this one may consider the question with the view of enlisting the support of scientific men or enter the lists, as the speaker does, with the conviction that, as the general public is to be affected by the success or failure of the project, it is to the general public rather than the technical men that special attention should be given.

All the ordinary Chicagoan wants to know or needs to know is, first, that this new system will be at least as reliable as the cable; secondly, whether it will be dangerous; and thirdly, to what extent will the overhead construction will be a disfigurement to the streets.

If the anxious heads of families living on the South Side can be made to feel that they will not have to get out and walk oftener than is usual with the cable, and that there is little danger of their being killed by the "terrible 500-volt wire" (that, by the way, has up to this time, as far as can be learned, invariably confined its attention to horses), and further, that the overhead construction which is to be erected in Chicago will be somewhat different from the pioneer triumphal arch of wood and wire and can be put up quicker and without any great tearing up of the streets—if *Paterfamilias* can be made to see this, all will be well.

1. Read before the Chicago Electric club, April 11, 1892.

First, as to reliability as compared with the cable. The Baltimore *Sun*, it will be remembered, said that "the entire series of cars is dependent upon the same wires, and any obstruction or break in the latter stops all cars defect is remedied." The *Sun* continues that it is the same with the cable, "but with respect to the latter the trouble is obviated wherever a double set of cables is used, so that if one cable breaks the grip can be shifted to the other."

Now perhaps in Baltimore or elsewhere they may maintain two cables in all the conduits, but I defy the able editor who thinks it is so easy to shift the grip to "the other" to find or introduce cable No. 2 into Chicago's long conduits! Two cables in the one conduit would without doubt make the cable system quite reliable, and it might be well for North Siders to petition Mr. Yerkes to equip his lines with the additional cable, but I think you will agree with me in the belief that our editorial friend would be surprised if he attempted to convince either Mr. Yerkes or the South Side company that it was economy to keep in all their extensive conduits another cable either "live" or "dead." As a matter of fact, the electric system, as it is to be installed on the South Side, will, as far as mechanical details are concerned, be far more reliable than the existing cable system. The diagrams, Figs. 1 and 2, will illustrate this fact. Fig 1 is a diagrammatic representation of the cable system, and Fig. 2 shows the electric feeder system.

I now invite your attention to a comparison of the two systems. In the cable system we have usually two large engines, either or both of which supply power to the cars through what for comparison's sake may be referred to as *a single movable power conductor* mounted on *movable insulators*. This is my idea of the cable as it runs on its multitudinous rollers and wheels.

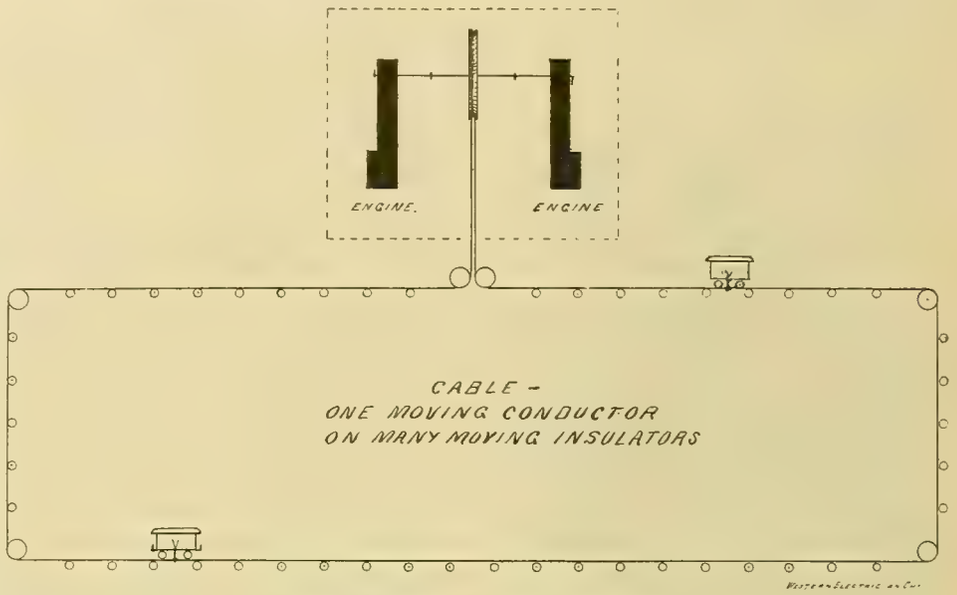

FIG. 1. THE TROLLEY SYSTEM FOR CHICAGO.

FIG. 3. THE TROLLEY SYSTEM FOR CHICAGO.

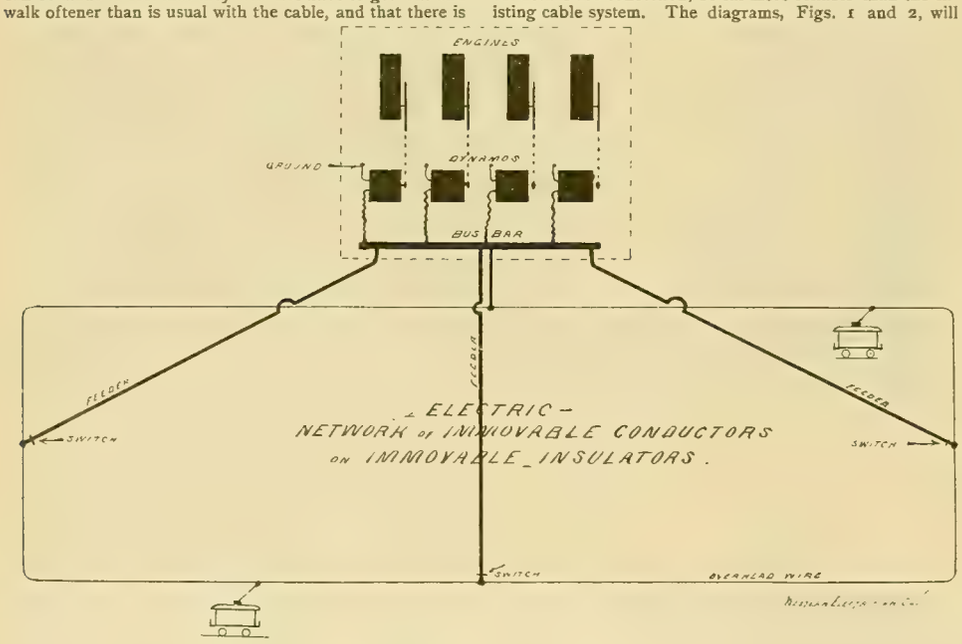

FIG. 2. THE TROLLEY SYSTEM FOR CHICAGO.

In the electric feeder system, Fig. 2, we find an equipment in which the steam plant may be applied in smaller and in a greater number of units than is practicable in a cable system. This flexibility of the driving equipment is a most decided advantage. But the greatest advantage of the electric system lies in the fact that the power reaches the car through *immovable* conductors mounted on *immovable* insulators. Further than this, in the electric feeder system the cars take current from *many immovable* conductors and not from a *single movable conductor* mounted on *movable* insulators as in the cable system. You will note that I say the cars take current from "many" immovable conductors. Now I wish it to be distinctly understood that, while in the overhead system there may be laid a large number of feed wires—in fact, we may have a veritable network of feeders—there need be only two wires in sight, for the feeders may be buried underground. This is an important fact, and one that should be borne in mind in referring to Fig. 2.

I think, therefore, that even those with only a meager knowledge of mechanics through Fig. 2 will appreciate this point in favor of the electric system, and with the writer, disagree with the Baltimore editor in his misleading association that "the entire series of cars is dependent on the same wires, and any obstruction or break in the latter stops all the cars until the defect is remedied."

Now for the comparative danger from the overhead wire. The mule is generally looked upon as a harmless animal, but most of us will concede that even this peaceful servant of man, if handled without due care, may become as dangerous as a steam locomotive or a shotgun. The whole question of danger from a trolley wire hinges on the possibility of accidental contacts with the conductor, and the extent to which one might be injured by such contact.

In my opinion the chances of the falling of a well strung trolley wire might be fairly likened to danger of house cornices or limbs of trees falling, bricks and stones falling from incomplete buildings, and similar hazards that insurance companies denominate as "safe," and to which all of us are exposed every day without a thought.

Admit, though, for argument's sake, that the wire falls once or twice during the year. The chances of the live wire striking any one would be extremely small. It should be borne in mind that in Chicago, contrary to the belief of many easterners, there are sidewalks, and that the majority of pedestrians in that city would walk upon them and not in the middle of the street under the trolley wire. A live wire might fall and strike a horse and the animal with its four feet on the ground might sustain a powerful and perhaps deadly shock, but it must not be forgotten that pedestrians would almost invariably pass beneath the trolley wire insulated better than the horse, with hat and shoes—not to mention rubber shoes in sleety weather, when the wires are subjected to their greatest mechanical strain. It is hardly necessary to point out, too, that in vehicular traffic man's chances of shock are still further diminished by his isolation from the ground and the conductor. But then why speculate on man's chances of making contact with the conductor? Under circumstances most favorable to the strongest possible shock—say, for instance, barefooted on wet ground and with both hands firmly grasping the wire—a man would then, and only then, be subjected to the full pressure. Nowadays, though, and particularly in these Northern cities, people do not wander about barefooted. Furthermore, at this time, when even the small boy has a knowledge of the fact that electric wires are to be looked at and not touched, it is not at all likely that any one but a half-witted person would be rash enough to fondle a fallen trolley wire. But, of course, a most pertinent question is, "What damage *could* result from contact with the conductor?"

O. T. Crosby, a well known and prominent electrical engineer, with such a wide experience in the operation of electric railways that his opinion deserves the most careful consideration, recently placed himself on record as to what 500 volts would do. Mr. Crosby was reported by the daily and technical press as follows:

"When the electricians put the electric pressure on street railway circuits at 500 volts they knew just what they were about and had the safety of the public in view. The history of the service has proven the wisdom of their action. The trolley has never caused the death or serious injury of a single human being, in spite of all the hue and cry against it. Every statement to the contrary has upon careful investigation been found to be untrue. I have investigated numerous reports of accidents, and they have, without exception, proved to be either gross exaggerations or baseless rumors. Hundreds of electric railroad employes have received shocks from the full pressure of the trolley wire in working about the power stations and car houses without result more dangerous than a scare and trifling burns. The pressure on the trolley wire is automatically kept constant. I have personally received shocks from the full pressure of a trolley wire, and know from experience that the effects are not serious."

Now, of course, we all know that Mr. Crosby is in the service of an electric railway company, and is therefore interested in the success of the overhead system, but unless the doubting Thomases are prepared to pronounce his statement to be a misrepresentation, there is nothing left for them to do but to admit that the chances are slim indeed of the walking or riding public being seriously injured.

"But," you will say, "what about the danger to and interference with the fire department? and what about the fires and damage due to stray telegraph and telephone wires falling across the railway wires?"

As far as the possible interference in Chicago with firemen is concerned, this seems to me the most absurd objection yet offered against the trolley wires. In Kansas City the fire department cuts a way for itself through overhead electric light wires with but little trouble by the aid of a simple tool, a picture of which will be shown to you later on. Fig. 3. The tool, about five feet long, is very similar to ordinary pruning shears and is provided with insulated handles. It is simplicity itself. Through this tool the Kansas City fireman was made independent of the electrical man. With this knowledge, therefore, of what is being done with multitudinous conductors far more dangerous than the two 500-volt trolley wires, I can boldly assert that we would not have to go very far to find men who would jump at the chance not only of furnishing the Chicago city fire department with a reliable trolley wire clipper, but would promptly back their offer with the agreement personally to illustrate the ease and safety with which an obstructing live wire could be cut down. So much for the case where the conductor, alive or dead, is in the way. Where, however, the overhead wire, mechanically speaking, does not interfere with the firemen it would not be necessary to resort to a clipper. In Chicago in the center pole equipment, switches may be provided in each feeder at the pole, Fig. 2. These feeder switches on the poles will make it an easy matter to cut off current from, and render harmless, any particular section of the line.

As to the possible danger from stray telephone and telegraph wires falling across the railway wires, this, you will admit, would be insignificant. Although, as we all know, for various reasons, many of the wires of our so-called "underground" systems are still a long way from Mother Earth, the proportion of the entire number of overhead wires that will cross the electric railway lines is small, and the chance of danger from this source will not be worth considering.

In addition to all this there is still another standpoint from which the danger objection strikes me as very much of an absurdity. All day long the multitude of Chicago's citizens tread the down town streets with not so much as a thought of the fact that in nearly every building and beneath almost every sidewalk there is a boiler carrying 80 to 100 pounds of steam. These same men will raise a hue and cry about two wires, in plain sight yet out of the way, and conducting an agent that cannot explode, and therefore absolutely harmless unless touched. A trolley wire may fall once during the year; it may fall twice, even thrice—but the falling of ten railway conductors would not be likely to send to eternity the number of souls that the Springer boiler explosion did.

I think, then, the whole "danger" objection may very fairly be put down as one of the very big mountains that have been made out of very little molehills.

FIG. 4. THE TROLLEY SYSTEM FOR CHICAGO.

The last objection made to overhead wires is the esthetic one, but I am going to show you that what has been called an "objection" is no objection at all. Before proving this to you, however, let us enumerate the reasons why just at this time the overhead electric railway system is particularly well suited to replace the horses on the lines of the South Side: First, there is no time to lose, for all the lines will have to be equipped by next spring; second, the overhead electric system is the most thoroughly tested of all the electrical street railway equipments, and it could be gotten into operation in less time than a cable plant; third, the use of the overhead wire would necessitate but comparatively little tearing up of the streets; fourth, there would be no need of an interruption of the present traffic; fifth, as there are but few curves on the lines to be equipped the street railway company would have a most excellent opportunity of showing how handsome an overhead system can be made; sixth, it is said that where cables cross cables the engineers sometimes resort to the dangerous cross bar in the conduit to prevent the cutting of a cable by the gripman's failure to let go. I do not say that this would be resorted to in Chicago, but I do say that with an electric overhead system installed there would be no temptation to insert this or any other such dangerous device.

Now for the esthetic objection. Realizing that the only way to thoroughly convince the practical Chicagoan that the trolley wire could be put up so as not to disfigure the streets and to be [illegible] I [illegible] in an expert, Carl Nemethy, and together we have equipped with overhead wires the Indiana avenue street car line. Doubtless this statement [illegible] with Mr. Nemethy's assistance I am prepared to show you, by photographic illustration, just how far we have fulfilled our contract. Before commencing our work we took a photograph of Indiana avenue looking south from the corner of Twenty-second street. This view is shown in Fig. 4. You will observe the Indiana avenue horse cars in the distance, the Cottage Grove avenue cable line to the left, and a few underground(?) wires.

I will now show you what Mr. Nemethy and I consider to be good overhead construction, Fig. 5. It is the bad work that has done the damage, so we now propose to show you the best construction, with the hope that with us, you will agree that we should have the trolley in Chicago, and without delay.

FIG. 5. THE TROLLEY SYSTEM FOR CHICAGO.

The Trolley System for Chicago.[1]

BY ALEX DOW.

The cry of the objectors to the trolley is always "obstruction to the fire department." Mr. Perry has answered the charge of obstruction, but I see that the trolley can be actually a valuable auxiliary to the fire department; that its presence permits doubling the efficiency of the engines by adding to each an electric pump. Every hose carriage should be so fitted; a wire clipped onto the trolley and another to the track or hydrant; press the button, and there you are. No boiler, no water, no fuel; only the hose cart, having fulfilled its first function, immediately enters upon a new one, and you have another two or three streams to direct on the fire.

Then there is the cry of obstruction to street traffic, blocking of sidewalks and so on. Now, no one dreams of setting a double row of cedar posts to support a trolley wire in this town. A center pole construction with a six foot wide raised walk down the middle of the tracks would be the ideal. And the raised walk would be a public benefit on our crowded streets. It would compel vehicles to keep their own side of the road. It would be a safe waiting platform for the crowds who block our street crossings morning and evening, waiting for the cars. It would be the proper place for street lamps. Indeed the handsome steel posts of the trolley system would be used as lamp posts. It would be a haven of refuge to ladies and timid people trying to cross the streets. I am sure that if we could by some Aladdin's lamp lay down the center walk in all its completeness on upper State street, every lady doing her Easter shopping these sunny days would call us blessed.

And of all Chicago street obstructions, is there anything to equal a cable breakdown? Everything along the string is stopped and you have two double tracked miles of blockade and profanity. No electric road would equal that; not so long as there was a cross town line opening to a parallel street. Clark street passengers would not have to make a foot transfer to Wells street, for the car would turn out at the nearest cross line and transfer itself in toto to the open tracks and the stoppage would be a matter of minutes, where it is now hours.

The use of electric signaling devices on American rail roads is constantly increasing. The Illinois Central is about to introduce the Hall system for its suburban traffic, and it is announced that the Chesapeake & Ohio will use the Electric Secret Service company's apparatus on its road.

1. Read before the Chicago Electric club, April 11, 1892.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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NOW that the contracts for the electric lighting at the World's Fair have been awarded everybody concerned will breathe more freely. The exposition authorities have succeeded in making advantageous terms for both the arc and incandescent lighting, and nearly all of the work will be done by the combined Thomson-Houston and Edison companies, who will doubtless also avail themselves of the resources of their allied companies. It is to be hoped that an agreement having been reached in relation to the great bone of contention, the relations of the electrical interests and the construction department will be more harmonious in the future than in the past.

ONE of the results of the recent contention in relation to the incandescent lighting at the World's Fair will be to materially increase the prestige of Chief Burnham of the bureau of construction and Frederick Sargent, the electrical engineer of that department. These gentlemen have labored earnestly and zealously for the interests of the exposition, and the thorough manner in which they investigated the question of lighting the fair is characteristic of the business methods employed in this department. If in times past the judgment of Messrs. Burnham and Sargent has been questioned in electrical matters, their motives have never been impugned.

MANUFACTURERS of electrical apparatus will be interested in the report that the big copper combination is already experiencing difficulty in controlling the output, and that there have been indications of a lack of harmony between the American and European members of the syndicate. It appears from the stories afloat in financial circles that the trouble arose in the negotiations of the American with the European owners of mines, the latter having been asked for a 10 per cent. reduction from their output for 1891, and having in turn asked for figures from the American producers for their output this year. Some of the Americans have sent over estimates for a larger production than that of last year, it is said. Negotiations are still pending but it is believed that the combination will prove unwieldy and that the conflicting interests will eventually result in the collapse of the combination.

THE recently awakened interest of the more advanced section of the farming community in the subject of the utilization of electricity in agriculture, lately alluded to in this journal, was exemplified by the action of the United States Senate last week, when, on motion of Senator Peffer, a resolution was adopted requesting the secretary of state to obtain from our consuls abroad information as to the application of electricity to the propulsion of farm machinery and to the propagation and growth of plants. The Kansas senator explained that it was understood that electricity had been applied in Italy to the compression of hay and also that electrical influences had been successfully used in the vicinity of Paris in the propagation of cabbages, and there was a desire on the part of the farmers to obtain definite information on these subjects. Much valuable information can doubtless be collected in this manner, as many scientists, and practical agriculturists both at home and abroad, are now studying this problem. The publication of the consuls' replies will be awaited with interest.

That there is a growing demand for information of this sort is shown by the fact that in many sections of the country experiments are being conducted on this line. A press dispatch from Auburn, Ala., announces that upon April 16th, cotton was ginned by electricity for the first time in the history of the world at the Agricultural and Mechanical College of Alabama. The class in electrical engineering, under the direction of Prof. A. F. McKissick, connected the generator at the dynamo room of the college with the motor at the Statun farm about 3,000 feet away, and the motor at the farm did the work of a ten horse power engine formerly used, grinding corn for cow feed and ginning cotton.

Of course as far as the electrical engineer is concerned the application of a motor to a cotton gin or any other piece of farm machinery is no startling departure. Such experiments and new adaptations as the one just referred to, however, do an immense amount of good indirectly in that they serve to bring electric power to the notice of the agriculturist. We must reiterate our conviction that an experimental station such as Senator Peffer of Kansas proposes would do an immense amount of good by educating farmers in the many advantages of electric power.

SAN FRANCISCO seems to be the center of opposition to electrical companies at the present time. The latest development in this line is told by a correspondent this week. It appears that house movers have been cutting wires of the telephone and electric light companies without complying with the formality required by these concerns. Heretofore, the electric companies have required the house movers to sign a contract binding themselves to assume all damages and expenses incurred by reason of the cutting of the wires. Recently one of the applicants was refused permission to open the wires when he failed to sign the contract, but he proceeded with the work, and the company whose wires he cut caused his arrest. Now he has begun suit against the company for $10,000 damages, alleged to have been sustained by reason of his incarceration. He charges the company with persecuting him, yet the cause of the trouble seems to be the failure of the house movers and electric companies to agree upon rates for cutting wires. Now, however, it is claimed by the opponents of the electric companies that the house movers have a right to demand the opening of the wires when and where they like at the expense of the owners of the wires. This is probably the ground upon which the suit will be fought. The question of the right of the electric companies to occupy the streets with their poles and wires has been raised before, and it is generally conceded that where the companies have secured the permission of the city authorities and the consent of the property owners, and have complied with all the requirements under which these privileges were granted, they have a right to maintain their poles and wires, and that this right must be respected. On the other hand, it does not appear that public highways should be blockaded by house movers—they were not built for the exclusive occupation of any class, and no one will deny that when the house mover is in possession of the roadway ordinary traffic must be suspended.

Yet, while these opponents of the electric interests appear to have no reasonable ground of action, they persist in fighting the companies, relying upon the prejudice against overhead wires which has already been developed in San Francisco, to help them worry the electric companies. Surely such proceedings should not be encouraged.

ABOUT three years ago Congress passed a law requiring that after August, 1892, horses should no longer be used as a motive power for street cars in the District of Columbia. This has now been supplemented by a bill, which has passed the House of Representatives, giving the Metropolitan company authority to use overhead wires for the electric system in the principal streets and avenues of Washington. The bill has not become a law, but that such a measure should pass one house of Congress shows an encouraging growth of sentiment in favor of the overhead system for use in large cities. The calamity howlers of the daily press to the contrary notwithstanding, the modern method of rapid transit is steadily gaining in favor in all the large cities of the country. Washington, with its wide streets and lack of congested traffic, offers conditions especially favoring overhead construction. But one objection can be made—the æsthetic one that the poles and wires detract from the appearance of the streets. Undoubtedly this argument can be urged with more force in the case of the nation's capital than in that of most other American cities, and it may prove of sufficient weight to prevent the stringing of trolley wires through the principal avenues. Overhead wires for electric railroads are not unknown in the outlying streets of Washington, however, and it is safe to hazard the assertion that, for some time at least, the tendency will be in the direction of extending their field rather than contracting it.

IN another column will be found abstracts of the reports for the year 1891 of the directors, engineer-in-chief, and chairman, which were presented at a recent meeting of the shareholders of the London Electric Supply company of England. Enough of these reports is given to enable those interested in the development of Mr. Ferranti's work to judge intelligently of the progress and the present condition of the enterprise. For the matter in question, it may be stated, we are indebted to an English contemporary that has been conspicuous in its opposition to the scheme. It is fair to assume, therefore, that the journal in which the report was published has, to say the least, done nothing in the way of embelishment. In a long editorial headed "The Dream of Ferranti" the English journal referred to, the London *Electrical Review*, continues its policy of discouragement.

It is rather curious that the *Review* should never have ceased calling attention to the fact that Mr. Ferranti is a young man or, as that journal dubs him this time, "a young enthusiast fresh from his dreams, talented it may be, but refusing to take the guidance offered," and "who starts on an unknown and dangerous route, and ends in disaster."

To an American with the *Review's* record of the corporation's business before him and a knowledge of what has been accomplished by young men on this side of the water, such attacks first cause wonderment and then disgust.

If all electrical ventures had been abandoned on account of financial and technical difficulties no greater than those met with by the Deptford-London company, we fear there would not be now established in America those immense factories that stand as landmarks of a new but most prosperous business, and one that was built up almost exclusively through the indomitable energy of just such young men as Mr. Ferranti.

We hardly know what to think of the *Review*. Can it be that Mr. Ferranti incurred its displeasure by his bold and daring display of that characteristic so distinctly American, or can it be that our contemporary is "grinding an ax" in its philanthropic efforts to throw cold water, so to speak, on the enterprise in this its darkest hour?

To be sure the enterprise has not borne fruit to the extent that was expected. But in justice to Mr. Ferranti we can only ask the reader familiar with central station management to give the reports a careful perusal. They will be found discouraging without a doubt, but we believe the unprejudiced will agree with us that the so-called "dream" may yet, through careful electrical engineering and financial management, be made to become a profitable reality

Welding Tubes in England with the Electric Arc.

Welding with the electric arc is not as yet carried on to any extent on this side of the water, and for this reason a description of the manner in which the Benardos process is applied by Lloyd & Lloyd, tube manufacturers of Birmingham, England, will be of interest. This firm has heretofore used gas for welding large tubes and it still employs it extensively, but the electric current is found to be for many purposes preferable as a heating agent.

A representative of *Electrical Plant* of London, who recently visited the installation, describes the plant and process substantially as follows:

On going into that portion of the works in which the electric welding process is carried on, one's first impression is that the experimental stage has been passed, and it has been found good policy to have permanent buildings and the most efficient machinery. About two years ago Lloyd & Lloyd began to work the Benardos process, and at first they used some existing steam engines and fixtures. These, however, were very soon found to be inadequate, so the present buildings and plant were laid out.

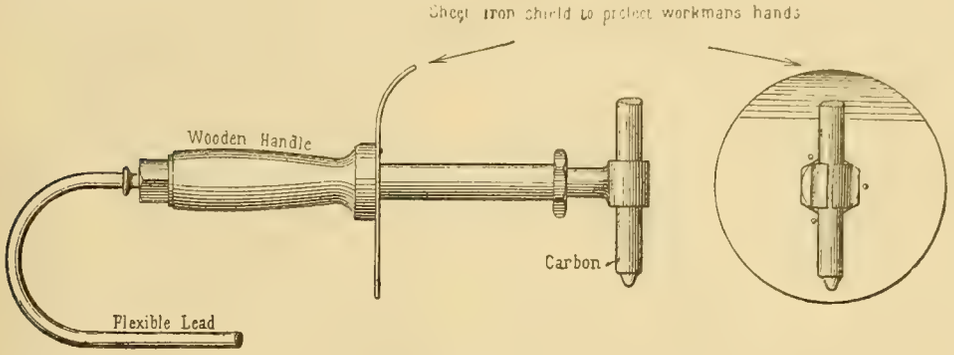


FIG. 2. WELDING TUBES IN ENGLAND WITH THE ELECTRIC ARC.

On the basement floor there is a battery of boilers, and above is the engine room. The engine for the welding plant is bolted down to wrought-iron floor girders, which form the framing above the boiler room. It is one of the Davey-Paxman horizontal compound condensing type, with cylinders 12¾ inches and 20 inches, with 24 inch stroke, indicating 110 horse power with 120 pounds boiler pressure. This engine drives, by means of a 16 inch link belt, the line shaft in the dynamo room. The shaft is overhead and in turn drives the dynamos by means of leather link belts. Beside the main engine there are also in the engine room a duplex Worthington hydraulic testing pump and a pumping engine to feed the boilers.

The dynamos are four in number and supply current to twelve electric welders and 300 incandescent lamps of 16 candle power each. The total output of the dynamos is about 800 amperes. Next to the dynamo room is the switch room, whence all the circuits for lighting, welding and motive power are controlled. Hung on the wall is a diagram of the connections, Fig. 1.

The battery room is next to the dynamo room. Here there are 1,800 storage cells of the Benardos type, arranged on nine sets of shelves made of varnished wood, there being 200 cells on each set. In the Benardos battery the plates are unpasted, that is, they consist of zigzag strips of lead burned on, by the arc process, to lead frames. The object of the storage battery is not so much to act like a gas holder in a system of gas distribution as it is to answer a purpose similar to that of the heavy fly-wheel in a rolling mill or the accumulator in a hydraulic system. If several welding arcs are at work at the same time they require much more current than the dynamos can supply, and this excess is given out from the storage battery, which is charged again from the constantly running dynamos.

The most interesting part of the work is to be found in the welding shop, a rectangular building about 100x40 feet. Along one side of this shop are six curious looking wooden structures, each about 6 feet square, open at the back, and not covered. Each of these little unroofed stalls is occupied by a workman using a welding arc, and the object of thus concealing the workmen is that persons passing through the workshop may not catch sight of the electric arc to the injury of their eyesight. On the inside of each of these screens is an iron table connected electrically with one pole of the storage battery. To the right of this table hangs, when not in use, the carbon holder, which, in its most improved form, is shown in Fig. 2. This carbon holder is connected by a flexible cable with the other pole of the battery. The workman stands on a wooden platform in front of the table. At his left hand is a sheet iron screen, with a pane of dark ruby glass in the center. This screen is supported on a folding bracket, like an ordinary gas bracket, so that the workman can easily place it between himself and his work when the arc is on, and push it away when he has to hammer the weld. Against the wall at the back of each workman there is a resistance frame, by means of which he regulates the current to the requirements of the work; but when, as is generally the case, he has a large amount of work of a similar character to do, there is seldom any occasion to vary the resistance. The voltage at the arc is comparatively low, being about 65 to 80 volts. Consequently there is no danger to the workmen.

To give a clear idea of the method of working, an application of the process as it was witnessed may be described. A number of short bent pieces of wrought iron tube were being welded. On the iron table was fixed an iron arm, something like a smith's "bick" iron, the projection being toward the workman. The workman pushed the glazed screen between himself and the work, then took

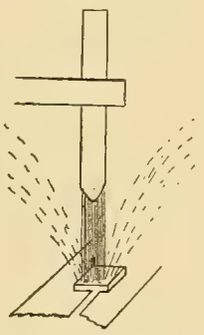


FIG. 3. WELDING TUBES IN ENGLAND WITH THE ELECTRIC ARC.

one of the bends, placed it on the "bick" iron, holding it in his left hand, the joint to be welded being uppermost. He placed on the intended weld a piece of wrought iron about ½-inch square by ⅛ inch thick. Next he took the carbon holder by its wooden handle, and touched the work. Then withdrawing the carbon a few inches the arc was struck, a brilliant light being instantly produced, with intense local heat. Looking through the ruby colored glass in the workman's screen, or through one of the portable framed glasses with which each visitor is provided, the steel is seen to be melted in a few seconds like so much wax. The workman then hangs up his carbon on its peg to the right, pushes aside the screen, takes up a light hammer, and dresses down the weld, the whole operation taking less time to complete than to describe. There is no switching on and off of the current, as removing the carbon a short distance from the work breaks the arc.

For the sake of having an easily understood explanation the application of arc welding to very small work was described. But in the same shop men were also at work making large fittings. The welding of these is a beautiful sight. Standing a short distance away and in such a position that the arc is hidden from the spectator, one sees the workmen and everything behind them in the intense glare of the arc light. But there is this striking difference, that, whereas in an ordinary unshaded arc light the radiant point, being extremely small, casts shadows intensely black and strongly defined at the edges, here, on the contrary, as the arc is some inches in length, and there is also a surface of several square inches of metal raised to a white heat, the edges of the shadows are ill defined, and appear surrounded with bands of different colors. Approaching closer, and guarding the eyes with a ruby glass of such a depth of tone that it is difficult to see daylight through it, the sight is one of the most striking to be witnessed in the whole range of metal working. The whole of the carbon tool, from the brass holder to the point, appears red hot, with the extreme end brighter than the rest. Of course the end is actually white hot, and at the fiercest heat that human agency can produce. From the end a bright stream of light is directed downward to the metal, Fig. 3, where the weld is being made. The piece of steel (about an inch and a half square by one-quarter inch thick) which is laid on the place to be welded is seen to soften and then to melt and become a pool of liquid metal under the action of the arc; a lambent flame plays about it, and a small fountain of sparks flies upward.

Beside the hand welding tables there are several special machines for dealing with particular kinds of work, such as lathes for welding flanges on pipes, and machines giving a combined rotary and longitudinal motion to the carbon holder, so as to bring a long strip of metal to a welding heat. It has been found that no difficulty arises in instructing ordinary workmen in the use of the electric arc.

One very noticeable feature of the process is the localization of the heat, for instance in welding fittings such as inch and a quarter bends; the workman holds the work in his hand merely protected by a leather glove. The work is finished before the metal grasped becomes too hot to hold. This is decidedly different from what takes place in an ordinary smith's hearth or furnace, where, in order to bring a small part of the work to a welding heat, a large part has to be uselessly heated, beside involving the burning of a quantity of fuel which does not heat the metal at all.

Messrs. Lloyd & Lloyd accomplish a great variety of work with the arc process, and weld many fittings of great complexity, with the best results.

There are also many miscellaneous applications of the arc welding process, such as the joining of a steel pulley,

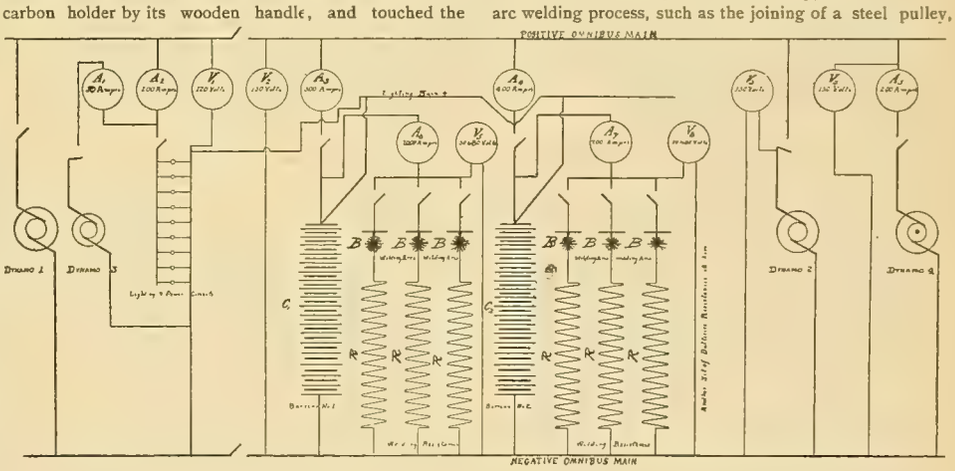


Fig 1.—Diagram of Connections of Electric Welding and Lighting Installation, at Messrs. Lloyd & Lloyd's, Coombs Wood Works, Halesowen, near Birmingham.

A_1 50 Ampère-meter.	A_4 200 Ampère-meter.	V_3 150 Voltmeter.	V_6 50-80 Voltmeter
A_2 200 "	A_5 1000 "	V_4 150 "	C_1, C_2 Batteries 1 and 2
A_3 500 "	A_6 700 "	V_5 150 "	R Welding Resistances.
A_4 400 "	V. 120 Voltmeter	V_6 50-80 "	B Welding Arcs

FIG 1. WELDING TUBES IN ENGLAND WITH THE ELECTRIC ARC.

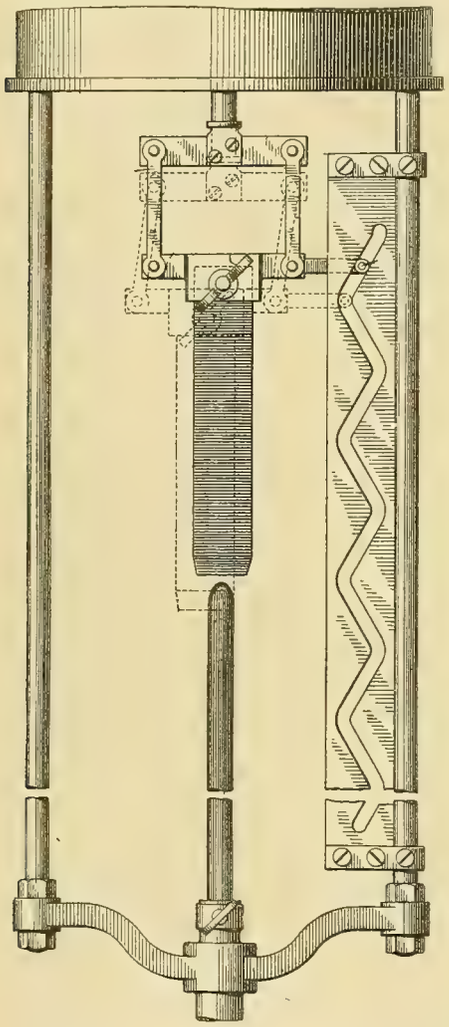
4 feet in diameter, broken in ten pieces. With it steel castings, such as spur pinions, may be repaired.

The battery plates are said to last very well, and a grid that had been in use eleven months, it is claimed, was apparently as good as when put in.

It is very evident that welding by the electric arc has a great future before it, especially in factories where electric energy is also used for lighting and power.

Ball's Reciprocating Carbon Holder.

The accompanying cut shows an ingenious device designed by Royal E Ball of New York, for the purpose of prolonging the time of burning of the ordinary arc lamp. This result, it is claimed, is attained by reciprocating or swinging one of the carbons across the arc, that is, in a direction transverse to that in which the carbon is fed. To accomplish this, the reciprocating or oscillating carbon is, of course, made with a greater cross-section than that of the other carbon. The construction of the oscillating mechanism will be readily understood from the illustration. The operation of the device is described by the inventor as follows: "As the upper carbon, which is of necessity of greater cross-section than the lower pencil, wastes away and is fed to the arc, it will be periodically moved across the arc, so as to consume one portion after another.



BALL'S RECIPROCATING CARBON HOLDER.

As the upper carbon is moved downwardly the carrier and carbon are gradually swung to the left into the dotted-line position. This downward movement continues until the carbon is gradually drawn over toward the extreme right-hand limit of movement. The further downward movement of the carbon moves it in the other direction, and this vibrating action is kept up while the carbon lasts."

The Electric Railway for Chicago.[1]

By E. E. Keller.

In considering the question of allowing the use of the overhead trolley for the propulsion of street cars in the business portions of Chicago, it is safe to say that the element of sentiment must, to a large extent, become a factor, in addition to all of the other arguments that may be advanced in the negative.

The progressive spirit that prompted the laying of the first underground electric cable in the city of Chicago has lived to see the displacement of all overhead electric wires in the business portions of the city, and it is now universally conceded to be not only the practical way of disposing of electrical conductors, but also the safest plan for the protection of our people and property.

The most ornamental pole or support that could be designed for overhead trolley wires could not add to the beauty or safety of our streets and buildings. The past has demonstrated conclusively the danger of delays of any character in the movements of the fire department. The presence of electrical conductors suspended in the air would certainly be a hindrance at times, no matter how they were sustained. While the interference that the fire departments of large cities meet from overhead wires is largely due to the maze of wires which impede the manipulation of their apparatus, they would encounter a new element were we to permit the erection of the overhead trolley wire, in the danger from contact with the bare wires carrying the current in use for railway motive power.

A glance through the streets in the business center of our city, where the wires have been entirely placed underground, will arouse the sentiment already mentioned, which must enter into the consideration of this problem. It would be poor policy to undo all that has been done in clearing our thoroughfares by erecting a network of trolley wires that would look like a fish net suspended over the intersections of principal streets, such as can be seen in Boston.

The projectors of our city had an idea of what the future might demand when they designed its broad thoroughfares; but it was surely sentiment that suggested the ornamentation of our beautiful buildings and perforce there must have been a touch of sentiment beside the desire for safety that induced the moving of the wires and permitted us to see the sky as well as our buildings, which up to that time had been largely obscured.

It is far from my intention to decry the overhead trolley system in its proper place, as its utility and practical value have become too well established, and it is undoubtedly the agent which has allowed the electric railway to reach its present high position; it is rather my intention to demonstrate the fact that in our business center we should endeavor to carry out the plan of relieving our thoroughfares of every possible obstacle in the way of protecting humanity and our property.

It has been broadly stated that there are no systems of underground electrical conductors that can be properly applied to street railway propulsion; but in reply to this broad assertion, I must borrow the words of a worthy contemporary, who, in a discussion before the National Electric Light association, where a statement was made that we could not bury electric light wires, as they could not be sufficiently insulated, replied by producing a roll of bills, and saying that the statement was an error, for with the material that he then held in his hand, not only could we insulate our wires successfully, but we could bury them as as well; and this is the case precisely regarding underground electrical conduits for street railways.

If the purchaser is willing to pay the price, underground electrical conduits for street railways can be made an absolute success. We must not judge of the possibilities in this line by the futile attempts of some of the inexperienced and theoretical men who have heretofore undertaken, merely in an experimental way, the work, which, to the practical electrician, contains no hidden mystery.

It may be possible that future developments will bring to us thoroughly practicable methods of transforming and transmitting the current at low voltages by conductors exposed on the surface of the road bed or by the rails or possibly by the use of multiphase transformers, without any exposed conductors; but until the development of these ideas passes the embryonic state we should adhere to plans that are more thoroughly worked out.

The open slot conduit, designed with proper drainage, and with facilities for reaching the conductors and especially the insulators, has received the attention of many thinking minds for years. The numerous obstacles that from time to time appeared in the path of this plan were one by one removed, so that to-day it is safe to say that there are several systems that could be constructed and operated, in which the insulation resistance of the conductors need never be impaired or lessened to any great extent. Operating under the worst possible conditions, a railway company using such a conduit would not subject the public to such frequent delays as do the cable systems.

A little excavation would be necessary to adapt the electric conduit system to most of the tracks already in use, and would occasion but temporary delay. Of course it would be better to build a new road bed for the sake of permanence, as the average horse car track is too light for mechanical propulsion. A conduit would present to the eye none of the objectionable features of an overhead trolley system, and would abolish all interference with traffic and the fire department.

The experimental railway conduits that have been built at various times and places, as at San Diego, Denver, Detroit, Columbus, Allegheny, Pittsburg, New York and other places, have all proven failures from lack of careful consideration of the severe conditions to be overcome.

All of these experimental conduits were built too cheaply and all of them were of the continuous conductor type, excepting the short "series" railway conduits, which were practically of this style, and the "shoes" in the conduit were always "alive" when the road was in operation. This latter system was nearly equivalent to having a continuous bare conductor charged along its entire length. It may be said that there are several continuous conductor underground conduit railways in operation in Europe, and that the same system should operate successfully here.

This, however, does not apply, as the conditions where these European roads operate are very different from the conditions in most of our American cities. The sewerage in most European cities is nearly perfect, the cities are built so compact and labor is so cheap, that the streets are kept remarkably clean. The roads cover a rather limited area, and the electromotive force used in these railway systems is low compared with the electromotive force used in our American railway systems.

There is at present an electric railway conduit, with continuous conductors, being tested on a short piece of road in this city that appears, to the inexperienced, as a successful experiment; but I think that any one having any experience in this line will concede that this apparently successful conduit would not operate if extended over a vast network of tracks, unless radical changes were made in its construction and insulation

One of the railway companies of this city intends putting down a conduit that has proven successful in a European city. This conduit, as built in Europe, has several good features from a mechanical point of view; but its insulation resistance would be hardly sufficient if operated under the American standard of 500 volts electromotive force and extended over any great length of track.

In my opinion, an underground conduit, to be successful in the majority of American cities, should have an underground feeder cable, with a well insulated bare conductor divided into sections of not more than from 20 to 40 feet in length; these sections should be cut in and out of circuit by simple mechanical means and not by electro magnets or anything of a nature unreliable under the severe and often exasperating conditions that must be met. There should be no springs or light and weak parts, nor should any part be moved suddenly or receive a blow when cars are moving at a high rate of speed. Any systems of distribution not having these features must necessarily prove troublesome if not absolute failures. There are any number of patented schemes for such sectional conductor conduits, but the vast majority look far better on paper than they would operate in the ground.

In conclusion I would say that the trolley system and the conduit system each has its own proper field, but the trolley should be restricted to the exclusively residence districts of our city.

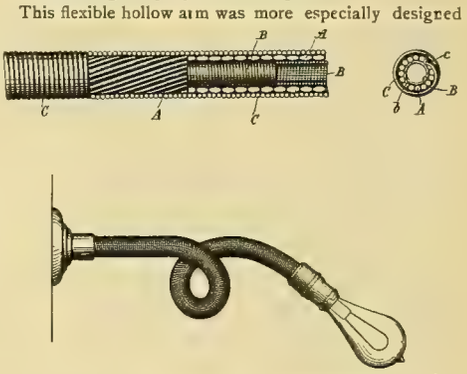
There is no doubt of the ability of experienced engineers to build a successful underground railway conduit in the business district of Chicago. If the owner is willing to spend a sufficient and not necessarily excessive amount of money.

1. Read before the Chicago Electric club, April 11, 1892.

The Cutter Electric Manufacturing Company's Flexible Arm.

From the accompanying cuts there can be obtained a clear idea of the details of construction of the flexible portion employed in the portable lamp stand and the flexible bracket manufactured by the Cutter Electrical Manufacturing company of Philadelphia.

This flexible hollow arm was more especially designed



THE CUTTER ELECTRIC MANUFACTURING COMPANY'S FLEXIBLE ARM.

as a support for incandescent lamps, and is used in wall brackets and as part of desk or table lamp stands. But the nature of the device renders it equally serviceable and useful as a flexible support for portable lamps, tool stands, lens holders, etc. It is particularly useful as a part of an electrical fixture from the fact that it is hollow throughout and admits of the passage of one or more conductors, and such passage is not obstructed by bending the arm in any way that may be desired.

Referring to the cut, *A* is a hollow tube or core made up of several strands of copper or other pliable wire, wound spirally on a mandrel and at a pitch determined by the particular service for which the arm is designed. If the arm is designed for a use for which it will be bent only slightly, for instance at right angles to itself, the pitch would be much shorter and the wires would have much greater number of turns to the inch than in the case of an arm which is designed to be bent up into a coil, say, of two inches in diameter.

In practice it has been found that for a flexible arm for a wall bracket or lamp stand the proper pitch for the strands of the hollow core is about one turn in two and a half inches. This pitch allows the completed arm to be bent into a coil of about two and a half inches diameter without subjecting the copper strands to any injurious strain.

Within the hollow core *A* is a spiral steel spring *B*. This spiral is relatively shorter than the core *A*, and it must be distended to bring its two ends even with those of the core *A*. *C* is an outer covering of steel wire in the form also of a spiral. Similarly to spiral *B*, *C* is made shorter than the core *A* and has to be distended to equal it in length. The ends *b b* of the spiral *B* are bent outward and the ends *c c* of the spiral *C* are bent inward over the ends of the core *A*, so as to hold them in position until they are soldered or brazed into the sockets. The strands composing the core *A* are wound on a mandrel and the ends are soldered or brazed together to form a tube of the desired length.

The best relative lengths of core and spiral have been found to be as follows: If the core be sixteen inches,

then each of the two spirals should be about fourteen inches. With these proportions and when the strands of wire composing the core *A* have one turn for about two and a half inches the arm may be subjected to any reasonable amount of bending without disturbing in any way the relative conditions of its parts, and without meeting any tendency to alter the shape or curve into which it has been bent.

This device is the invention of Lucius T. Stanley of Brooklyn, N. Y.

Edison Triple Expansion Engine and Multipolar Generators.

The Edison General Electric company has recently brought out a new line of central station units, consisting of two multipolar dynamos coupled directly one on either side of a triple expansion engine, and ranging in capacity from 100 to 1500 indicated horse power. This combination secures an increase of efficiency, and a great saving of floor space, but as the armature of the bipolar generator now in general use must, of necessity, be run at a comparatively higher number of revolutions per minute, it is evident that unless a special engine is employed, another design of generator is called for.

The multipolar generator is peculiarly adapted to this purpose, as it may be designed to generate any desired electrical output, at an armature speed corresponding to that of a slow speed engine. This type presents the additional advantages of requiring but small floor space, of being able to withstand sudden variations of the load, and of carrying heavy loads continuously without danger of overheating.

The armature is of the Gramme ring type, and is built up of ⊂ shaped copper strips, which are slipped (in a single layer) over the laminated wrought iron core, the upper end of one being connected with the lower end of the adjoining loop, by a copper bar of corresponding thickness, these bars acting as segments of the commutator. The armatures are mounted directly on both ends of the crank shaft, and act as the fly wheels of the engine.

The number of brushes correspond to the number of poles of the generator, and it is found that the large current output can be divided among these brushes much more conveniently, than if only one set of brushes were used. The mechanical device for controlling these brushes allows of their being operated together, so that when once adjusted, they can be handled as though but one set were used.

The field coils are wound on separate spools, slipped over the field magnets, which are then inserted in an annular or polygonal field frame, mounted on the bed plate of the engine.

The engine is of the triple compound three crank inverted cylinder, automatic condensing type, well proportioned throughout, having large wearing surfaces which can be easily adjusted. The bed plate to which the main bearing boxes of the crank shaft are cast is strong and is firmly bolted to a massive foundation box, which also carries the dynamo frames—thus perfect rigidity between engine and generators is insured. The crank shaft is of forged steel, fitted with cast iron balanced disks to which the crank pins are fitted. There are two bearings to each crank and an additional large bearing on each end of the shaft to carry the armature. On the shaft are three eccentrics, each operated by its own independent governor, so that the point of cut-off in each cylinder is changed equally with the load, thus doing away with any tendency to race. Strong cast iron columns carry the cylinders, which are bolted together. These engines are almost fac-similes of the latest and most improved types at present in use on ocean steamships, with necessary additions to make them as highly efficient for electric generating purposes as their prototypes are for marine work. The compactness of this arrangement, as shown in the following table, proves the advantages to be gained by the use of the dynamos and engine thus combined:

Important Telegraph Suit.

Justice Brewer, sitting as a judge for the United States Circuit Court embracing the district of Nebraska, has rendered a decision in the suit brought by the United States against the Western Union Telegraph company and the Union Pacific Railway company to have declared illegal and annulled the contract between the Western Union and the Union Pacific by which the former operates the telegraph lines along the line of the railroad. The decision, which is in favor of the United States, sets aside the contract of 1881 between the two companies and directs the Union Pacific henceforth to operate its own telegraph line by its own agents and not through the instrumentality of the Western Union. This suit was brought by the United States under an act of Congress, in 1888, declaring that all railroads which had received government aid and were required under their charter to maintain telegraph lines should henceforth maintain and exercise by themselves all telegraph franchises conferred upon them. Under this act the government sought to have canceled and annulled a contract made July 1, 1881, between the Western Union and Union Pacific by which, as was claimed, telegraphic franchises granted to the railway company had been improperly transferred to the telegraph company.

In speaking of the case Attorney-general Miller is reported to have said: "This decision, of course, upholds the validity of the Anderson act, and maintains the right of the government to demand of the railroad company the execution of its telegraph as well as its railroad franchises. There are a number of cases against other Pacific railroads dependent upon the same principles covered by this decision. Whether the defendants in this case will appeal to the Supreme Court is not known to me, although it seems very probable, in view of the magnitude of the interests involved."

It is said that persons interested in the Kentucky Midland Railway company, will apply to the legislature for a charter for the Kentucky Midland Terminal Railway company, to build an electrical railroad in Paris, Ky.

No Overhead Wires in Chicago Streets.[1]

BY ST. JOHN V. DAY.

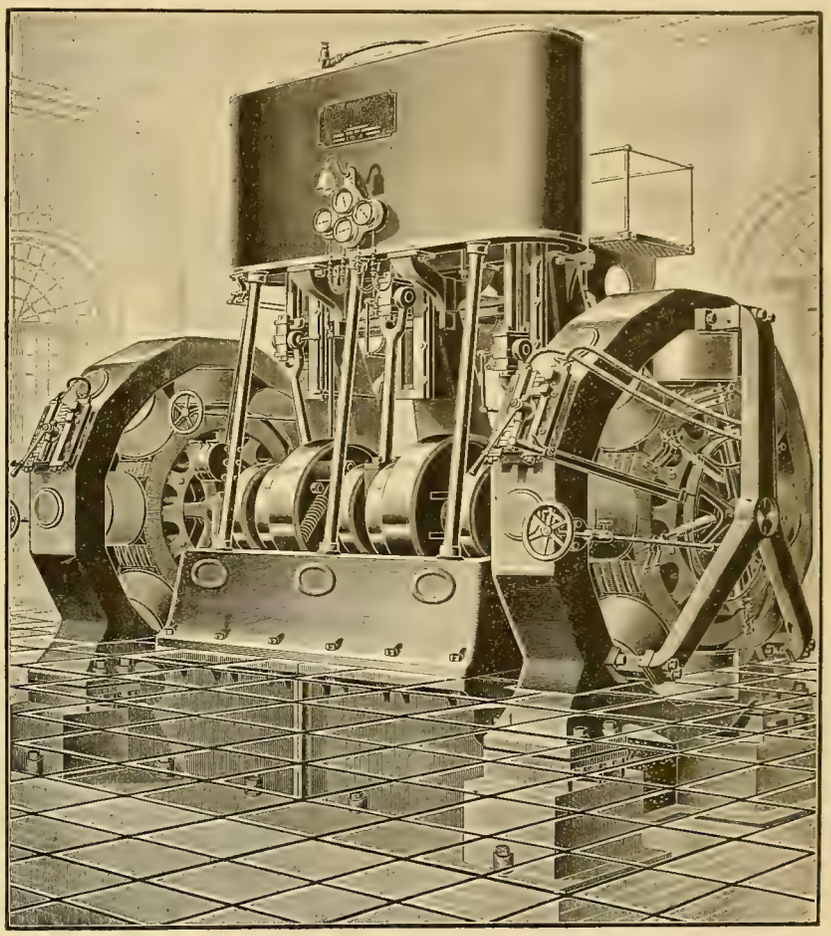
In Mr. Perry's paper attention is directed to the æsthetic side of the question, but I do not think it pertinent in Chicago, where great improvements are carried on so hastily. The tremendous pressure of public interest, which forces the carrying out of an enterprise in the quickest way possible to accommodate a present need, compels the almost entire non consideration of the æsthetic view of the matter. So far as I can see, though, Mr. Perry has not touched the root of the matter, and I think that no one who would venture to suggest the possibility of any surface railway being capable of solving the root of this matter would be listened to.

There are two ways of relieving the heavy traffic in the streets. One is by a continuous system of tunnels, such as is used in the Metropolitan railway of London, at enormous cost. I was for many years associated with that railway, and the work upon that line cost in some places as much as half a million pounds sterling per mile. That system is not adapted to Chicago, because of the difficulty of constructing a tunnel at a cost that may be made a profitable investment by the amount of traffic.

In New York an elevated railway has been constructed at about one-fifth the cost of the underground Metropolitan railway in London. As far as it goes, and as a pioneer system, it has done its work admirably, but there are very few cities situated as New York is, and where that system could be carried on as a financial success. It could not be done in Chicago for this reason: That in the latter city the area of business is extremely small compared with its enormous area; it is, in fact, extremely small as compared with the business area of many cities of much less population. An elevated railway of some kind or other is the only solution of this question for the heart of the city, and it matters not whether the trolley system, the conduit system, or a system of conductors laid upon a low level between the two lines of rails, with a low line trolley resting upon that, be adopted. There is no occasion to attack the overhead trolley system, but I think that no surface railway will ever become a permanent thing in the city of Chicago. I have had many opportunities of seeing the trolley system work in other cities, and I have been struck with the beauty of the system in operation at Indianapolis, and I think it shows almost exactly the same thing as Mr. Perry represents in his illustration with the center pole and arms on either side, carrying the wires.

I have noticed that while in the cable method of traction, the cable being below the center of gravity of the car, the horizontal motion of those cars over the rails is easy, and is almost free from oscillation, in the case of electric cars operated by the trolley system, or by the storage battery system, those cars oscillate very seriously indeed. The reason is that the motor which drives the wheels is placed in a comparatively elevated position, and as soon as the

1. Abstract of address before the Chicago Electric club, April 11, 1892.



EDISON TRIPLE EXPANSION ENGINE AND MULTIPOLAR GENERATORS.

COMPARATIVE FLOOR SPACE REQUIRED BY GENERATORS BELTED AND COUPLED DIRECTLY.

TWO BIPOLAR GENERATORS BELTED TO ONE HIGH SPEED ENGINE.

Total Capacity Two Generators		Minimum Floor Space in Square Feet.
K. W.	16 c. p. Lamps.	
50	900	270
90	1,620	374
200	3,600	511
350	6,300	571

TWO MULTIPOLAR GENERATORS COUPLED DIRECTLY TO ONE EDISON TRIPLE EXPANSION ENGINE.

Total Capacity Two Generators		Minimum Floor Space in Square Feet.
K. W.	16 c. p. Lamps.	
50	900	56
100	1,800	121
200	3,600	180
400	7,200	356

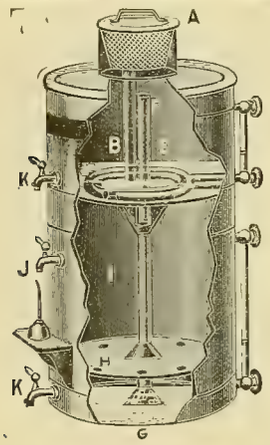
car begins to swing the position of the motor tends to increase the oscillation, and it becomes quite serious in passing over points such as crossings or any small inequalities in the road. I think that is an objection to the trolley system. But there certainly can never be any objection to it from difficulties of contact, as Mr. Perry has urged, and I quite agree with him in all that he has said about that.

But I want to refer to one other point: We are close upon the World's Fair. We have to carry between the city and the World's Fair an average attendance of 300,000 persons per day. We have the Illinois Central, Rock Island, Fort Wayne, Baltimore & Ohio, the Lake Shore, and other lines going down there which present serious difficulties. They do not know how to get into the World's Fair. A great many lines have been proposed, and a great many difficulties have been raised in the city council. But I believe that if all the streets that lead down to the World's Fair were equipped, as Mr. Perry has suggested, with surface cars, operated by the trolley system, or by the conduit system, or by a system of storage batteries, the whole thing would be utterly inadequate to handle the traffic which it would be called upon to handle between the city and the World's Fair from May to November in 1893.

Darragh's Ideal Oil Filter.

The most important advantage claimed for the "Ideal" filter by the designer, Albert C. Darragh of Pittsburg, Pa., is that there enters into its construction no part or substance that has to be renewed. It is entirely automatic, and is operated by steam and water. The refining is accomplished through gravity. By referring to the accompanying cut the manner in which the filter may be employed will be understood.

A steam connection is first made to the coil, which is in what is called the "refining chamber." After filling chambers *E* and *I* with water to the depth of six inches, steam may be turned on. The dirty oil is then poured in-



DARRAGH'S IDEAL OIL FILTER.

to receiver *A*, whence it is strained and passed down through pipe *B* into the water. Each day's accumulation of oil is poured into receiver *A*.

The refining chamber when full overflows into pipe *F*, and the oil passes to the bottom of the reservoir *I* and up through the water again. Tray *H* is for the purpose of catching any precipitation from the oil after leaving the refining chamber. This tray can be drawn out (by taking hold of the pipe and pulling up) without emptying the reservoir of its oil. This practically amounts to pulling the bottom up, and washing off and putting back is but a moment's work. When tray *H* is again in place the reservoir is clean.

A peculiar feature claimed for Mr. Darragh's filter is that the oil is refined at the top, then passes into the cooling chamber or reservoir and when drawn from faucet *J* is thoroughly purified. Faucets *K* are for the purpose of drawing off the water when it becomes foul.

The "Ideal" filter is being introduced by the Purity Oil Filter Manufacturing company, Pittsburg, Pa.

There is a project on foot for the building of an electric road in Hagerstown, Md.

Telegraphing from Minneapolis.

A writer in the *Chicago Tribune* indulges in some interesting speculations on the manner of handling press dispatches and other matter sent out from Minneapolis by telegraph during the national Republican convention in June. Minneapolis is unfortunately situated from a telegraphic point of view. It lies on the extreme edge of the telegraphic system of the country. Generally speaking, it can reach the rest of the country only through Chicago. A wire or two are run to Winnipeg and along the Canadian Pacific railroad, and it has a circuit or so apiece to Omaha and Dubuque. Neither of these places is provided with any wires to spare, in case Chicago is cut off on the direct route. When the latter event happens, as it sometimes does in winter storms, Minneapolis is practically cut off from the rest of the world. If such an emergency should arise during the convention, the newspapers of the country would very likely be bereft of all news.

Except matter for papers in California, Colorado, the far Northwest, and in fact, all the sparsely settled territory west of Omaha and Kansas City, all of the specials filed at Minneapolis will be telegraphed to Chicago and distributed from this city. It is impossible to give any exact figures beforehand of the amount of matter which correspondents will offer for transmission. During the six days' session of the Republican convention which nominated Gen. Garfield in 1880 the Western Union company transmitted about 15,000,000 words of special dispatches. In the 1884 convention, when Blaine was nominated, their reports indicated that nearly the same quantity of matter had been handled. In 1888, Gen. Harrison's year, 14,000,000 words passed over the wires. These three conventions were stirring gatherings, and while the convention in June may not furnish the same amount of exciting news, it is entirely possible that the newspapers may require fully as much telegraphic matter. The tendency to print the news with greater detail is noticed in all newspapers.

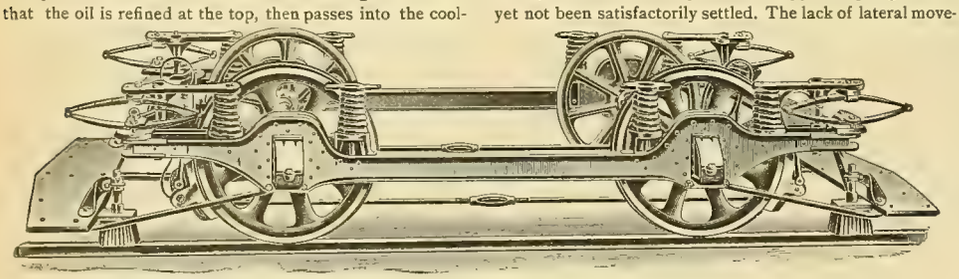
It is estimated that the principal morning papers of the country will order 330,000 words daily in specials. The bulk of this must be transmitted from Minneapolis between 5 o'clock in the afternoon and 1 o'clock in the morning—that is, eight hours. The Western Union company can improvise during those hours about thirty sending wires from Minneapolis to Chicago. This includes two new copper wires which it has erected, and also two or three railroad wires, which it is calculated can be used. The Wheatstone system will be applied to one wire, but the others will be worked by the Morse alphabet. It is said by telegraphers that the fastest rate at which an expert telegrapher can transmit successfully does not exceed 2,000 words an hour. At this rate thirty wires will carry 60,000 words of special matter an hour or 420,000 words from 5 P. M. till 1 A. M. This leaves an apparent margin of 90,000 words to spare with respect to the estimate. But all of the thirty wires may not be in working order; no account is taken of the regular commercial telegraph business of the Minneapolis office; and lastly, the unexpected may happen, and the specials filed may be doubled in length.

General Superintendent Clowry says that all applications for special wires are being refused. "We can make no discrimination whatever," said Col. Clowry, "and have refused every application. We will need all our facilities ourselves, and I am free to say they will be pushed to their utmost. We have built two new wires, and could build another in twenty days. I shall send our most experienced and best men to Minneapolis to take charge of the office. We will do our best, and we hope to handle the business."

The Postal people assert that they can handle 150,000 words nightly from Minneapolis, leaving a margin for any contingency which may arise.

Improved McGuire Truck.

In the accompanying illustration is represented the latest improvement in steel trucks made by the McGuire Manufacturing company, Chicago. The "19 B" McGuire truck, which has already made for itself an enviable reputation, is altered by the insertion of an elliptical instead of a spiral spring at the extreme ends of the frame. It is not claimed by the company that an elliptical spring is better than a spiral spring at this point, but this arrangement is offered to meet the preferences of a number of customers. The question of durability of the two types of springs has as yet not been satisfactorily settled. The lack of lateral movement in elliptic springs, while it certainly steadies the car when new, may overstrain the frame of the truck. The McGuire company recognizes this fact and has designed the steel frame to meet any strain that can come upon it. Recently one of these trucks with a 6 foot wheel base was placed under a car body 30 feet long and put into service on the Milwaukee street railway in a trial with four other makes of trucks. The *Milwaukee Sentinel* of March 30th referred to the car mounted on this truck as the most perfect riding car ever seen.



IMPROVED M'GUIRE TRUCK.

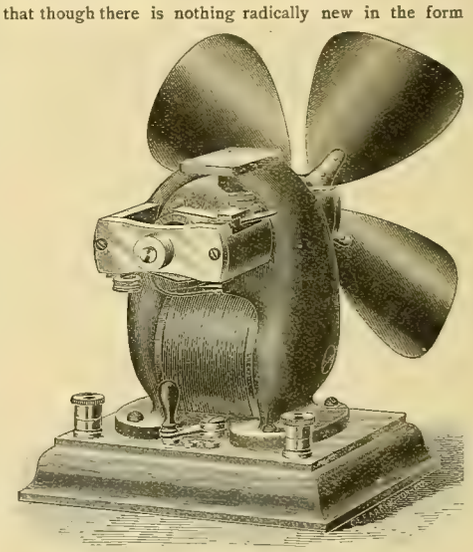
Western Union Stock.

Considerable attention has been devoted to Western Union stock in Wall street during the last two weeks. Commenting on the market the *Daily Financial News* of April 11th says: "A relief to the situation was an advance in Western Union to 90 on sales of 13,918 shares, leading the list in buying. The company has met with no formidable competition as threatened, while the business and profits have been such as to justify an increase of dividend. While the price has always ruled low from an investment standpoint at current rates a 6 per cent. dividend basis upon actual earnings is unquestioned seriously. We look for a further advance upon the outlook as it stands."

On the following day the same authority announced that "Western Union continues a live market factor, but the capitalization is so large that progress is slow. The figure 90 is in itself reasonable," continues the *News*, "considering the gigantic business of the company and the absolute necessity of making some division of the great profits steadily accumulating."

The Bernstein Motor.

The Bernstein Electric company, Boston, which has heretofore confined itself principally to the manufacture of series and multiple incandescent lamps and general supplies, has put on the market this season a very neat little motor for continuous currents, and it is now building the machines in several sizes. The accompanying cut shows the smallest size motor which the company is building. This size was designed particularly for fan work. The motor carries an 8 inch fan, which revolves at either 1,700 or 2,000 revolutions. From the illustration it will be seen that though there is nothing radically new in the form



THE BERNSTEIN MOTOR.

adopted the motor is handsome and of good mechanical appearance. Great care is taken in finishing these small fan motors. The motors of larger size which the company is making can either be used for large ventilating fans or for light power work. It should be mentioned, too, that the Bernstein armature is wound in such a manner as to reduce sparking to a minimum.

Copper from a European Standpoint.

The London *Financial Times* claims that the recent advance in copper was brought about by a purely bull movement on the part of American producers, who at this season book contracts for the season's delivery. It says: "It is no longer deniable that the copper supply of the world is considerably ahead of current consumption. Statisticians are doing their best to disguise the fact, and save the market from being upset."

On the basis of the proposed copper combine the *Times* claims that the following European supply is advocated:

From Spain, Germany, the Cape and Venezuela	75,000
From United States	50,000
From Chili	23,000
Total	148,000
European supply in 1892	119,517
Increase	28,483

This, it is claimed, Europe would not be able to absorb.

Rapid Transit in Buffalo.

Reviewing the growth of the street railway interests, the *Buffalo Express* says: Buffalo has grown a good deal in the matter of street car service since a year ago. It had then 67 miles of track and 96 cars operated only by horse power. It has now 96 miles of track and in about 60 days will probably have 208 cars in operation. At present 64 trolley cars and 88 horse cars are in use. Supt. Littell vouchsafes the information that something like 20 miles of additional track will be built by the street railway company next year. In 60 or 70 days after the frost is out of the ground trolley cars will be running the full length of Main

street. There are now 41 miles of electric road in operation in Buffalo.

The past year has not only seen practically the beginning of electric motor power, giving a transit of seven miles an hour including stops, but will be remembered as the year in which all transfer charges were abolished. This great change was brought about by an agreement through which the city gets two per cent. of the gross receipts of the entire street railway system. Last year the company carried about 1,200 transfers a day at three cents apiece. Now it carries about 10,000 a day for nothing.

The Buffalo Street Railway company has one of the best trolley plants in the country, and some of the best cars. They are operated from a power house where 1,750 horse power is generated—an amount greater than for any other one business in the city, yet which will be largely increased very soon.

The Present Condition of Ferranti's Deptford-London Enterprise.

Ferranti's daring scheme for the distribution of alternating current from Deptford to London is now developed to an extent that will enable American engineers to pass intelligent judgment as to whether the London Electric Supply corporation attempted to carry out a visionary project or one that is entitled to financial support.

Descriptions of the details of the machinery employed at Deptford and accounts of the various difficulties encountered in the development of Mr. Ferranti's gigantic work have already been presented to the readers of the WESTERN ELECTRICIAN. The following abstracts, then, of the reports of the directors, engineer-in-chief and the presiding officer of the fifth general meeting of the company for the year 1891 will be of considerable interest:

According to the directors' report the result of the year's working was adversely affected by the fire which took place at the Grosvenor distributing station on Nov. 15, 1890, which caused an entire cessation of the lighting for a space of three months. After supply was resumed on Feb. 15, 1891, it was found that many of the corporation's old customers had resorted to other companies. Although a considerable amount of new business was gradually acquired, it was only toward the end of the year that the number of lights installed equaled those connected at the time of the fire. Advantage was taken of this interruption to business to reorganize the system of distribution. The whole of the overhead cables were removed and concentric underground cables substituted; at the same time the distributing mains were extended to many districts in the authorized area of supply which had not previously been touched, and where there is good prospect of remunerative business being obtained. The extension of electric lighting generally has been less rapid than was anticipated, but the light is undoubtedly growing in public favor. The greatly improved supply now given by the corporation gives reason for anticipating a material increase of business during the current year. As referred to in the engineer's report, measures are being taken by which the cost of producing the current will be very materially diminished, and the efficiency of the generating plant increased. During the year the engagement of Mr. Ferranti has ceased by effluxion of time. P. W. D'Alton, the chief assistant to Mr. Ferranti during the construction of the generating station, has been appointed chief engineer.

The chief engineer's report was substantially as follows: When the supply of current was resumed on Feb. 16, 1891, only 9,000 lights were at once installed, and the number gradually increased to 36,000 by the end of the year. In the interval the two dynamos, each of 625 horse power, were removed from the Grosvenor station and erected at Deptford, with two new tandem compound horizontal engines. Until August last these dynamos furnished the supply unassisted, the current generated at 2,400 volts being transformed up to 10,000 volts, and at that pressure transmitted to the distributing stations in London. The two dynamos, each of 1,250 horse power, which, prior to November, 1890, had supplied current direct to the mains at a pressure of 5,000 volts, were, during the latter end of 1890 and the early part of last year, altered to generate current at 10,000 volts. An unsuccessful attempt to run one of them was made toward the end of July; but they were not ready for work until August 10th, about which time Mr. D'Alton assumed the duties of engineer-in-chief. Since then all these machines have been at work, the larger ones generating current at 10,000 volts. During the past autumn considerable difficulties were experienced in working the 10,000 volt system, and there were occasional failures of the dynamos, high tension transformers, and trunk mains, many of which were due to the present arrangements for working the machines in parallel. Unfortunately these failures have caused interruption of supply on several occasions, but measures have been, or are now being taken, by which it is believed these difficulties will be overcome. For the last four months there has been great improvement, and breakdowns have been of very rare occurrence. A number of faults occurred in the trunk mains during the year, but they are now causing less trouble and anxiety. Mr. D'Alton is of the opinion that such faults are more or less inseparable from any new system, and that they will eventually be eliminated. During the first four months after the resumption of supply the failures were numerous; during a second similar period they diminished to less than half, and latterly they have been gradually ceasing. Similar troubles were experienced with the high tension transformers, but as the year advanced the failures became less frequent, owing to careful repairs, and during the last four months we have had but one failure. A few months since there was established at Deptford a new department, where transformers are made and other parts repaired. The work already turned out by the department is equal to anything done by outside contractors, and superior to most of the work; at the same time a considerable saving in money is effected, and work is more promptly done. The work on the 10,000 horse power dynamos was suspended in May last, but the parts of the machines have been properly protected, and are in good condition. The distributing mains have been greatly extended during the year, and, as there are now upward of 27 miles laid, a large increase in the volume of business may reasonably be anticipated. They are in a thorough state of efficiency, and have caused but little expense for maintenance or repair. The permanent switching gear is now being erected at the distributing stations, and will shortly be completed. At two of the stations it is already in use, and is working satisfactorily. The engines and boilers have been kept in good working order. The two sets of generating plant of 625 horse power cannot be worked to their full capacity, owing to faulty design, in consequence of which it is impossible to produce a larger output than 8,500 to 9,000 lights from each. This defect is about to be remedied to a considerable extent at a moderate outlay. A scheme for condensing the exhaust steam is under way, and when completed it will greatly improve the running of the engines, and will have the effect of saving at least 25 per cent. of the consumption of coal.

J. Staats Forbes, presiding at the meeting of the company, said: There is a loss by balance of £6,957. In 1890 the receipts were £28,624, in 1891 only £15,560. If in the interval the calamities of the company had not led to a great number of consumers who were customers in 1890 having left us altogether, and so reduced upon the year the income by that £15,000, our position would have been very different. Expenses in 1890 were £28,704, and in 1891 £22,517; that accounts for the greater part of the £6,127. After we had started again, and people began to come back, we had casualties, breakdowns of mains, of transformers and dynamos, interruptions of the lights, and so forth. A very serious calamity of this nature occurred in the month of November, when the whole thing came to a collapse, the dynamos, mains, and everything went wrong, and for four days or more we were without light. There was in a lesser degree what had taken place at the time of the fire. We had worked up our customers from 9,000 in February to 36,000 in November; then came the disaster, and down the numbers went again. Not only did they go down, but people who had not contracted to take current were alarmed and did not become customers. All these things account for the state of the balance sheet at the end of the year, a disjointed year by the way, and which only commenced in the middle of February, and which had in itself the drawbacks arising from these accidents and breakdowns as seriously to retard the progress of the business, and in fact, to diminish the number of customers who from time to time had been induced to take current. Although the income was only £15,000, expenses had not diminished, because expense of the machinery is practically at 9 000 lights what it is when supplying 36,000. Except in the item of coal and water and small stores, fixed charges are not in the least affected. There is one item which one cannot carry to the profit and loss account, and that is the value of the experience gained during that year. Being anxious that the proprietors should know as much about it as we do ourselves, we were careful in the preceding reports to have in black and white from the company's engineer, Mr. Ferranti, his views, in unmistakable language, as to the position of these experiments, and the worst that can be said about Mr. Ferranti's views is that they were somewhat too sanguine, and the experience of these breakdowns has led us to believe that they were only too sanguine, and not wrong in principle. It may be interesting to know that these various accidents, interruptions to the dynamos, to the mains, and to the transformers, beginning in very considerable ratio in the early months, diminished in the later months of the year to zero. It comes to this, that the theory being right, the application or adjustment of the parts—being novel, and at the same time a very delicate thing—has to be made, not from a drawing or on paper, or as an abstract proposition, but has to be felt out in practice. I will mention an instance which occurred the other day; when London was blest with a fog, not only of great density, but prolonged four or five days. Our machines at Deptford ran in the most perfect manner; there was no hitch or halt during all these hours, and the full pressure was maintained the whole of the time. I need hardly say that during this time the board room of the company has not been altogether a bed of roses. It will be satisfactory for you to hear that the difficulties we have passed through, and the experience we have had during this month, has left our minds—I speak in the presence of most competent judges—in a much happier state than they were at the beginning of the year and during the many periods in the year. We think it is possible to develop this system of high tension to an extent and at a cost which, notwithstanding the bad start, and notwithstanding the possible losses which will result from entering upon experiments of that nature, will eventually land the company in a satisfactory position. Steps are being taken by which the cost of producing the current will be diminished. We have made some advance in that respect already, because the expenses have been reduced by £6,000. For the sake of argument, suppose we doubled the output this year, the expenses would not be doubled, they would be very slightly increased; as a matter of fact, they would really have only increased by the additional driving force, or the coal, water and oil; the fixed charges of the establishment, the rents, the capital lying buried in the mains would remain exactly where they were. The outlook is rather better than might be thought from a superficial study of these accounts. Every new subscriber now means very nearly the whole of his subscription as additional profit, and you will easily see what the effect will be of a rapid multiplication of subscribers. We must hang on to that hope. We believe it to be thoroughly well grounded, and we believe we can assure you what we feel ourselves, after some very unpleasant quarters of an hour, that we ourselves are more confident than we were at the starting of this year, that this company is to be really a success.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 16. Telegraphers will regret to hear that General Wire Chief Fred W. Baldwin, of the Western Union company, died on Tuesday last. Exposure, loss of sleep and a cold contracted during the refitting of the Western Union building, brought on an attack of pneumonia, which developed into consumption and resulted in his death. Mr. Baldwin was thirty-nine years of age and entered the telegraph service as a messenger boy in 1865. He was one of the charter members of the New York Telegraph Aid society, and was its treasurer. When the Western Union building was burned in July, 1890, Mr. Baldwin had in his mind a complete map of the lines extending for a radius of 200 miles around New York, and while the firemen were pouring water into the upper floors of the building, he stood on the first floor giving orders with such marvelous skill that within forty-eight hours wires were working in all directions. A large delegation of employes of the Western Union company attended his funeral on Friday afternoon at his home, in Mott Haven.

The bill for the incorporation of the General Electric company has passed the assembly. This bill, which was engineered by Senator Cantor, provides for the payment of one-twentieth of one per cent. to the state as a corporation tax. An effort was made to amend this section, so as to require the company to pay a tax of one-eighth of one per cent., but it was voted down, and the bill passed by a vote of eighty to twenty. It is thought that the bill will be signed by Governor Flower.

Mayor Boody of Brooklyn, Senator McCarty and the presidents of the Brooklyn surface railroad companies have had a conference in regard to McCarty's amendment to the Cantor Railroad Act exempting Brooklyn from the necessity of selling franchises to the highest bidder, and also to talk over McCarty's bill compelling roads to pay five per cent. of their gross receipts into the city treasury. After the meeting Mayor Boody gave out this statement:

"The result of the conference was that the subject of local taxation on railroad franchises for both old and new roads needed a very careful consideration, and that the few remaining days of the legislature didn't afford that opportunity; that the subject should be taken up in vacation time and gone over carefully before new legislation should be attempted."

Sing Sing is getting well into line so far as electric railways are concerned. The incorporators of the Ossining electric railroad, which is the name of a new company to operate a line in Sing Sing, have signed papers of incorporation, the directors have elected officers, and by-laws have been adopted. The capital stock of the railroad is placed at $50,000, 500 shares at $100 each. The proposed route is from the railroad station to Main street, to Water street, to Central avenue, to Main street again, to Croton avenue, to the Sing Sing camp meeting grounds. A branch will strike off south from Main street down Spring street to the south line of the village. A uniform fare of five cents will be charged.

The Telephone Subscribers' association has realized that the Bell interests are not easily frightened, and that they are ready to maintain their position. Word came from Albany, though, under date of April 13th, to the effect that Mr. Aspinall (Rep., Kings) had amended his telephone bill so as to make practically a new measure. This bill provides for a state board of telephone commissioners of three persons, to be appointed by the governor, to serve two, three and four years, one a republican, one a democrat, the third a scientist, to be selected without regard to party affiliations. The commissioners will exercise toward telephone companies powers similar to those of railroad commissioners to railway companies. They will adjust the rates to be charged. Their principal office is to be in Albany. Their compensation is fixed at $10 a day.

On Thursday night, April 14th, burglars entered the office of Baker & Co., Newark, N. J., and blew open one of the safes. It is reported that quite a large amount of plunder was taken.

It is stated that Peekskill is to have an electric fire alarm system.

The power house at Yonkers for the new electric railroad is practically finished; the cars have arrived, and all that remains to be done before operating the road is to connect the rails with the underground wire. It is expected that the cars will be running in May.

It looked for awhile as though the days of the New York Electric club were numbered, but it has now been decided to keep the club alive. In future, however, it will be run on a less pretentious scale. It is thought that the only chance for an electric club in this city is to make

it a commercial club, and in all probability hereafter the club will be managed with this idea in view. The annual meeting of the club will take place next Thursday evening. The feature of the evening, of course, will be the annual election of officers, and there may very possibly be some action on the question of the club's new quarters. All the present officers have been renominated, and, in the lack of any opposition ticket, may be regarded as good as elected. They are: President, Samuel Insull; vice-presidents, Charles W. Price, Erastus Wiman, W. L. Candee and Edward Weston; secretary, Stephen L. Coles; treasurer, George M. Phelps; board of managers, H. L. Shippen, T. H. Alexander, T. C. Marshall, C. E. Stump, E. F. Peck, E. E. Bartlett, Dr. J. B. DeLory, H. D. Cheever, Charles D. Shain, Joseph Barre, C. O. Baker, Jr., H. D. Stanley and J. H. Hericrk. W. F. O.

San Francisco, Cal.

SAN FRANCISCO, April 14.—Two suits have been brought before the supreme court of the city and county of San Francisco, which are being watched with great interest by all electric companies maintaining overhead wires. These suits are brought by George Davis, a house mover, one against the Pacific Telegraph & Telephone company and the other against the Edison Light & Power company, claiming $10,000 damages in each case, for malicious prosecution. The question involved is that of the right to remove overhead wires when they obstruct the use of the street for such purposes as house moving, a question which has long been the cause of controversy here. In San Francisco the electric companies have required house movers to apply for the temporary removal of wires and to sign contracts to pay for labor and the damage sustained to the wires. The house movers protested against this proceeding claiming that the amounts charged were extortionate, and at last they have combined and raised a fund for the purpose of testing their rights. Accordingly, one day about a month ago, Davis gave written notice to the telephone company that on a certain day, and at a given hour, he would move a house across Union street, along which a telephone pole line extends, and requested that the wires be opened temporarily. Thereupon the company presented the usual form of contract, which Davis refused to sign, maintaining that it was the company's duty to open the wires at its own expense. His belief was emphasized with the threat that if the wires were not opened he would cut them. The company refused to remove the wires at its own expense and threatened Davis with arrest if he molested the circuits, but nevertheless, Davis disregarded the warnings and was engaged in cutting the wires when he was arrested and taken to the city prison. After three hours' confinement he was released on bail and when he appeared for trial before the police court on the charge of "maliciously cutting telegraph wires," the judge discharged him, holding that no criminal offence had been committed. Almost the same procedure was followed in the case of the Edison Light & Power company when Davis cut a 2,000 volt alternating circuit with an ax. He was again arrested and imprisoned for this offense, but on being examined was again exonerated. It is for these arrests and alleged persecutions that Davis asks redress.

A leading San Francisco daily heads an article on "The Deadly Dummy" with the following partial list of persons who have been killed by cable dummies in this city:

Samuel W. Redington	Nov. 7, 1886.
Joseph Doyle	March 21, 1886.
Mary A. Stewart	Feb. 28, 1887.
P. H. McElhinny	Jan. 27, 1888.
Thomas Leonard	Feb. 27, 1888.
Harry Mangels	March 18, 1888.
Casper Arnold	June 26, 1888.
Oliver P. Grant	Aug. 22, 1888.
E. O. F. Hastings	April 30, 1889.
Mrs. M. Thomey	Oct. 3, 1889.
William O'Brien	May 1, 1890.
Rinaldo Salona	Aug. 17, 1890.
Charles F. Duenwald	Oct. 5, 1890.
Edward Brandon	June 16, 1891.
George Kerlin	Sept. 13, 1891.
Jeremiah Twohig	Jan. 18, 1892.
Rev. William J. Walsh	Jan. 18, 1892.

In cable systems, as is well known, there are no intermediate speeds, as the car must go at the speed of the cable or not at all. Consequently the rate of travel in crowded thoroughfares is the same as that in sparsely settled districts. To this unfortunate individuality is perhaps due the fact that cable cars are more "deadly" than any other means of urban transit.

The Edison Light & Power company of this city has completed the plans for its new central station, which will be one of the largest incandescent plants in the United States. The building is to be of brick and will be located mostly on the site of the California Electric Light company's old station. Its ground area will be 165x80 feet, and the building will be one story 54 feet high. Twenty-eight 250 horse power vertical boilers having a capacity of 7,000 horse power will be placed, and the power plant will consist of six triple expansion engines aggregating 7,000 horse power. The chimney will be 180 feet high and its smallest inside diameter is to be 12 feet. Nothing but incandescent and constant potential motors are to be operated from this station. S.

Milwaukee, Wis.

MILWAUKEE, April 16.—The Milwaukee Street Railway company is likely to be successful in its efforts to secure a franchise on Fond du Lac avenue, which runs diagonally across the northwestern part of the city. The ordinance, it will be remembered, aroused strong opposition several months ago, because Fond du Lac avenue merchants believed that street cars on that street would cause farmers to use other thoroughfares, and thus would ruin their business. After a long fight in committee, during which opposing delegations of taxpayers argued with the aldermen, the matter was placed on file. Election was only a few months off then, and some of the aldermen were afraid to vote for or against the ordinance. Last week Tuesday the election was held, and at the first council meeting following the ordinance was taken from the file and referred to the local committees of the Ninth and Tenth wards. There is little doubt of its passing the council. The territory through which the line will run is thickly populated, and is in sore need of rapid transportation facilities.

In the Superior Court the case of Elias R. Bowen, as receiver of the Great Western Telegraph company against Ferdinand Kuehn, ex-state treasurer, has been dismissed, and in the Circuit Court the case of Receiver Bowen against the heirs of John Burnham has met with a similar fate. The company was organized many years ago, and a number of citizens of Wisconsin and Illinois took stock in it. The lines were never built, and only a small portion of the capital stock was ever paid in. Within a few years a great many suits have been started to compel stockholders to pay in the balance of the money subscribed. In the present case the defense took the form of demurrers stating that the complaint did not state facts sufficient to constitute a cause of action. The courts sustained the demurrers and held that the assessments were unequal and unjust.

Edwin B. Cottrill, auditor and purchasing agent of the Wisconsin Telephone company, has been appointed superintendent, succeeding F. E. Parker, resigned. Mr. Cottrill has been with the company a number of years, and his promotion is deserved. The former position is held by D. E. Roberts, who is an experienced accountant.

On the morning of April 6th about 100 telephone subscribers on the South Side discovered that their instruments were useless. The trouble was due to the burning out of the Broadway cable house. An electric light wire had become connected with a telephone wire, and the cable house, cable heads and arresters were destroyed. Superintendent Hyde put his men to work, and by evening the disabled telephones were again in use.

The project of building a summer resort line between Oconomowoc and Waukesha has been revived. The matter has been agitated for several years, and has been encouraged by Waukesha county people. Some surveys were made, and it looked for a time as though the line would be built at once, but nothing was done. It is now proposed to build a line for summer use only, and to use the trolley system. Milwaukee people, including Judge Mallory, H. J. Killilea and Charles Polacheck, are interested in the matter.

It was at first reported that an electric light wire caused a fire which did $6,000 worth of damage at the residence of L. F. Hodges, Ninth street, on April 7th, but the Badger and Edison people made an investigation, and discovered that the flames were due to the explosion of a lamp which a servant accidentally dropped.

The plant of the Sheboygan Electric company at Sheboygan has been purchased by the Mattoon Manufacturing company, which will improve and operate it.

A few days ago a broken telephone wire which had fallen on a trolley wire struck and killed a horse belonging to the Hoffmann & Billings company.

There was an electrical display on Grand avenue bridge a short time ago. The trolley slipped and struck a guard wire, which fell on the rear platform of a Becker car and wrapped it in flames for several seconds. Then, as the car passed along, the wire fell on the rails, and there was another electrical display until the wire was removed.

Commissioner Dunck of the Board of Public Works declares that the Milwaukee Light & Power company has been stringing some wires on poles since January 1st, contrary to ordinance. He ordered such wires on Fond du Lac avenue to be taken down.

The Milwaukee street railway system was tied up for about an hour on the second Saturday of the month by another accident to the machinery at the Edison power house. Such accidents will be well-nigh impossible when the plant is complete.

Shortly after midnight on April 5th fire was discovered in the telephone exchange at Superior, and before it was extinguished it had completely destroyed the batteries, leaving that city without service for a day or two. The fire was caused by telephone wires crossing street railway wires. At the same time the telephone wires were weighted down with ice, and sixteen poles were broken in consequence. The fire alarm service was also considerably impaired. It took several days to repair the damage.

The switching arrangement which the Milwaukee Street Railway company is putting in at the corner of West Water and Sycamore streets will permit a car being transferred at that point from one line to another. The crossings, curves and switches make quite a network.

The Villard street railway people have received two sample cars from the St. Louis Car company and one from the Pullman company. They are all very fine.

President Payne says that work will be pushed at once on the Russell avenue and Island avenue line, and that it will be running by June if the repairs on East Water street bridge are completed in time. In the meantime the Bay View and Forest Home cars will run via West Water and Reed streets so as to avoid transferring passengers at the bridge. This arrangement will allow quicker work on the Clinton and East Water street tracks.

Manager Lynn of the street railway system of this city, has added still further improvements to his "patrol wagon" illustrated recently in the WESTERN ELECTRICIAN. In the new wagon the whole tower and ladder for the trolley repair man, only part of which could be folded in the first wagon, may be foldable throughout, and may be lowered and raised at will.

Some mischievous people have discovered that the starting device on the platforms of electric cars can be manipulated by means of pocket knives, and have been giving the railway people considerable trouble. The knives may be inserted in the slit in the rod for the motorman's lever, and the current turned off or on at will in the absence of the motorman. Not long since a Third street electric car crossed Grand avenue and stopped on the south side of that thoroughfare. The road being clear, apparently, a Becker car started to pass the Third street crossing. As it neared the crossing, going very rapidly, the Third street car began to back up, although the motorman had not touched his lever. For a moment a bad collision seemed imminent, but the Becker motorman shouted to the conductor on the other car, which was moving all the time, to pull down his trolley, which he did, and in skipping by, the Becker car just missed the other. About the same time, from the same cause, a Third street car would have run away down the hill on that street but for the presence of mind of the conductor and motorman. An effort is being made to catch the guilty persons. On the Hinsey and Becker cars the current can only be turned off or on by the motorman's lever.

Manager Lynn of the Cream City railway is not putting that little palace of a street car, that he made himself, into common use. He is keeping it for people who may wish to charter it for balls, the theater, etc. It is announced, by the way, that Mr. Lynn is going to get out a car that will beat the one mentioned. The new one, it is said, will be finished and furnished more elegantly, and be provided with a snug smoking room beside.

A company has been organized to furnish residents of Whitefish Bay electric light as well as water and power. It is the Whitefish Bay Water, Light & Power company, and its capital stock is $50,000. C. R. Gether, David Harlowe and H. M. Gilbert are the incorporators. There is not any prospect that the company will begin operations at the bay until the number of residents has materially increased.

The North Greenfield people are determined to have the Villard electric system extended to that suburb and the new fair grounds. At a recent meeting the general sentiment was in favor of accepting any fair proposition that the Villard syndicate might make, but it was decided to try to secure a franchise and build an independent line if nothing else could be done. A committee was appointed to receive Mr. Payne's estimate and any formal proposition he might submit. C.

On April 14th Judge Truax, in the Supreme Court, dissolved the injunction obtained by the W. J. Johnson company against W. T. Hunt and the Electrical Age Publishing company, New York. This was an action brought by the W. J. Johnson company to restrain W. T. Hunt from soliciting advertising for the *Electrical Age*, and the Electrical Age Publishing company from employing Hunt.

PERSONAL.

W. C. Fuchs of the Milwaukee Street Railway company, was in Chicago last Monday.

H. H. Brooks of the American Circular Loom company of Boston, Mass., spent several days in New York last week.

Edward E Higgins, general manager of the Short Electric Railway company of Cleveland, O., visited Chicago on Monday.

The friends of C. E. Gregory are congratulating that gentleman on his re-appearance on the streets after a severe struggle with a second attack of typhoid fever.

Secretary and General Manager C. J. Swift of the Duplex Electric company, Corry, Pa., spent several days in Chicago last week, leaving for home on Friday night via St. Louis.

NEW INCORPORATIONS.

Hull Electric Light & Power company, Hull, Mass.; capital stock, $10,000; to generate and furnish electricity for light, heat and power.

Cyclo Clock company, Jersey City, N. Y.; capital stock, $250,000; to manufacture, sell and let electric self-winding clocks, etc.; Kohn, Ruck & Lippmann, 38 Park Row, New York N. Y.

Wisconsin Electrical Construction company, Milwaukee, Wis.; capital stock, $12,000; buying, manufacturing and dealing generally in electrical apparatus; Van Dyke & Van Dyke, Milwaukee, Wis.

Cajon Mining & Water company, Los Angeles, Cal.; capital stock, $250,000; mining, dealing in water and water rights, works, etc., electricity, lighting, etc.; T. H. Ward, Los Angeles, Cal.

Citizens' Electric Lighting company of Pontiac, Mich., Detroit, Mich.; capital stock. $40,000; furnishing electric light and power in the city of Pontiac; Commercial Electric company, Detroit, Mich.

National Electric Brake company, St. Louis, Mo.; capital stock, $50,000; to manufacture, sell and operate electric brakes and electrical appliances, etc.; Thos. B. Crews, Sixth and Locust streets, St. Louis, Mo.

Rockville Electric Light & Power company, Rockville and Indianapolis, Ind.; capital stock, $20,000; to put in, maintain and operate a plant for supplying electric lights and electric power to the citizens of Rockville, Ind.

Egg Harbor City Water, Electric Light & Power company of New Jersey, Camden, N. J ; capital stock, $30,000; to supply Egg Harbor City with wholesome water for fire protection, etc.; W. W. Taylor, Philadelphia, Pa.

Winona Electric Light company, Winona, Minn.; capital stock, $50,000; to construct, own, maintain and operate a plant for generating electricity, for light, heat and power in Winona; J. A. Tawney, Winona, Minn.

Massillon Street Railway company, Massillon, O.; capital stock, $50.000; constructing and operating a street railway in Massillon, electricity or other suitable means of propulsion to be used; William A. Lynch, Canton, O.

Menominee Electric Light, Railway & Power company, Menominee, Mich.; capital stock, $110,000; consolidation of Menominee Electric Railway & Power company and Menominee Electric Light company; B. J. Brown, Menominee, Mich.

Metropolis Water company, Metropolis City, Ill.; capital stock, $5,000; to furnish water, electric light, heat and power for Metropolis, Ill., and the neighborhood; H. A. Gardner, First National Bank building, Chicago, Ill.

Connecticut Tramway company, New London, Conn ; capital stock, $20,000; to build and construct railroads, waterworks, pipe lines, electric light plants, street railroads and electric railroads in Connecticut; Tracy Waller, New London, Conn.

National Investment & Improvement company, Davenport, Ia.; capital stock, $2 000,000; to buy the stock of manufacturing corporations, operating street railways, water plants and electric light and power plants; Ferd. Ascherman, Davenport, Ia.

Canton-Massillon Electric Railway company, Canton, O.; capital stock, $200,000; constructing, owning and operating a railroad between the cities of Canton and Massillon and in said cities, to be propelled by electricity; William A. Lynch, Canton, O.

American Electrical company, Portland, Maine; capital stock, $500,000; to build, equip, lease and dispose of water works, electric light plants, ice factories, cold storage warehouses, and any other manufacturing plant; Geo. F. Gould, Portland, Maine.

Harvey Steel Car & Repair Works, Chicago, Ill.; capital stock, $250,000; to manufacture and dispose of all kinds of railway and other cars, railway and other car trucks, car wheels, railway and other machinery, apparatus and supplies, electric and other motors; Alfred Ennis, 409 Rookery, Chicago, Ill.

City Plumbing & Construction company, Chicago, Ill.; capital stock, $15,000; to do a merchandise and contracting business, consisting of plumbing, gas fitting, steam and hot water heating, electric lighting, constructing sewers, pavements, buildings, etc.; Wm. Holgate, 305 South Leavitt street, Chicago, Ill.

Indianapolis Street Railroad company, Indianapolis, Ind.; capital stock, $1,500,000; formation of a street, horse, or electric railroad company, and for the purpose of constructing, owning, operating and maintaining such railroads, switches and side tracks upon the streets and highways of the city of Indianapolis and vicinity; A. L. Mason, Indianapolis, Ind.

ELECTRIC LIGHTING.

The Bridgeport, Tenn., Ice & Electric company has let the contract for the erection of an electric light plant.

An isolated plant, of 1500 lights' capacity will be installed in the *Pittsburg Times* building by the Westinghouse company.

A Hungarian at Johnstown, Pa., was instantly killed last week while attempting to light his pipe at an electric lamp. He was told by a fellow workman as a joke to use the arc light in this way.

The gas and electric light companies of Massillon, Ohio, have consolidated under the name of the Massillon Light, Heat & Power company. The company will expend $50,000 for improvements.

A contract has been made by the Electric Lighting company of Buckhannon, Pa., with the Edison General Electric company for a plant which will have double the capacity of the one recently destroyed by fire.

The *Globe* of London states that a curious ceremony has taken place near Poitiers, in France. The electric light has just been introduced in the parish of Sainte Philomene, and the bishop of the diocese "solemnly blessed the dynamos." A special ritual had been composed for the ceremony, and was entitled, *Benedictio machinæ ad excitandum lucem electricam.*

A recent Boston dispatch says: "A dead man securely strapped to the top of an electric light pole was discovered near Dover street and Shawmut avenue this morning at 6 o'clock. The man was James Hayes. He was employed as a trimmer, and went up the pole in front of 54 Dover street this morning, tied himself to the pole by means of his belt, and started to fix the lighting apparatus, wearing only one rubber glove. It is thought that the unprotected hand came in contact with a heavily charged wire, causing death."

Dr. Hartridge, an English surgeon, has been devoting himself to the examination of the various forms of artificial illumination, and their effects on the eyes, and he has come to the conclusion that the electric incandescent light possesses advantages that no other illuminant can claim. Dr. Hartridge takes good and sufficient sunlight to be the standard of illumination best suited to the eyes, and he shows by analysis that the incandescent electric light comes nearest to it. It combines, moreover, the maximum of illumination with the minimum of heat, and there are no products of combustion.

ELECTRIC RAILWAYS.

It is expected that an electric road will be built in Llano, Tex , next fall.

The Port Norfolk, Va., Electric Railway company has commenced the construction of its street railway.

It is reported that negotiations are pending for the construction of the Alton Park, Tenn., electric railway.

The West End Street Railway company of Knoxville, Tenn., will extend its lines and adopt some system of rapid transit.

The Bath, Me., Electric Street Railway company expects to soon equip four miles of road with electricity. The first order will call for six cars.

The Richmond & Manchester Railway company of Richmond, Va., has petitioned the city council for a franchise to operate its Ninth street line by electricity.

Manager Allen, of the East Chattanooga Land company, is investigating the cost of building an electric railroad to East Chattanooga with a view to interesting capitalists in the building of such a line.

The Boston rapid transit commission has made a report recommending an elaborate system of elevated railways. The motive power recommended for the roads contemplated in the proposed legislative act is electricity. This fact, it is thought, will lessen the popular opposition to such structures.

Erastus Wiman and several Boston capitalists, will put up a 2,000 horse power electric power plant at Livingston station, Staten Island. Power will be sold in small or large quantities to manufacturers, a 600 horse power lighting plant will be operated, and a system of electric roads will also be run.

A Boston dispatch says: "The Westinghouse Electric & Manufacturing company has secured contracts for equipping five street railways and for the establishment of six central station lighting plants in New England. The street railways are in Waterville, Me.; Springfield, Mass.; Amesbury, Fitchburg and Worcester. The lighting plants are at North Attleboro, Abington, Auburn, Me.; Newport, Vt.; Manchester, N. H., and one other point."

On May 10th the Indianapolis street car lines will pass from the hands of their present owners, Cyrus McCormick, S. W. Allerton and other Chicago capitalists, to the control of a New York syndicate headed by R. L. Belknap. The consideration is $2,500,000. This, it is claimed, will insure their reconstruction as electric railways. It has been reported in the East that the Thomson-Houston company was interested in the deal, but Mr. Belknap has announced that "the buyers of the property are Gold, Barbour & Corning, bankers at No. 18 Wall street, New York." He added: "They are the only ones I know in the matter. I do not think the Thomson-Houston company is interested."

Murry A Verner of Pittsburg is establishing a reputation as a successful street railway manager. Mr Verner about a year ago took the Pittsburg & Birmingham Traction company and made it the finest short electric line in the country. Now he has resigned the presidency to go to Rochester and Buffalo, where he will give his personal attention to the interests of the syndicate which controls the roads in these cities. Mr. Verner is succeeded by H. Sellers McKee as president of the Pittsburg & Birmingham Traction company. The Pittsburg *Daily Financial News and Price Current* says: "Mr. Verner has placed the Birmingham in such condition that it no longer requires his personal attention."

TELEPHONE.

At a meeting of the Canadian House of Commons on banking and commerce, the act respecting the Bell Telephone company and empowering it to increase its capital stock from $500,000 to $5,000,000 was approved and reported.

TELEGRAPH.

J. A. Payne and G. C. Bennett have incorporated the Merchants & Traders' Telegraph company at Covington, Ky., with a capital stock of $500,000.

J. K. Miller, who recently finished a term of thirty days in the county jail at Brazil, Ind., was again sentenced to sixty days in jail before he left the city, on another charge filed by the Postal Telegraph company. Miller is believed to be insane. He owns a fine farm two miles west of the city, on the national road, and is rated as one of the wealthiest farmers in the county. His mania for cutting telegraph poles is unequaled. He vows that the national road in front of his premises belongs to him, and that he will cut every telegraph pole raised on his property.

The Mercantile Telegraph company of St. Louis has applied to the Circuit Court in that city for an injunction to prevent the police from raiding its office, as the chief threatens to do if the company continues to post horse-racing events for the benefit of ex-pool alley patrons. J. H. Townsend, the manager of the company, was fined $1,000 by Judge Claiborne for violating the Stone pool law by posting the races at the company's office on a blackboard. The company claims that it is a legitimate telegraph company, having offices in all the chief cities.

MISCELLANEOUS.

Boston has a new and attractive paper. *Electrical Progress and Development*, which succeeds *Modern Light and Heat*. The paper proposes to devote itself particularly to New England, and the first number is a promising one. R. F. Ross is the editor and proprietor.

TRADE NEWS.

O. S. Platt, Bridgeport, Conn., manufacturer of the "New England switch," has brought suit against the Bryant Electric company for infringement of patents.

The John E Beggs Machinery & Supply company, New York, has secured the contract to furnish the electric light station at Rutherford, N. J., including boilers, engines and other appurtenances.

George Cutter is making another large batch of conduit connectors for use on Chicago underground arc light circuits, not to mention numerous other specialties which are keeping the "Cutter Novelty Works" in full blast.

The Security Insulator company, New York, has appointed the Electrical Appliance company of Chicago to represent it in the West. The southern agency of this firm has been given to the Enterprise Construction & Supply company of New Orleans.

W. H. Eckert, general agent for Day's Kerite wires, spent several days in Chicago last week in the interest of his house. Mr. Eckert reports that the new Kerite wire is finding a very ready sale and that the factory is running at night to keep up with its orders.

The Electric Heat Alarm company, 113 Devonshire street, Boston, has received many commendatory letters in regard to its safety device. Among the firms who have recently adopted this heat alarm system is the Paine Furniture company and E. R. Stillings & Co. of Boston, Mass.

Electrical companies opening offices will be interested to know that the committee of experts appointed by the assistant quartermaster general in New York to examine the various makes of typewriters and obtain bids reported unanimously that the Densmore machine was the best adapted for army work.

J. Holmes, the well known electrical commission merchant of New York, left on Saturday for an extended trip through the South. He will spend some time at Asheville, N. C. Mr. Holmes is now taking the first vacation he has had in three years, and his many friends hope that he will return much benefited.

The Lunkenheimer Brass Manufacturing company of Cincinnati, Ohio, is exhibiting its customary enterprise in preparing for the World's Fair a most elaborate display of its popular specialties in valves, sight feed lubricators, oil and grease cups, etc. The company will also exhibit a complete line of brass and iron goods, beside some novelties in steam whistles and sight feed lubricators. The Lunkenheimer company reports business exceedingly brisk, being crowded with orders and having received large contracts for special work for United States cruisers.

BUSINESS.

Secretary A. S. Brown, of the Security Insulator company, New York, has been receiving the congratulations of his many friends upon the advent of an heir.

"Cheap goods are dear at any price!" So says the W. S. Hill Electric company, 54 Devonshire street, Boston, in presenting its revised list No. 1, of electrical switches.

Sargent & Lundy, electrical engineers and contractors, Chicago, will remove their office from the Rookery building to the fourteenth floor of the new Monadnock building, Dearborn and Jackson streets, Chicago, on May 1st.

George Cutter is elated over the fact that Simplex wire has been selected for the new German Opera House on Randolph street, Chicago. The contract for the work is in the hands of the Western Electric company, Chicago.

Ralph Schainwald, of the Standard Paint company of New York, has just returned from an extended trip through the West. It is hardly necessary to state that Mr. Schainwald brought home the usual amount of orders for the well-known P. & B. insulating compounds, papers, etc.

Robb MacKie, until recently manager of the Edison local interests in Cincinnati has rented an office in the Neave building and will hereafter give his time to expert electrical work. Mr. MacKie is a brother of Col. C. H. MacKie, New York, president of the Electric Secret Service company.

Doubleday, Mitchell & Co., New York, have taken a suite of offices in the Electrical Exchange building, and arrangements were completed this week with the American Circular Loom company of Boston for the sale of this company's well-known wire in the states of New York, New Jersey and Pennsylvania.

The Roy Valve company, 15 Cortlandt street, New York, has just issued a very neat pamphlet entitled "Tight Valves at Last." This little pamphlet contains some very useful information as to the proper method of handling valves, and there is also presented a complete list of the various kinds of valves which the company manufactures.

The office of F. W. Cushing, general western agent for Day's Kerite wires and cables, now presents a very attractive appearance. Mr. Cushing has made a collection of portraits of twenty of the most prominent electricians of the world, which have been enlarged and framed, and now embellish the walls of his rooms. His collection is quite unique.

The Electric Construction & Supply company, New York, has booked a large number of orders for its new photo engraving lamp, which seems to meet a long felt want. The adoption of this company's theatrical lamp by a number of the leading theaters, after having subjected it to many severe tests, proves its superiority over the calcium light. This concern is also receiving many orders from steamship companies for the new search light "No. 13."

Secretary and Treasurer Albert C. Darragh of the Purity Oil Filter Manufacturing company, Pittsburg, is exploiting the "Ideal" filter, apparently with marked success. Orders have recently been received from the Citizens' Traction Railway company, the Pittsburg Traction company, the Chautauqua Lake Ice company, and the Allegheny County buildings, all of Pittsburg, not to mention the New Castle, Pa., Wire Nail company and other outside firms.

Word comes from Queen & Co., Philadelphia, to the effect that they have recently received an order from a large manufacturing company for more than 200 magnetic vane volt and ampere meters. These instruments are to be installed with the light and power plants put up by this company. This transaction is especially satisfactory to Messrs. Queen & Co., as a sort of competitive examination was instituted and the magnetic vane type of meter was adopted after a careful comparison with other types.

B. Sebastian, Jr., working under the corporate name of the Sebastian Lathe company, Cincinnati, is engaged in the manufacture of a lathe for general machine purposes and is meeting with most satisfactory results. Mr. Sebastian was, until November last, at the head of the well-known Sebastian-May company of Sidney, Ohio, when he removed to Cincinnati and started this enterprise which now requires the labor of twenty skilled workmen. The factory is crowded with orders, and the outlook for a busy season is very bright.

H. K. Gilman has not rented the entire Springer building for the use of the Great Western Electric Supply company, although he has secured nearly the entire second floor and has the right to use the consecutive numbers from 195 to 207 inclusive. A better idea of the size of the space to be occupied by the new factory will be had when it is known that the space rented amounts to over 34,000 square feet, or an area equal to that found in a building with a single front, 150 feet deep and 9 stories high. Nearly all of the recently acquired space will be used for manufacturing purposes.

The following claims made by the Forest Silver Bronze Packing company, 115 Liberty street, New York, for its silver bronze rod packing, will be appreciated by electric railway and lighting men. The company points out that this packing is applicable to any ordinary stuffing box without change of gland; it can be applied to any rod without disconnecting; it is kept steam, air and water tight, without the use of soft or fibrous packing; it does not touch the walls of the stuffing box, so it cannot bind or crowd the rod; it is non-corrosive and proof against galvanic action; when it requires renewing it is only necessary to provide the two inner rings at trifling expense; it has no delicate springs or parts.

The Jeffrey Manufacturing company, Columbus, O., has now in daily use 51 electric mining machines, not including the orders enumerated below. Through the employment of thoroughly practical men, together with its experience of the past three years, this company is enabled to contract for complete plants with a guaranty to accomplish all that is claimed for the machinery. Recent sales of the Jeffrey company, as reported by Secretary Charles W. Miller, are as follows: Second order for one Jeffrey electric mining machine from the Congo Mining company, Congo, Ohio; third order for a Jeffrey machine from the Redstone Oil, Coal & Coke company, Grindstone, Pa. There were also three additional orders for four Jeffrey machines—the first for a complete electric coal mining outfit for the Hocking Valley, in which there are boilers, engines, dynamos and all necessary connections to run with a daily capacity of 800 tons. The third plant comprises six coal mining machines, with a daily capacity of 1,200 tons.

W. R. Mason, for the past two years president and general manager of the Electric Merchandise company, Chicago, and W. L. Adams, secretary and treasurer of the same company, have withdrawn from the old corporation, and, with a strong list of stockholders, have organized the Railway Equipment company, "for the purpose of manufacturing and dealing in electric railway supplies for use on all systems." Mr. Mason has been prominent in the electric railway supply business, and in a short time built up a concern with an enviable reputation. It is proposed to give the new company a broad scope, and several new departments will be developed. It is understood that Mr. Mason will be elected president and general manager of the new company, with W. L. Adams associated with him in the management as secretary and treasurer. The present address of the company is rooms 617 and 619 Pullman building. Permanent quarters have been secured, which it is expected will be ready May 1st.

The Pelton Water Wheel company has recently furnished the Commercial Mining company of Arizona a power plant which affords a good illustration of the extraordinary results that can be obtained from a small quantity of water under a high head, as also the estimate of value placed upon water power where so large an outlay is made for a comparatively small amount of power. This plant consists of a four foot Pelton wheel which runs under a 1,200 foot head at 699 revolutions per minute developing 45 horse power, using a nozzle tip 53-100 of an inch in diameter; also a 24 inch Pelton wheel running under the same head at 1380 revolutions, developing 20 horse power with a nozzle tip 35-100 of an inch in diameter. These wheels run a concentrating and smelting plant including rock breaker, blowers, pump, etc. The pipe line is 20,000 feet in length, the upper end being 6 and 5 inch casing and the lower end 5 inch lapwelded pipe. All the water supply that can be counted on during the dry season is a flow of about 30 cubic feet per minute.

"Submarine cables laid in shallow waters," says the New York *Sun*, "are often exposed to greater risks and rougher treatment than the great ocean cables, which sometimes cost their owners a small fortune in repairs. Not long ago an ocean going steamship, in leaving her dock at Jersey City, plowed up the soft bottom with her powerful propellor, and secured a costly and valuable catch in the shape of about a dozen submarine cables, which enmeshed themselves in the blades of the propeller so effectively that all the cables were torn asunder, and the ship had to go into dry dock to clear her screw of the garlands of iron, hemp and Kerite with which it had become embellished—not to say embarrassed. It is quite conceivable that the powerful machinery of an ocean steamer should make light work of gathering up and rending into fragments a dozen or so of submarine cables, but that a river tug should take to the same game and twist some hundred feet or so of heavily armored seven conductor cable into a bunch of Gordian knots is a little too much. The cable is the property of the American Telephone & Telegraph company, and serves to connect the pole line across Staten Island with that running through New Jersey, the cable crossing the Kills between Linoleumville and Carteret. Few would believe that a cable could resist long enough to be twisted up into such hideous shapes instead of breaking almost at once. The cable, which is a seven conductor, Kerite make, has been down for about five years, and was found to be in perfect condition when repairs were made. Indeed, the snarl testifies to that."

ELECTRICAL STOCK MARKET.

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, April 16th, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	100	101
Edison Illuminating company of New York	81½	82
" " " Brooklyn	78	80
" " " Boston	110	115
" " " Chicago	130	140
Edison Ore Milling company	15	20
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomson-Houston Electric company	59	60
" " " Preferred	28½	29
Westinghouse Electric company	28	29
" " " Preferred	43	44
North American Phonograph company	5	8
New York " "	2½	5
Automatic Exhibition company	4	7

ELECTRICAL PATENTS.

Issued April 12th, 1892.

472,529. Insulator Support. Dennis Doren, New York, N. Y.

472,579. Electro Magnetic Valve Controller. Olaf E. Lundstedt, Brooklyn, N. Y.

472,596. Trolley Wire Clamp. Montraville M. Wood, Chicago, Ill.

This invention consists in the combination of two clamping parts pivotally connected together with co-acting jaws to grasp the trolley wire between them, said parts provided one with an aperture and the other with a portion to pass through such aperture, so that the parts are pivotally connected with the use of a pivot pin.

472,610 Electric Switch. Lucius T. Stanley, Brooklyn, N. Y.

472,611. Flexible Supporting Arm for Electric Lamps. Lucius T. Stanley, Brooklyn, N. Y.

The flexible supporting arm of this invention consists of a hollow core formed of spirally wound strands of ductile wire, in combination with an outer spiral of resilient wire.

472,623. Electric Lighting System. John M. Lockwood, San Francisco, Cal.

472,628. Dynamo Electric Machine. Lazarus S. M. Pyke and Harry T. Barnett, London, Eng.

472,634. Bracket for Electric Heaters. George D. Burton, Boston, Mass.

The object of this invention is to secure adjustability of the electric heater on the supporting or converter rings to which it is connected, and adjustability of the two members of the heater with relation to each other.

472,643. Electric Conductor. William R. Patterson, Chicago, Ill.

This invention consists of a cable of insulated conductors, having sections of its length formed of conductors insulated with waterproof covering lying directly upon the surface of the conductors, alternating with sections in which fibrous insulation is next the conductors.

472,688. Alarm for Hot Axles. Anton Backhaus, Altenburg, Saxe Altenburg, Germany.

472,691. Art of Making Tin Plates. George H. Benjamin, New York, N. Y.

472,708. Electric Motor or Generator. Rudolph M. Hunter, Philadelphia, Pa.

472,721. Electric Search Light. Barton B. Ward, New York, N. Y.

472,747. Electric Arc Lamp. Royal E. Ball, New York, N. Y.

This invention consists in a carbon carrier for an electric arc lamp, comprising a horizontally swinging or reciprocating bar or member upon which the carbon is mounted.

472,772. Circuit for Multiple Switch-board Systems of Telephone Exchanges. John A. Seely, New York, N. Y., and Charles E. Scribner, Chicago, Ill.

This invention consists in using the same connections upon the switch-boards for the single or ground circuits as for the metallic circuits, and any single circuit line may be changed to a metallic circuit without in any manner disturbing or changing the connections upon the switch-board.

472,784. Safety Attachment for Overhead Electric Wires. Charles D. Brown, Minneapolis, Minn.

472,800. Incandescent Electric Lamp. George C. Baillard, New York, N. Y.

472,801. Incandescent Electric Lamp. George C. Baillard, New York, N. Y.

472,806. Adjustable Microphone. Hermann O. Henneberg, Berlin, Germany.

472,810. Electric Railway Wire Suspension. Alexander Philipsborn and Walter Reichel, Berlin, Germany.

This invention consists in providing double working wires at such places where the track curves from cross-wires by a polygonal arrangement, and placing between the two portions of these wires a rigid spreader or piece of stiff insulating material or metal, but preferably of insulating material. To some point of this spreader between the two wires the cross-wire is attached.

472,909 Electric Elevator. Charles R. Pratt, New York.

472,912. Magic Lantern Advertising Apparatus. William G. Spiegel, New York, N. Y.

472,933. Joint for Electric Conductors. Thomas F. O'Connor, New York, N. Y.

472,935. Arc Light Hanger. Charles A. Pfluger, Chicago, Ill.

472,943. Dynamo Electric Machine. George E Dorman, Chicago, Ill

This invention consists of a series of inwardly projecting pole-pieces, in combination with a series of coils about such pole pieces, each of said coils being curved to conform with the surface of a cylinder.

472,947. Cable Rack. William M. Goodridge, Highland Park, Ill.

The primary object of this invention is to relieve the portion of the switch-board frame which carries the sections of the spring-jack switches, from the weight of the cables, and at the same time provide ready means for taking out any one of the cables, together with the strips of the spring-jack switches with which its conductors are connected.

The tenth claim reads:

"The combination, with spring-jack switches in layers, of cables at the rear thereof in layers connected with said switches, two or more layers of switches being connected to each layer of cables, whereby space is provided to remove the spring-jacks at the rear."

472,953. Trolley Wire Support. Frank C. Prickett, Kansas City, Kan.

472,956. Canopy Telephone Exchange Switch-board. Charles E. Scribner, Chicago, Ill.

Of the six claims the first is given:

"The combination, with a switch-board containing the switches of a portion of the telephone lines of an exchange, of a canopy-board placed above said switch-board, said canopy-board containing the switches of other lines of the exchange."

472,968. Electrical Surgical Instrument. Stephen R. Bradley, Nyack, N. Y.

ASSIGNEE'S SALE.

The entire stock of the Illinois Electric Material Company will be sold in bulk by the Judge of the County Court of Cook County, in the room usually occupied by him as a court room, in the County Building, at 10 o'clock A. M. on the 23d day of April, 1892, to the highest bidder.

Sealed bids must be in the hands of the undersigned at No. 158 Fifth Ave., Chicago, Ill., by 6 o'clock P. M., the 22d day of April, 1892

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In every city in the U. S. where we are not already represented. Liberal inducements and exclusive territory to the right party. Address,

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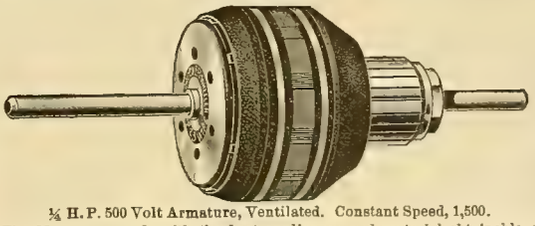

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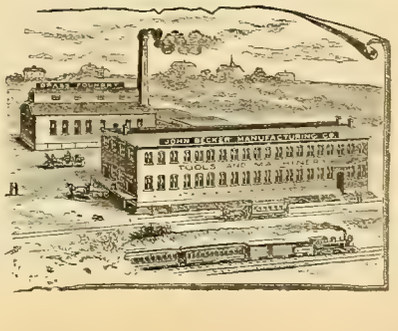

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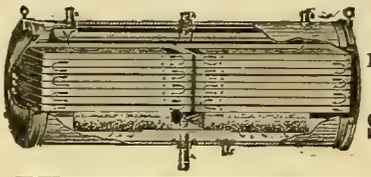

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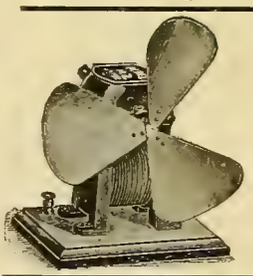

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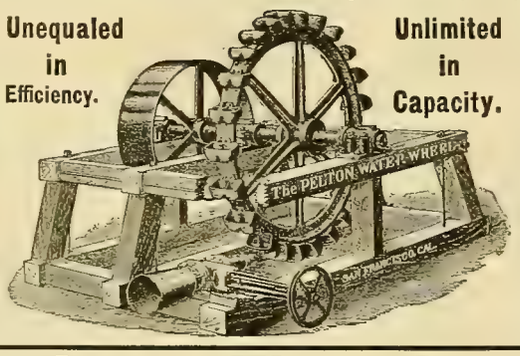

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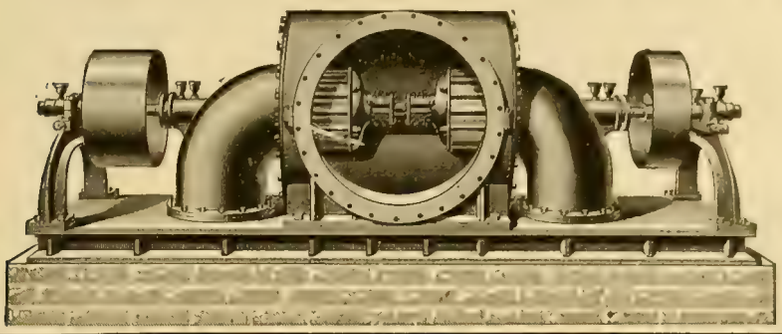

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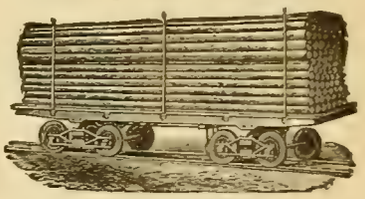

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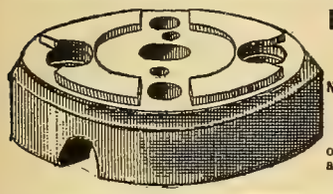

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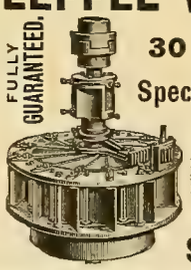

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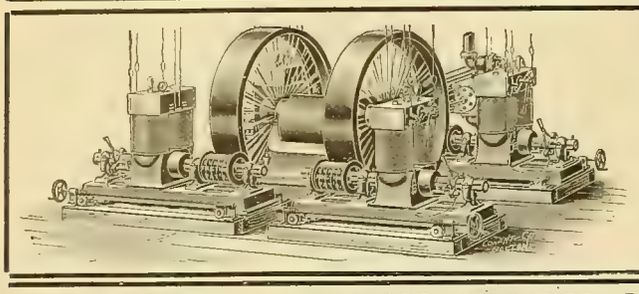

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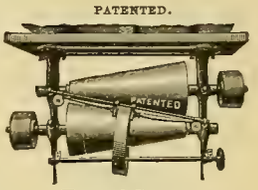

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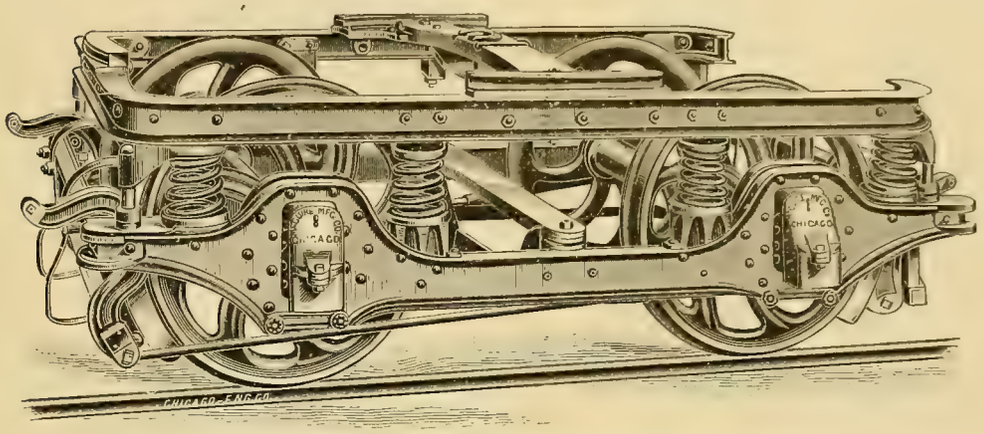

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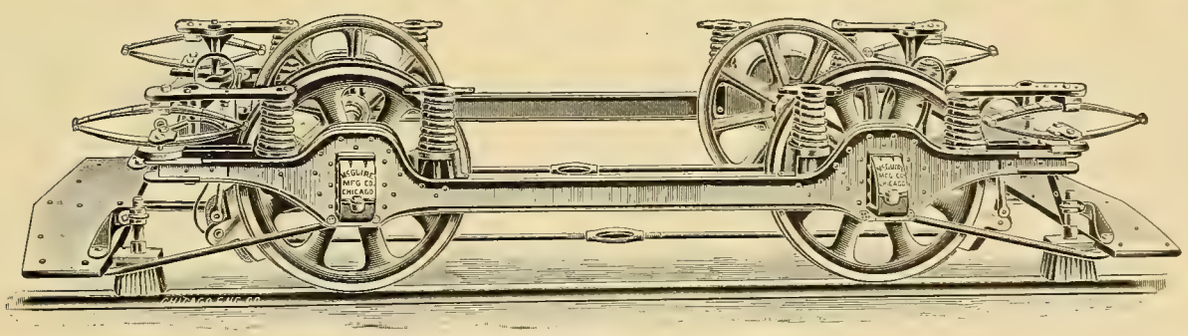

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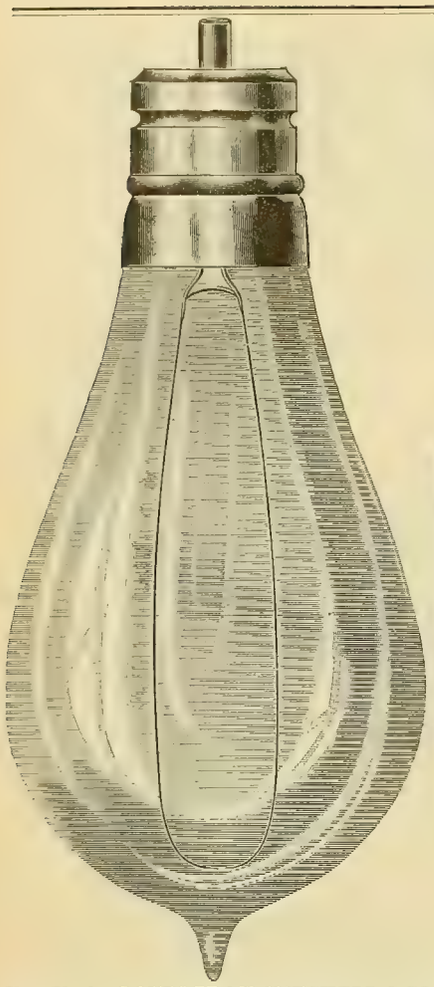

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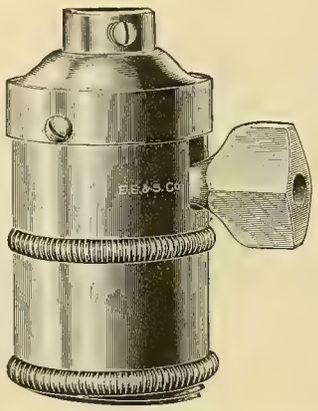

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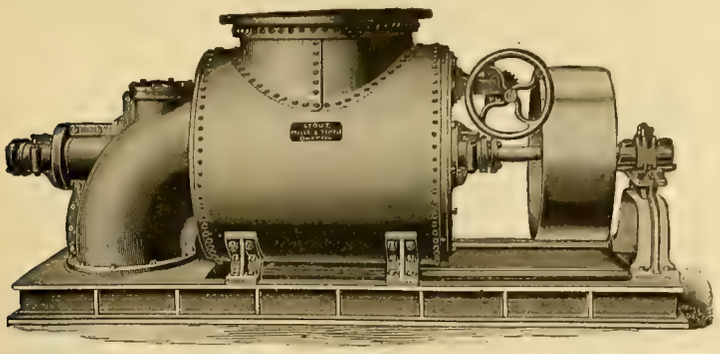

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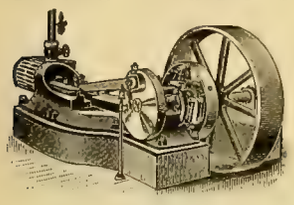

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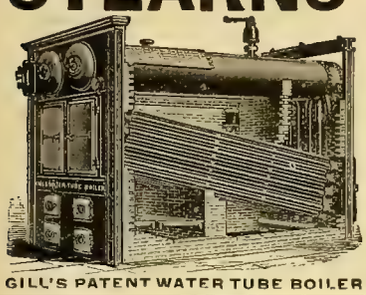

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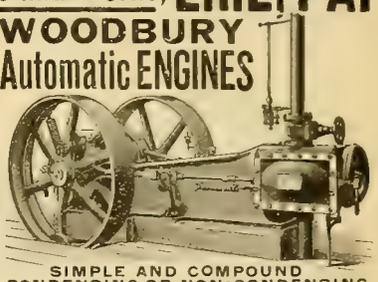

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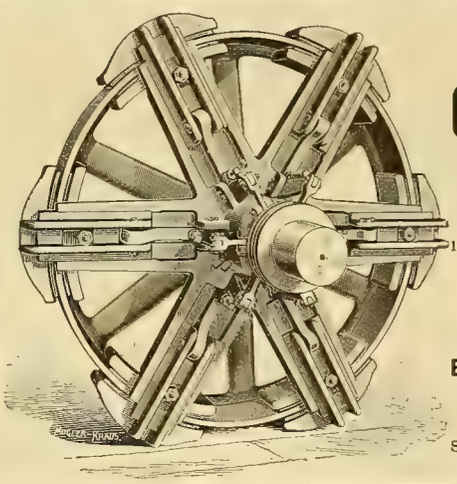

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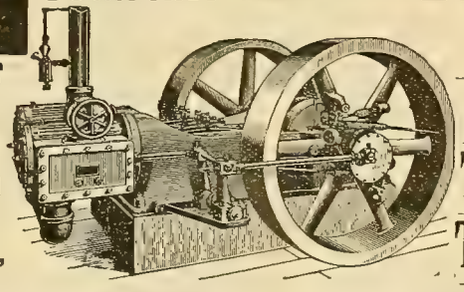

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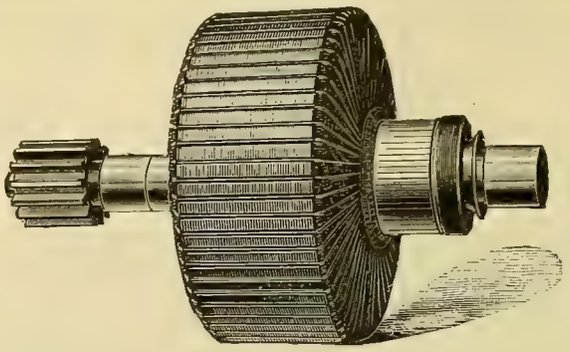

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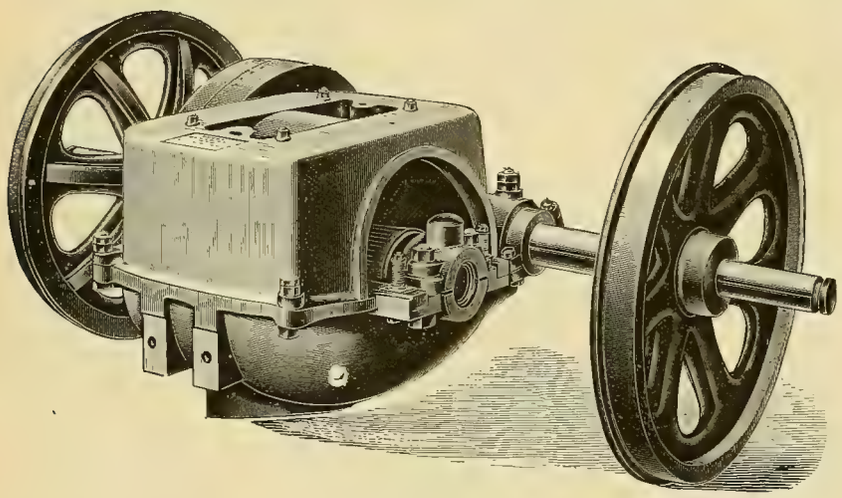

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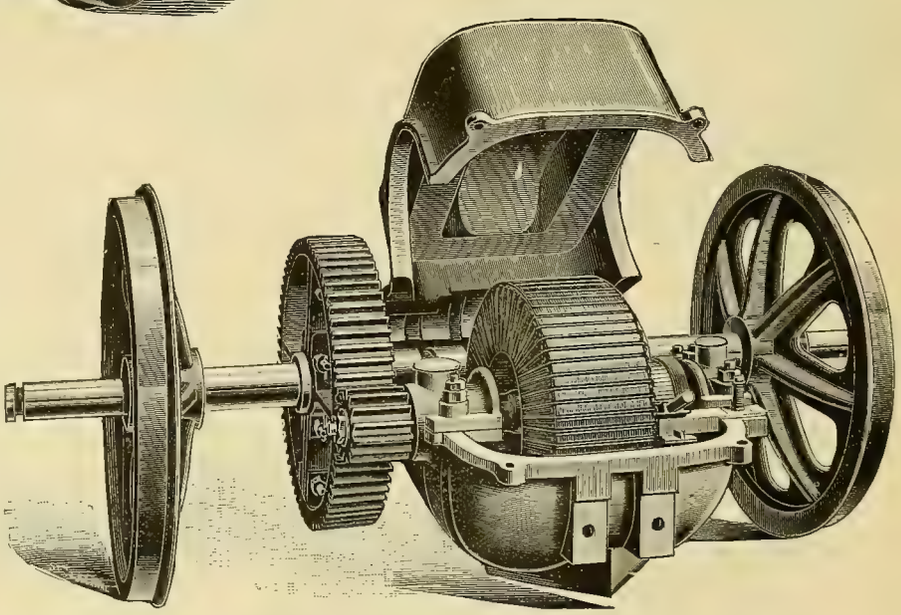

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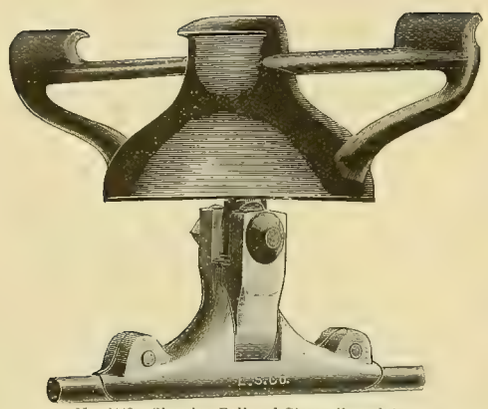

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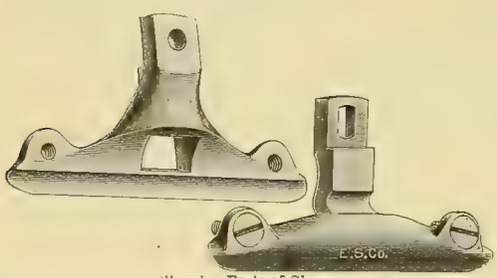

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IT WAS A SAYING THAT

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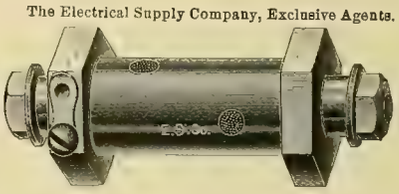

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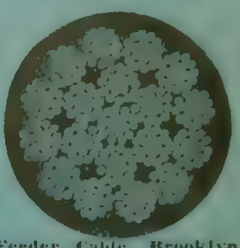
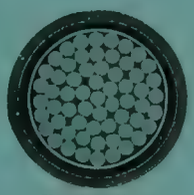
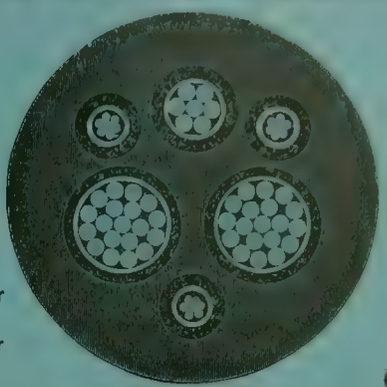

Feeder Cable, Brooklyn Edison Electric Light Co.

Underground Core, N. J. Central R. R.


Feeder Core, Broadway Theater.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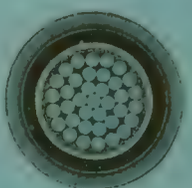
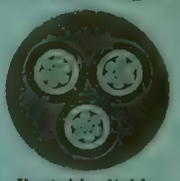

Naval Core, United States s. s. "Chicago."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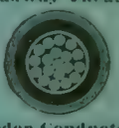
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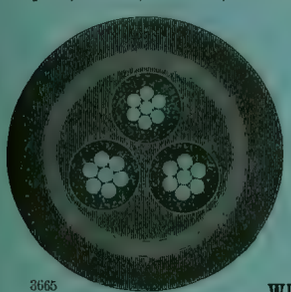
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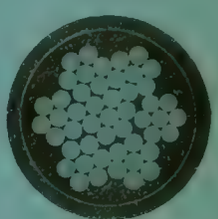
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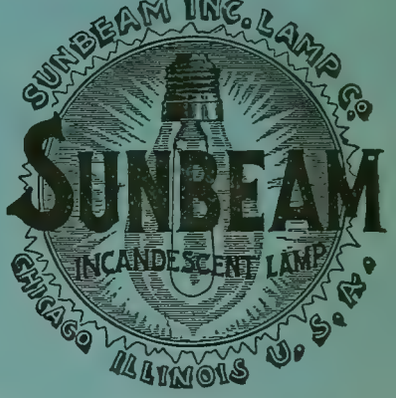

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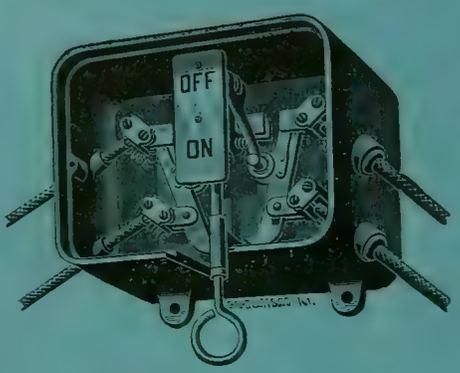

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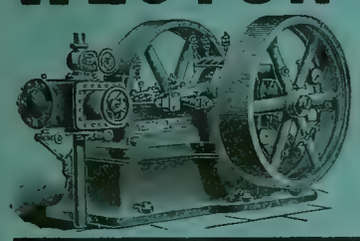

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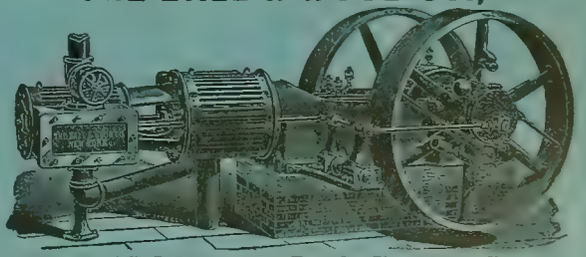

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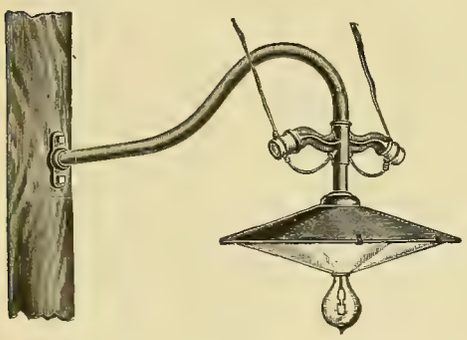

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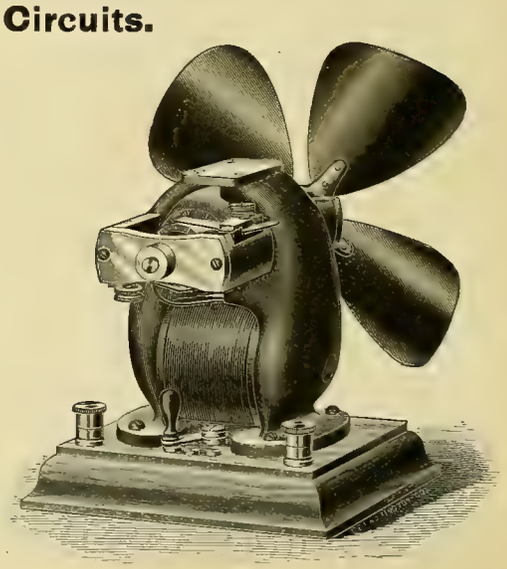

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JOHN F. SCHAEFER, Superintendent.

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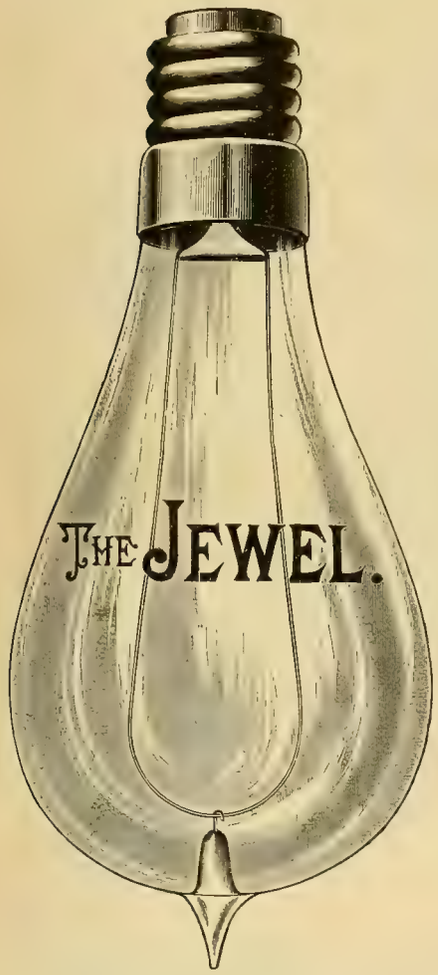

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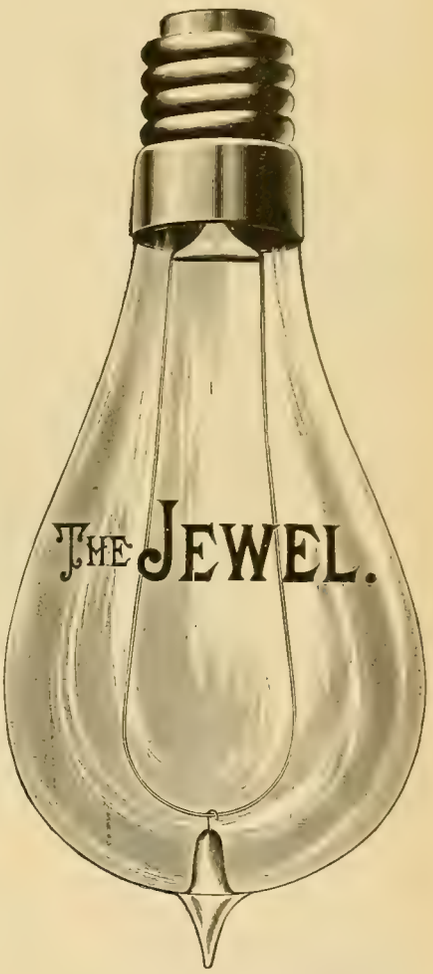

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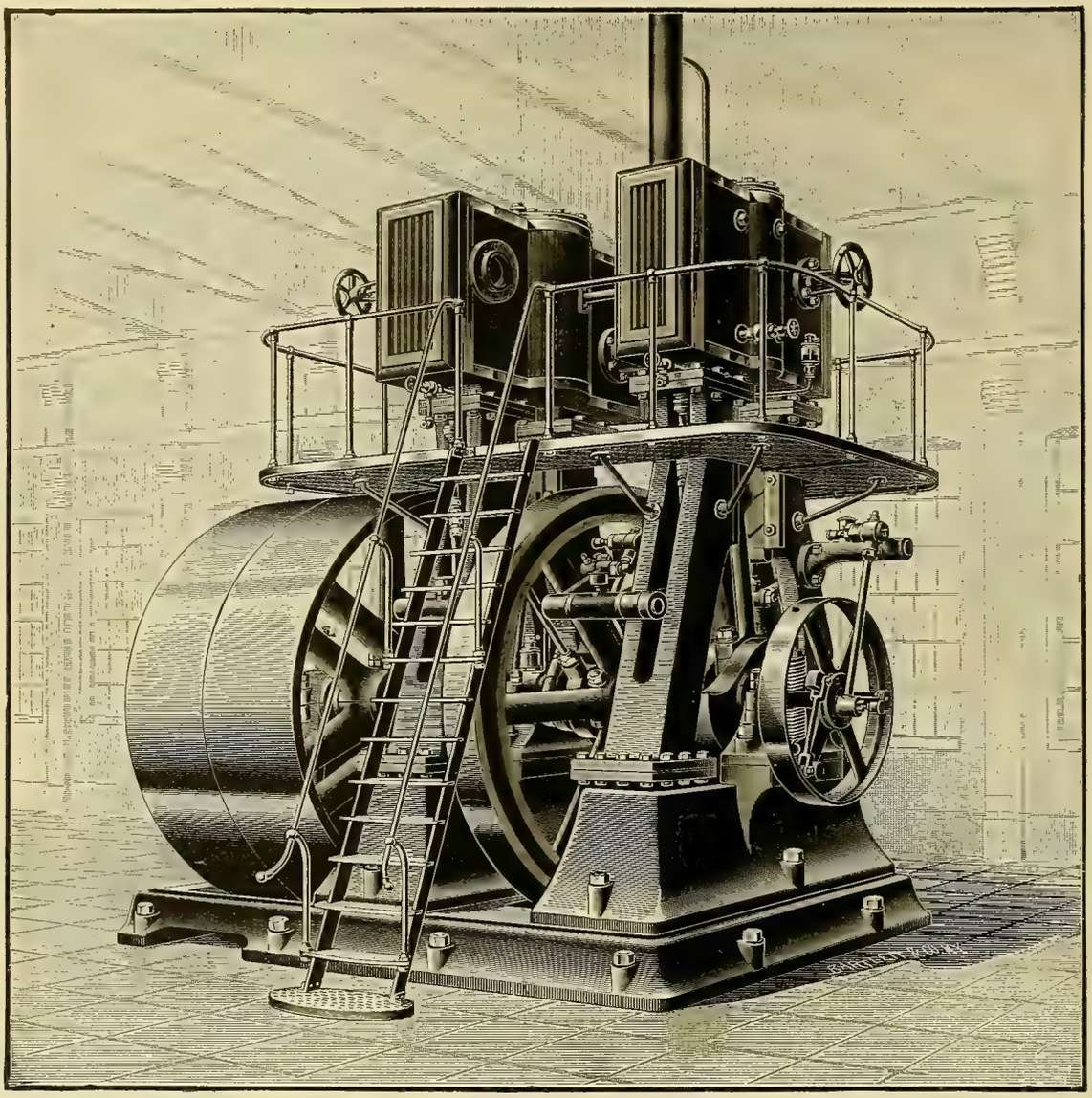

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The Interior Conduit & Insulation Company's tubing, plain and brass, out-classes all others.

SWAN LAMPS.

The Swan Lamp is one of high efficiency, long life and brilliancy.

WASHINGTON CARBONS.

The Washington Carbons are noted for long life, low resistance, high efficiency.

GLADIATOR DRY BATTERY.

A tower of strength in the electrical arena.

OKONITE TRADE MARK.

Central Electric Company,

116 and 118 Franklin Street,

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OKONITE TRADE MARK

AN OLD FRIEND IN A NEW DRESS.

The more you see of the "Ward" lamp the more you become interested. Mechanical and electrical perfection. It is all that. Are you aware that we are combining these features with a line of ornamental lamps that surpass in beauty of finish and design any arc lamp ever offered to the trade, and equal to the handsomest electrical fixtures manufactured?

You need such lamps for interior lighting and decoration. They increase the output of your station, and delight the consumer. How about prosperity? Of course you're through with experiments. Why need you injure your business and add personal worry by the purchase of any other style of lamps, which are so imperfect that they will have to be changed over every month, and brought out as a "New Lamp"?

The "Ward" lamp, in all cases, is specially designed to meet the varying conditions demanded, and had passed the experimental stage when first offered to the public by this Company. The thousands of "Ward" lamps in use prove it to be the only lamp that works satisfactorily on an incandescent circuit.

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ORGANIZED 1881.
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FOR INCANDESCENT AND STREET RAILWAY CIRCUITS.

AN ESTABLISHED FACT: THE ONLY ARC LAMP THAT WORKS SATISFACTORILY ON AN INCANDESCENT CIRCUIT.

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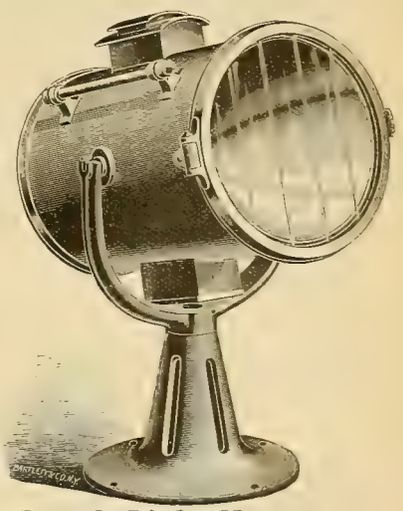

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ELECTRIC RAILWAY SUPPLIES

EXCLUSIVELY.

Everything for complete equipment and maintenance of electric roads of all systems.

PROMPT SHIPMENTS. **LOWEST PRICES.** **WRITE FOR QUOTATIONS.**

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General Manager.

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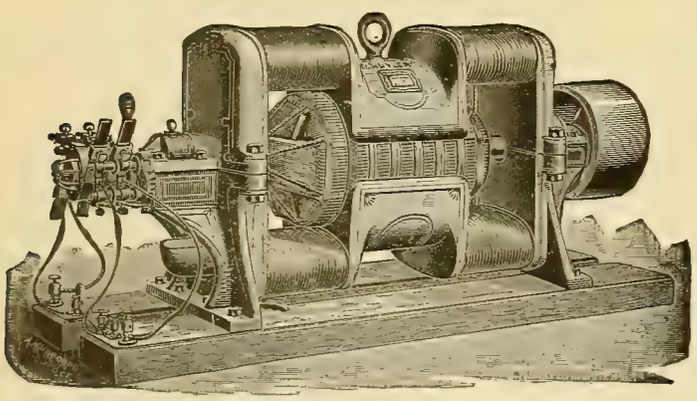
—SYSTEM OF—
ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES



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Ventilated Armature, proof against a burn-out.
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HEAD QUARTERS

FIRE DEPARTMENT.

* CITY TELEGRAPH. *

Chicago, Mar 21st., 1887. 18

C. B. Hotchkiss. Esq.

Gen'l Agent Days Kerite.

New York.

Dear Sir:-

I send herewith a piece of Kerite Wire cut out of service on account of construction of manhole. The wire, two pieces of about 3000 feet each, was placed in one inch common gas pipe and buried beneath the pavement about thirty inches, on Cass Street from Chicago Avenue to Erie street, thence to Pine street. This work was done in the summer of 1877 and the wire has been in continuous, and is now in service, without interruption of any kind. I see no perceptible change in the material and congratulate you upon the record.

Yours respectfully,

J. P. Barrett Sup't.

P. S. This piece was removed March 14th, 1887.

April 18, 1892.—This wire is still in service after 15 years' use.

DAYS KERITE

No other rubber covered wire in this country can show such a record as this, as none of them were in existence when this wire was laid.

DAYS KERITE

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Gen'l Agent,
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F. W. CUSHING,
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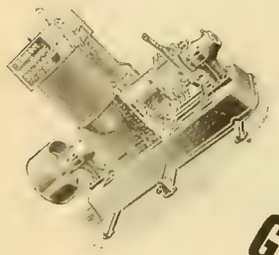

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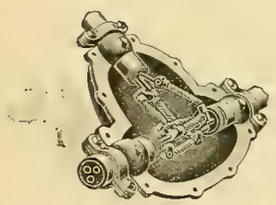

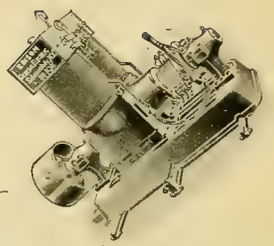

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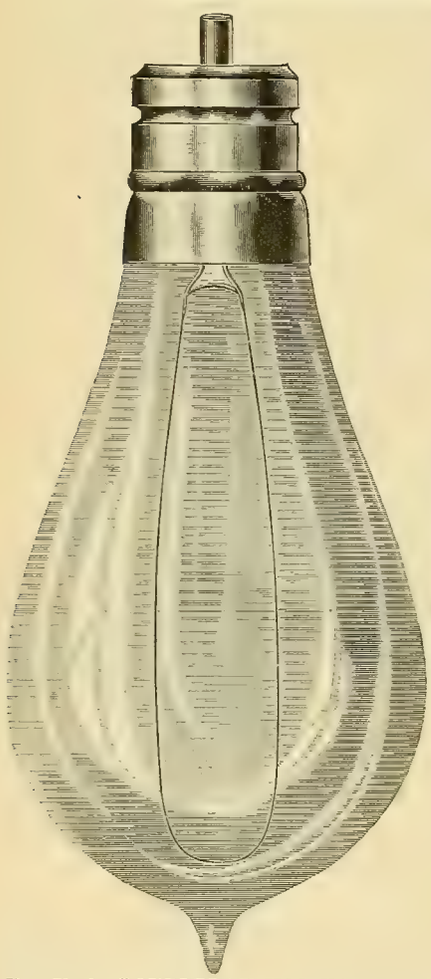

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LONG LIFE, HIGH EFFICIENCY.

FULL RATED CANDLE POWER.

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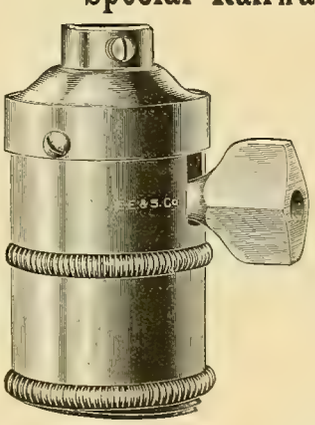
All Candle Powers. Bases to fit all standard Sockets.

Special Railway Lamps. Satisfaction Guaranteed.



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Of Best Quality, Standard Styles.

PRICE OF SOCKETS:
In small lots.....25 cents each net.
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(You may thank us for it), and indications are it will soon fall apart, each fellow pulling for himself. Then

Your Harvest Will Come,

So don't make Long Time Contracts, ONE YEAR IS LONG ENOUGH. We booked orders last month for

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And this month, (up to the 16th inst.), have sold **1,871,000,** and indications are, demand will run AHEAD OF LAST MONTH.

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OUR CARBONS ARE NOTED FOR THEIR

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POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

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Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

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DYNAMOS,

100 TO 1200 LIGHT.

Installed complete for City or Town Lighting.

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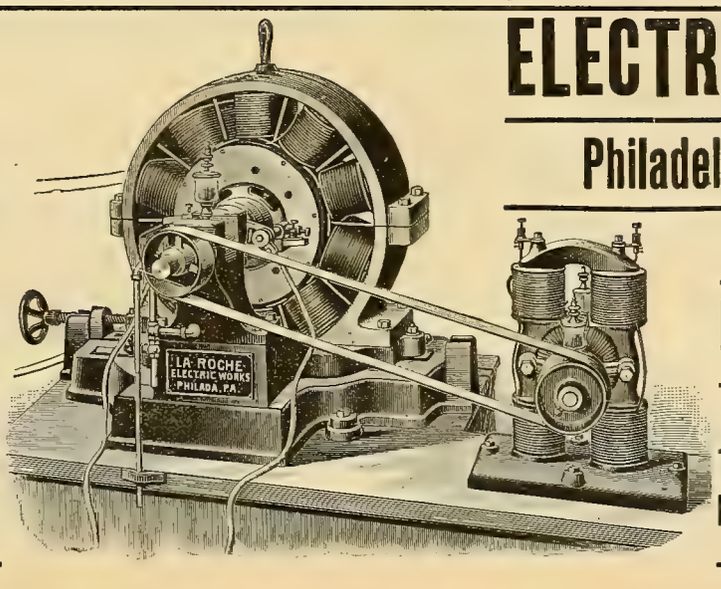

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For Arc or Incandescent.
Currents from 1-8 to 50 H. P.

USE THE RIES REGULATING SOCKET

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Graphite Rods of Various Lengths, from 1 Ohm to 100 Ohms Resistance to the inch. Graphite Boxes and Crucibles, Resisting Heats of 4,000 Degrees. Inquiries Gladly Answered.

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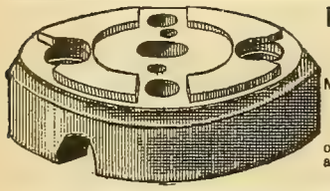

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Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

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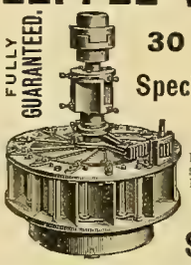

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30 YEARS' CONTINUOUS BUSINESS

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Plants of all kinds driven by them. Easy working gates. We guarantee highest power, with smallest quantity of water, at full and part gates; insuring easy regulation and steady motion. Successfully operating under heads of 2 to 400 feet. Write us for fine pamphlet and state your wants.

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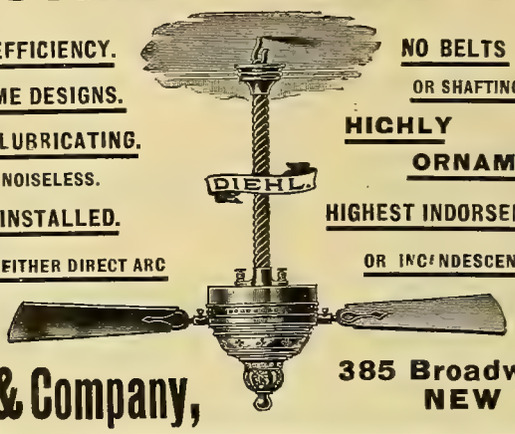

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Incandescent Lamps.

Something New and Practical, and of interest to users.

The special coiled filament, as shown in cut, used in all lamps of high voltage.

Guaranteed not to droop against the bulb.

A trial will fully convince you that the "Buckeye" is efficient, and of long life.

Is acknowledged to be the handsomest lamp in use.

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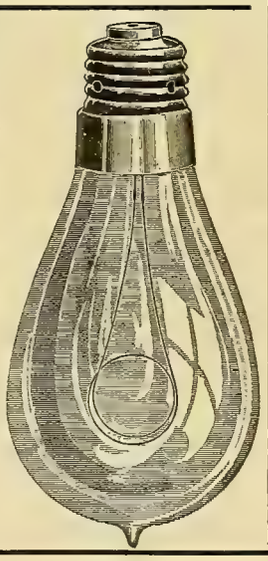

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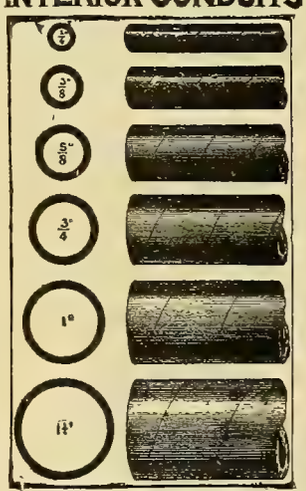

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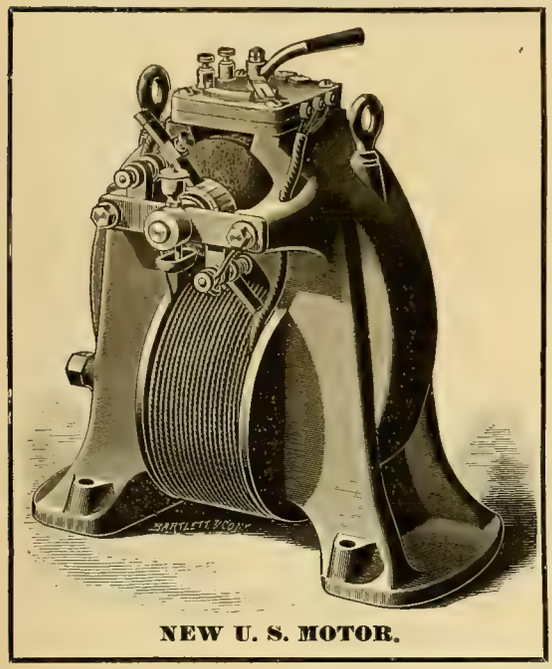
ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



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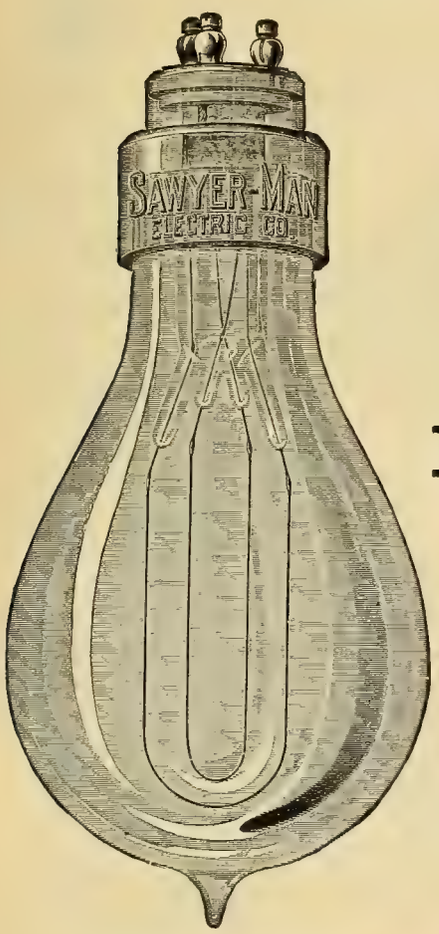

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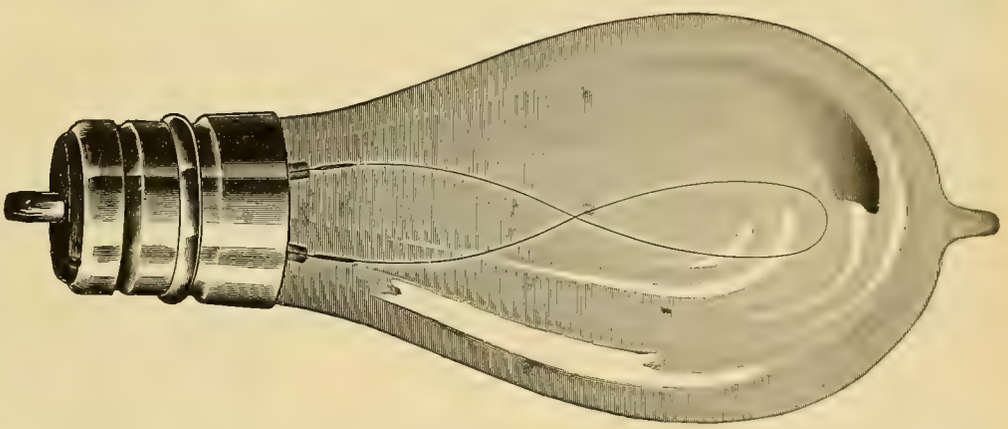
100 c. p. and 150 c. p.



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8 CANDLE POWER TO 50 CANDLE POWER,
FITTING SOCKETS OF PRINCIPAL SYSTEMS.

75 CANDLE POWER TO 150 CANDLE POWER,
FITTING LARGE SPECIAL KEYLESS SOCKETS.

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SUPERIOR REGULATION AND ECONOMY FOR ELECTRIC LIGHTING AND GENERAL PURPOSES

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WE TEST EACH ONE OF OUR ENGINES BEFORE SHIPPING

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SOLID BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

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MICA.

For all Electric Insulating Purposes East India Mica is the best on the market.

I SELL NO OTHER.

Send for Samples and Quotations.

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CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

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Agents Wanted for Exclusive Territory.

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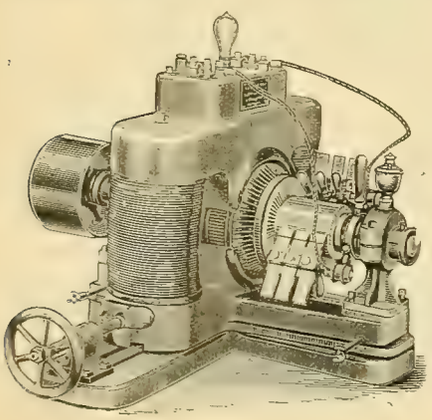

MANUFACTURERS OF

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"DUPLEX" ARC LAMP.

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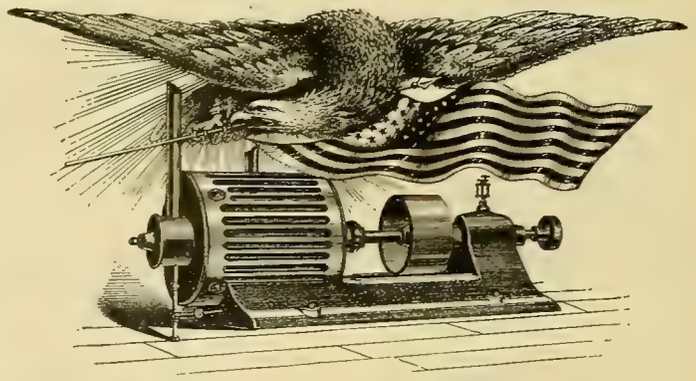

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This Engine revolutionizes the manner of applying steam in generating power. It can be regulated so as to run at any speed desired, up to

1000 OR MORE REVOLUTIONS PER MINUTE!

It is not a rotary Engine, yet the motion of its parts is such that there are no "dead centers." It takes steam and exhausts four times at each revolution. For

SPEED, SIMPLICITY AND ECONOMY,

this Engine has no equal. It possesses many striking advantages over all other Engines, either slow speed or so-called high speed. Its speed is closely regulated by a sensitive and reliable automatic governor. Built of any required size,

FOR ALL STATIONARY AND MARINE PURPOSES.

It can be **coupled directly** to dynamos, fans, blowers, fire engine and other rotary pumps; in fact, to **any** machine requiring great velocity. It is smooth running and **noiseless.** Being light and compactly built, it takes up less room than any other Engine of equal power. No heavy foundations are required. This Engine is

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No skilled engineer is required.

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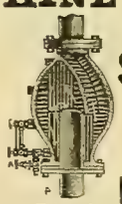

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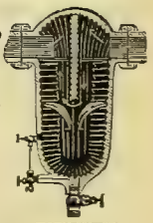

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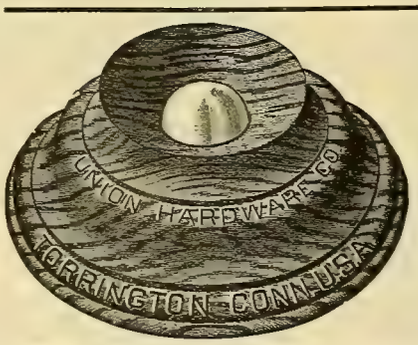

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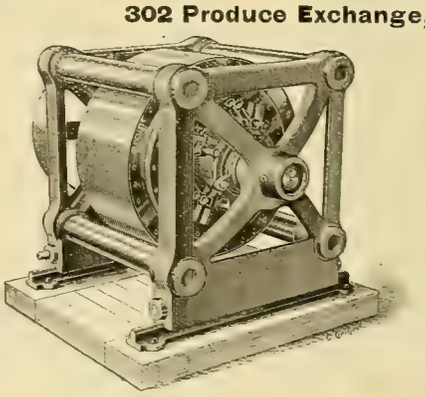

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Western Electrician.

EVERY SATURDAY.

Vol. X. CHICAGO, APRIL 30, 1892. No. 18

Haverford Storage Battery Sub-station Electric Lighting System.

The Haverford Electric Light company was the first corporation organized in this country for central station lighting with storage batteries. Its works are situated at Haverford College, a station on the Pennsylvania railroad nine miles from Philadelphia. Its main circuits run one mile east through Ardmore, and two and one-half to three miles west, passing through Bryn Mawr and Rosemont, suburban stations on the Pennsylvania railroad, in a section containing many large country residences.

Operations were commenced in May, 1887, but until one year ago no serious effort was made to extend the business and occupy the field. This delay was chiefly due to two reasons: First, because the system was a new one and investors were cautious, and second because of the failure of the underground cables used as charging mains.

About fifteen miles of underground cable were laid when the company first commenced business, only a very small portion of which is now in use. The experiment proved costly and demonstrated that underground construction is not suitable for an electric lighting system in a country district. The reason for this is that the cost of construction and maintenance is entirely too great for the business done, and the underground system is not elastic enough to admit of additions and extensions except at a cost which is prohibitive.

During the last year overhead lines have been built to take the place of the underground cables and supply the new customers who have been secured on the most advantageous routes. This change resulted in great economy, both in the maintenance and running of the plant. The customers of the company are for the most part large consumers of light, and the houses supplied have installed in all about 3,690 sixteen candle power lamps. The batteries in some cases supply but one house, but as a rule each battery supplies from three to ten families. The cells are usually located in the basements of the houses and are connected to the charging main in some cases by a non-break hand switch, and in others by an automatic time switch. The batteries are disconnected from the charging circuit by the hand switch or by automatic devices operating either at a definite time or when the battery is sufficiently charged, depending upon the character of the consumption. The cells are charged in series. The generating plant is run ten hours a day, and the batteries are put on and off the different circuits at such times as will give the dynamos an approximately full load at all times. Where a large number of lamps are regularly in service, taking current from the same battery, the cells are connected with the circuit during the whole ten hours of charging. Charging is continued, too, during the hours of heavy lighting. The battery is thus receiving current during the hours of light or no load, and is discharging during the hours of heavy load.

As a battery increases in voltage as it becomes fully charged, an automatic regulator is employed in cases where a battery is to be used at the same time that it is receiving charge, otherwise if but few lights were burning the voltage would be too high for the lamps. The regulating device throws a resistance into the lamp circuit sufficient to overcome the surplus voltage, while the battery is receiving charge. If, however, there are a sufficient number of lamps in service to use the current received from the dynamo, and at the same time make a demand upon the battery, the switch is automatically thrown so as to take out the resistance in the lamp circuit. In cases where the battery is charged in the daytime no voltage regulator is required.

By this system it is possible to supply as much current to a building as the dynamo and battery combined are capable of delivering; in other words, with a thirty ampere charging current and a discharge of thirty amperes from the battery, as many as one hundred and twenty 16 candle power lamps can be burned from one battery. Where a greater supply is required a second battery is installed. With the new types of battery it is entirely practicable to take as high as one hundred amperes from a single series of cells without damage to the plates; such a rate of discharge, however, would soon exhaust the battery.

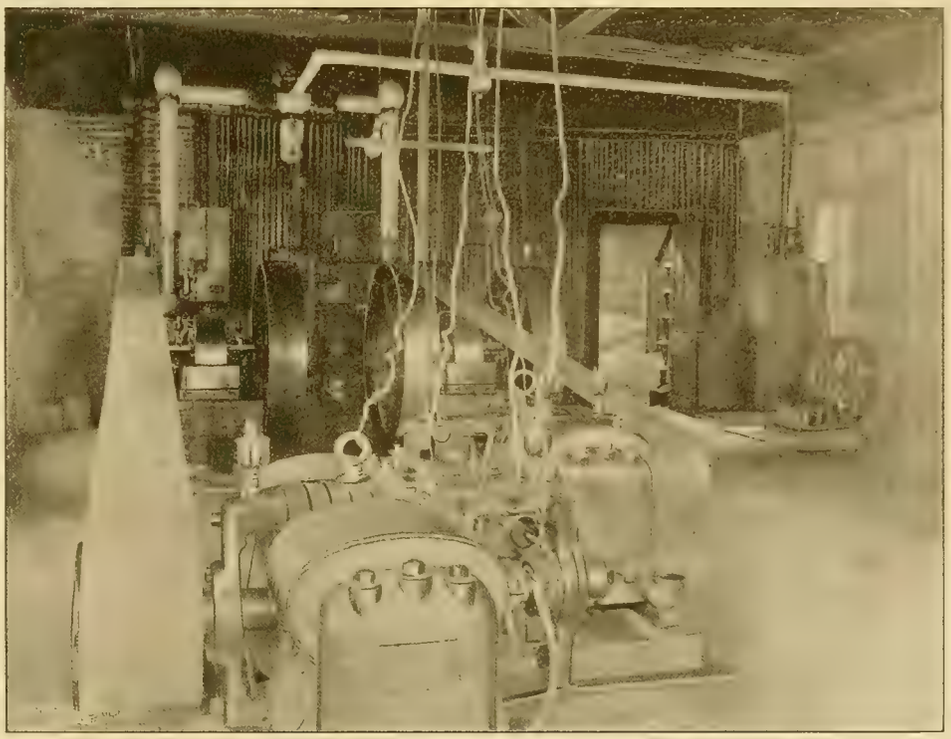


FIG. 1. HAVERFORD STORAGE BATTERY SUB-STATION ELECTRIC LIGHTING SYSTEM.

Where several small residences requiring only from six to ten lamps at one time are situated near each other, one battery is sufficient to supply from six to ten houses. It has been found that it is entirely feasible to light from one battery, houses within a radius of from six to eight hundred feet. In such a case as this, though, a regulator is required to keep the voltage constant.

The Haverford company lights the three railroad stations situated within its district, the lamps burning all night. Two of the company's customers have from three hundred to four hundred lamps each.

The dotted lines in the map, of the main circuits of the Haverford system, Fig. 4, give an excellent idea of the territory covered. The battery sub-stations are located at many points on these lines, and one battery, Fig. 3, at the extreme end of the line, above Rosemont, supplies about 400 lights. This last mentioned battery is the most distant one, and is supplied as regularly and as satisfactorily as any other on the line. Branch lamp lines, etc., are not shown on the map, for, as there are about 3,000 lights installed on this main circuit and additions are being made constantly in various houses, it would not be possible, without going over a large field, to indicate the exact number at any point. Three thousand is, however, the very least number.

The charge for the light is based upon the current consumed as indicated by the Edison electrolytic meter. The company first started out by charging a fixed sum per annum for each consumer, based upon the probable consumption. This method proved unsatisfactory in many ways. The customers, as a rule, used the light lavishly, and with little regard to the interest of the company. This arrangement, therefore, was more disastrous to the company than if it had been running a direct system, because, as the batteries were attached to the lamp circuit for the whole twenty-four hours, they would become exhausted by lamps which were left burning during the whole time, with the result that many battery plates were thus destroyed. The introduction of the new system secured an economical use of the light, and the charge per lamp hour, being less than the cost of an equivalent amount of gas, made the system acceptable to the patrons of the company. Gas costs in the same territory $2 per thousand feet, and this rate, it is believed, is as low as it can be furnished in a country district. The price fixed for the electric light is at a rate per ampere of current consumed, which varies according to the voltage of the battery from which it is supplied, but which corresponds to a rate of $1.75 per thousand feet for gas.

The experience of customers with both gas and electric light has always been found to be favorable to the latter At the present time the electric light company is securing many new customers and is putting a large amount of machinery, new batteries, etc., into service.

The Haverford company uses the system of the Accumulator company, which controls the patents for devices used in the Haverford system.

One of the advantages which have been developed by the experience of the Haverford company is that well pumps, fan and small motors of all kinds can be satisfactorily run from the battery at any time during the twenty-four hours. At these country residences water is now pumped by motors taking current from these batteries. This pumping was formerly done by wind-mills, and there is a noticeable disappearance of the latter from that section covered by the storage battery system.

The station equipment, Figs. 1 and 2, for lighting the Haverford district, Fig. 4, consists of about one hundred and fifty horse power in boilers, two fifty horse power engines, one eight horse power engine for exciting the fields of the dynamos, and one steam pump for the artesian well, in addition to two boiler pumps. The artesian well pump took the place of an electric motor which was destroyed in a fire three years ago when the station was struck by lightning. The pump was put in on one day's notice and has since remained in service, although a motor would perform the same service as cheaply and probably with even greater economy.

The engines are run without a governor. The valves are set to admit a sufficient amount of steam to produce a current of thirty amperes in each dynamo at any voltage. The speed of the dynamo, and consequently of the engine, is regulated by the voltage in the main circuit. The dynamo, therefore, governs the speed of the engine, which receives a greater amount of steam from the boiler in proportion to the number of revolutions. The engines are permitted to run up to three hundred revolutions per min-

ute, which is a full load for the engine. As batteries are thrown on or off the circuit, the speed of the engine increases or decreases respectively. The automatic device shown on the wall in Fig. 5 is operated by a magnet in the main circuit, which closes the steam valve whenever, by accident, a break may occur in the main circuit. The action of this device is instantly to shut off steam from the engine. This system has been operated very successfully and with very much less wear and tear of dynamos than when the shunt system was employed and governing was accomplished by the engine; it requires, less care too, on the part of the dynamo tender.

The company uses buckwheat anthracite coal, with natural draught, under one 80 horse boiler of the return tubular pattern and two Harrison safety boilers. Water is taken from a well one hundred and seventy-five feet deep, and passes through a National heater and a Hoppes purifier before being put into the boilers.

For long distance incandescent lighting the Haverford system seems to be eminently suited. The ability to supply a large amount of current at a low voltage at a long distance from the station is one of the best features of the system. One of the largest consumers is located at a distance of nearly three miles from the station, and at times there have been burning at this residence as many as three hundred lights at full candle power. Fig. 3 shows this careful yet energetic management. H. H. Yarnall, present superintendent of the Haverford company, was engaged in conjunction with Mr. Scott in developing the plant, and is therefore entitled to a share in the credit for having demonstrated to what an extent the storage battery sub-station system could be made successful.

New Developments and Renewed Hopes for the Storage Battery Street Car Propulsion.

By J. K. Pumpelly.

It is with some hesitancy, but with more certainty than heretofore, that I now, in the face of many disasters, take up the cudgel for the storage battery as a source of power for street cars. Fully one year ago, when I addressed the Chicago Electric club on this subject, I was forced to concede and recount many failures. But through many years of study of the nature and behavior of accumulators, and an expenditure of much money in building and experimenting with them, I even then had hopes, and so expressed myself at that time. In order to give you some reasons why there is now a better prospect for this very convenient methed of street car propulsion, I must first mention the causes of failure of the several experiments thus far tried.

tion and the pasted oxides a different way. The result after a short time, therefore, is disintegration and destruction; hence loss of money and disgust. Chemists have tried to remedy this great fault, have gone over Plante experiments, and have lately discovered what they believe to be good reasons for following his line of work. Plante, after experimenting with many metals, fixed upon lead as being the most practical and commercial material from which to make accumulators. The great objection to his method was that in order to make a heavy deposit of oxide of lead upon the lead conductor, and make it by electrolysis out of the supporting conductor itself, much time, and constant care, and watching were needed. It was for this reason that Faure quickened the process by using oxide of lead applied as a paste to the support. But this construction lessens the durability of the battery, and chemists have again turned their attention to Plante's first process, that is, the electro-chemical process of forming the oxide, or active material on the supporting frame.

Within the last few weeks my attention has been called to the excellent results which have been attained by two young men in Des Moines, Iowa; one a practical worker in the battery business, and the other, his companion and partner, a prominent chemist holding a state office as chemist and as president of State Laboratory of Pharmacy of Iowa. After much work and money spent on improving

FIG. 4. HAVERFORD STORAGE BATTERRY SUB-STATION ELECTRIC LIGHTING SYSTEM.

sub-station. Another valuable feature claimed for the system is that the economy in the use of current from a storage battery is greatest when the least current is taken from the battery; that is, with a discharge of from one to five amperes there is a loss in electrical energy, as compared with the current required to charge the battery, of not more than two or three per cent., while with the maximum discharge the loss is estimated at about thirty per cent.

The safety of electric lighting by this system has been demonstrated by an operation of nearly five years. In that time, it is stated, no complaints have been received either of fires or shocks.

The maintenance of the batteries is the question of greatest importance in connection with the economy of the system. The experience of the company and the many automatic safeguards now used in connection with the system, as well as the rapid improvements in the construction of the battery plates, have made the cost of maintenance very much less than when the company first commenced business. Nevertheless it is believed that a still greater economy can be secured now that the company is doing its business on a larger scale and getting a greater amount of service from the batteries installed.

The Haverford system was introduced under the supervision of Superintendent E. A. Scott of the Electro-Dynamic company of Philadelphia, and its present satisfactory operation is due in a large measure to that gentleman's

What has actually been shown is that sufficient energy to do the work can be stored up in a certain number of batteries, and that number of cells can be conveniently carried on the car, and quite easily handled by machinery now made for the purpose. It is known, too, that the storage battery car is capable of carrying a full load of people for a certain number of hours, and at a certain speed, the energy being exhausted in proportion to the work done.

The practical objections are now as well known. They are a want of durability to continue this output of energy for any great length of time, counted in months and years, and the cost of the manufactured batteries, and, of course, the expense of renewals or repairs. The electro-chemist has constantly striven to overcome at least this one great objection, lack of durability of the battery. Experimenters have been contending with the difficulty of using a paste of oxides, embedded in the interstices of a metal frame or plate that is able to resist the action of strong acids as well as the more powerful action of electrolysis. The support for the paste has to be a good conductor of electricity, and at the same time hold firmly to itself, or within itself, an oxide of the same metal which is not a conductor, and which, consequently, is acted upon by electrolysis in a different way from its support. As a natural consequence of this, when in action, the lead-supporting conductor is forced in one direc-

the paste or Faure battery, these young men turned all their attention to developing and improving the Plante or lead battery. In their cell the lead plates are made very rapidly by folding long strips or ribbons of lead about ½ inch wide and about ⅛ inch thick. These plates are immersed in a certain salt solution for the electrolyte, and after being connected to the poles of a dynamo, as other battery plates are in the process of forming, the current is turned on. This current, it is said, can be of greater quantity in amperes than for any paste battery plate. In ten hours these plates have become one smooth mass of spongy lead, black like slate, yet at the same time very absorbent of hydrogen. Nothing remains after the ten hours charging but to separate these plates, connecting a number sufficient for a battery of the size needed, one lot to the positive pole and the other to the negative, and then changing the current for ten hours more. This done, the plates are formed ready to be dried and put away for future use or shipment.

I have seen this battery tested in many ways, under the heaviest work, and the plates, instead of appearing to disintegrate, seem to grow smoother and firmer. This process, I consider therefore, is an important improvement on the Plante process. To form a regular Plante plate in ten hours instead of in three months is, I think, breaking the record. The battery holds its electromotive force of over two volts to the cell under very heavy discharge, until 90 per cent. of the charge is drawn out; that is,

there is not the usual drop in voltage. I have recently seen a storage battery carriage, which was built to hold from six to ten people, lately brought to this city. The inventor of the battery guarantees to seat six heavy men, and with his twenty-four batteries under the seats, take them at the rate of 13 miles an hour from the Richelieu or the Auditorium hotel to the World's Fair grounds and back to the hotel, on one charge of the batteries, which charge can be made in three hours. Seeing, though of course, in this case will be believing so far as the batteries go. On this one trip it

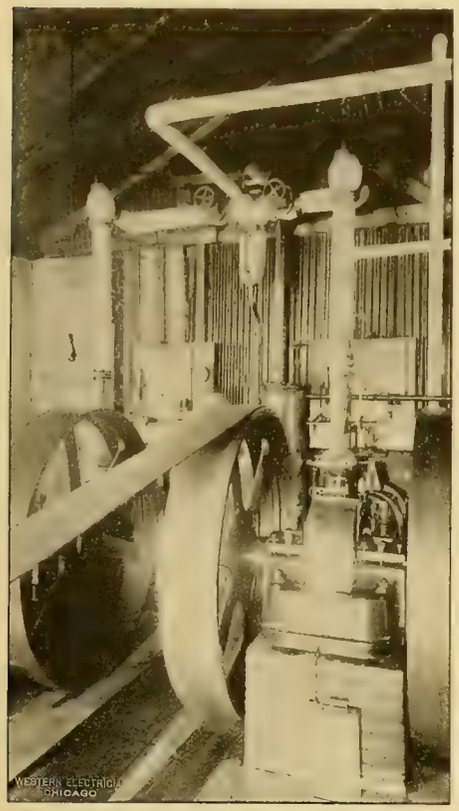


FIG. 5. HAVERFORD STORAGE BATTERY SUB-STATION ELECTRIC LIGHT SYSTEM.

must be conceded that the work over uneven ground would involve overcoming a heavier strain on 24 batteries than would be the case in pulling a loaded car on a smooth track with 95 batteries. The batteries that I examined which were taken from the carriage on its arrival in Chicago two weeks ago to be charged, had been used eight or nine months. But they showed not the least sign of crumbling or disintegration; a discharge by short circuit of 500 amperes seeming to produce no harmful effect at all.

Electricity at the World's Fair.

None of the contracts for lighting the World's Fair has been executed as yet. The agreement in the case of the arc lighting was reached several weeks ago, but the papers are yet to be signed. Some time ago Lieut. Spencer took the contract made out to cover the Thomson-Houston company's share of the work, but the papers have not been returned from Boston thus far, but the delay causes no apprehension, as there is no misunderstanding as to terms. In the case of the incandescent lighting, however, a strenuous effort is being made to have the matter reopened. On Friday of last week Mr. Westinghouse, with Capt Black, a Chicago lawyer, as his attorney, appeared before Vice-president Higinbotham and Vice-chairman Ketcham of the committee on grounds and buildings, and endeavored to induce these gentlemen to reconsider the action by which the contract was awarded to the Edison company at $5.95 per light. Mr. Westinghouse asserts that his company was not fairly used and that something of a preference was shown for the Edison company. In the argument of Friday morning Capt. Black insisted also, on behalf of his principal, that there was a good profit on the contract at the price named, and that the work could be done for less. The Edison people, on the other hand, assert that there is no money in the job at the rate agreed upon. The World's Fair officials have listened to all the complaints, but the general impression seems to be that no change will be made. Among the protests is one from the Electrical Construction company of Chicago, which was one of the original bidders.

During the last two weeks the daily papers of Chicago have published a number of articles relating to the possible resignation of John P. Barrett, chief of the department of electricity at the World's Fair. There appears to be no doubt that Chief Barrett has entertained the possibility of such a course in consequence of a flattering offer that he has received to take charge of the electrical inspection department of the National Association of Fire Underwriters of New York. It is stated that Prof. Barrett was offered $25,000 a year to superintend this department in New York, but that he refused, owing to his desire to remain in Chicago, where he has other interests. In a brief interview in the *Chicago Tribune* of April 21st Chief Barrett describes how the negotiations were continued. "I submitted alternative propositions, however," he said. "I told the representatives of the association that if they would make two departments—one east and the other west—I would take charge of the western department at a salary of $20,000 a year. In case they decided to make four departments, one of which should include a district embracing Chicago, I would assume the management of that one at a salary of $15,000. After submitting these two propositions I left it with the officers to reach a conclusion. As I understand it, they were not qualified to close an arrangement with me. They were obliged to await a meeting of the board of directors of the association, which will be held within the next two weeks. If the directors want my services on either of the two conditions named by me, I will resign as chief of the department of electricity of the World's Fair. It would not be practicable for me to hold both offices." Prof. Barrett is also city electrician of Chicago, as is generally known. The *Chicago News* states that he was offered the position because "the percentage of losses by fire from electrical causes was less in Chicago than in any other city in the country, and this low percentage was attributed to the regulations and restrictions applied to electric plants and made effective by Prof. Barrett." Whatever action Prof. Barrett may take, he will undoubtedly remain in the service of the city for a couple of months longer, and thus complete an even thirty years' term of employment by the city of Chicago. He has drawn but $2,500 a year from the World's Fair—half of the regular salary of a department chief—in consideration of the fact that much of his time was given to his municipal duties. As city electrician his salary is $3,000. In the event that Chief Barrett should resign from the World's Fair, Secretary Hornsby has declared his intention of doing likewise, and a complete reorganization of the department of electricity would follow.

On Thursday of last week an important contract was signed, the two parties to it being the World's Columbian Exposition company and the Chicago Telephone company. By its terms the Chicago Telephone company agrees to establish a telephone exchange and its American District telegraph service, "on the most improved plan," the necessary space in the various buildings for the toll stations. In consideration of these privileges the telephone company agrees to put in, free of charge, as many instruments as are called for by the Exposition company, not exceeding 300. The telephones are for use in connection with the fire and police service, bureau of public comfort and other administrative departments of the exposition, and are to be used solely and wholly within the grounds, except for fire and police, and by no persons other than the officers and employes of the Exposition company. All wires are to be placed under the direction of the chief of construction of the World's Fair in the subways and buildings of the Exposition company. The telephone company is not obliged to build subways, and its employes are to be admitted to the grounds free. The contract is to remain in force from April 21, 1892, until April 30, 1894. The contract provides that the rate for private persons, for metallic circuit, long-distance telephones, connected with the Chicago exchange, shall be $175 per annum or $100 for six months. This provision is also made: "Any ex-

FIG. 2. HAVERFORD STORAGE BATTERY SUB-STATION ELECTRIC LIGHT SYSTEM.

hibitor within a radius of 100 feet of any subscriber's telephone may combine with such subscriber in the use of said telephone upon the execution by the said subscriber of an extra exchange service contract and the payment of an extra service rate of $10 per year." The rate at the pay stations is to be 10 cents for a conversation of five minutes or less to any point in the grounds or upon the lines of the Chicago exchange. The regular rates will be charged on the toll lines to points outside the city. Messenger service will be furnished at 30 cents an hour. Negotiations in relation to the telephone service at the World's Fair have been in progress for several months, and the present understanding was only reached after many conferences, in which the construction department and several committees of the directory were, from time to time, represented on the part of the World's Fair. Superintendent Wilson of the telephone company promises to put up an exchange at the World's Fair as good as, or

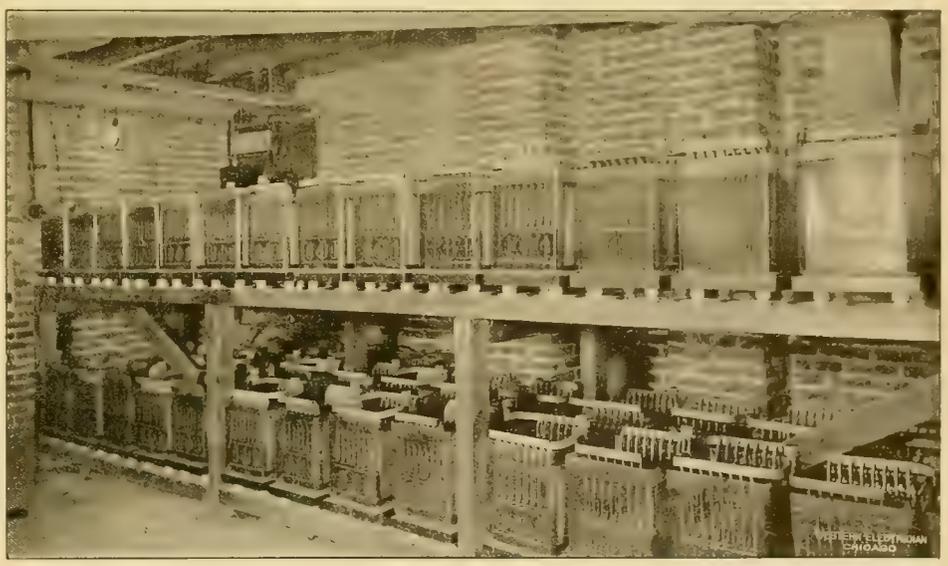


FIG. 3. HAVERFORD STORAGE BATTERY SUB-STATION ELECTRIC LIGHTING SYSTEM.

at Jackson Park, for the World's Fair, to be connected with the exchange system of Chicago, so that "for every seven exchange telephone subscribers in the exposition grounds at least one double copper metallic circuit trunk line shall be furnished." Toll stations, to the approximate number of twenty five, are to be conveniently located about the grounds for the use of the general public. The exposition company is to furnish free space in the service building for the offices and requirements of the service, the amount, exclusive of store room, not to exceed 900 square feet. The Exposition company also agrees to furnish, free of cost, better than, anything in the world. Nothing but long-distance instruments and metallic circuits will be used. It is expected that the long-distance copper line to New York will be ready for use by the time the World's Fair is opened, and connections will be made directly with this line at Jackson Park, independent of the Chicago exchange and the city underground system. Exhibitors will be enabled, it is expected, to talk to Boston, New York or Philadelphia without difficulty. In addition to the three hundred telephones to be furnished the World's Fair people and the pay stations, the telephone company will

lay trunk lines for about three hundred commercial telephones, making an exchange of over 600 instruments. Of course the capacity will be enlarged if necessary. Jackson Park is nearly eight miles from the telephone building, and none but the best cables will be used. The wires will be buried at far south as Forty-second street. It is estimated that the entire cost of the plant will be $140,000. The officers of the telephone company assert that they will congratulate themselves if they come out without loss. This can only be done, they say, by saving the material and using it again.

Three electric traveling cranes will form an important addition to the exhibits in machinery hall, and for this purpose a contract has been recently entered into with the Yale & Towne Manufacturing company of Stamford, Conn., William Sellers & Co., Philadelphia, the Morgan Engineering company of Alliance, Ohio, and the Edge Moor Bridge Works of Wilmington, Del. The first three companies named will each furnish one of the three twenty ton electric traveling cranes, the Edge Moor Bridge Works constructing and furnishing the runways, or series of longitudinal girders and posts supporting the cranes and forming the tracks upon which they will move. The posts and girders supporting the structure will be utilized to carry the lines of shafting by which power will be distributed to operate the moving machinery of the exhibits throughout the building. Each crane will be 75 feet long, and the three runways will be placed side by side throughout the length of the great building. The length of the runway for each crane is approximately 1,400 feet, the combined length of the three being 4 200 feet, or about four-fifths of a mile. Each crane is to have two trolleys, each having a capacity of 20,000 pounds. The contract calls for the completion of the cranes and runways in place on or before Nov. 1, 1892, in order that they shall be available for the installation and erection in place of the machinery composing the heavier exhibits. In like manner the cranes will be utilized after the exposition to assist in taking down and reshipping the same exhibits. During the six months of the exposition the trolleys will be

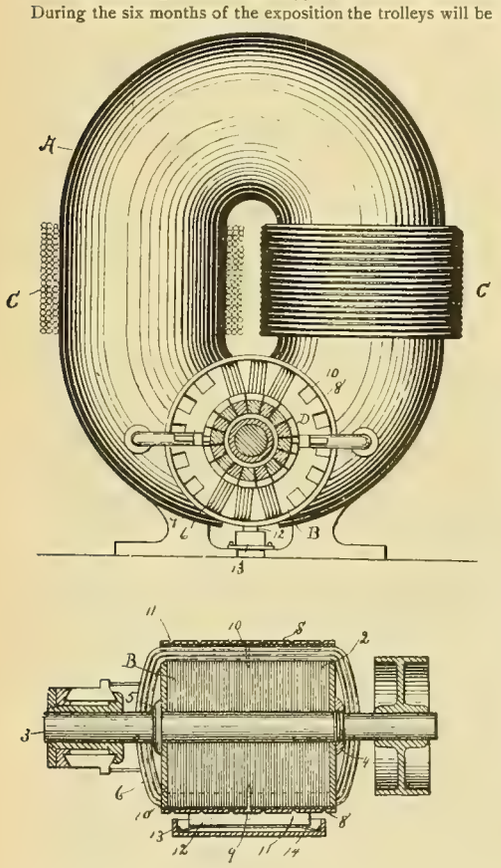


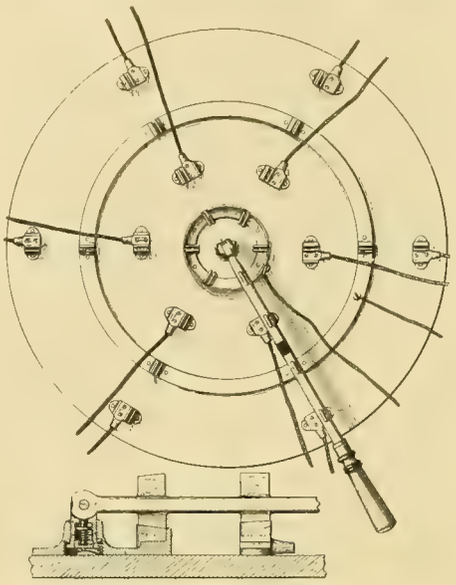
FIG. 1. DEPARTURE IN DYNAMO AND MOTOR CONSTRUCTION.

removed from the cranes and the latter covered with broad platforms, providing accommodation for the carrying of passengers, of whom several hundred can be easily transported at each trip. This service will be under the management and control of the exposition authorities, and will contribute greatly to the interest and comfort of visitors and assist them in seeing the machinery on the floor spanned by the cranes. Each crane will be capable of traveling at a speed of 500 feet per minute, although probably this will be reduced to not exceeding 300 feet when carrying passengers, in order to afford better opportunity to see objects of interest in passing.

The recently issued prospectus of the department of electricity has been very generally noticed by the foreign technical press, which, as a rule, compliments the department for the work thus far accomplished.

Soden's Switch.

The switch shown in the cut was designed by F. H. Soden, Chicago. The features of the device will be readily appreciated after an inspection of the illustration.



SODEN'S SWITCH.

The base is provided with contacts arranged in concentric annular sets as indicated. These annular series of contacts are distributed on concentric circles about a central point. At the center the switch arm is pivotally held by a universally jointed swivel set in the base. The switch arm comprises a couple of conducting sections or portions, insulated from one another, and each provided with a couple of contacts. The contacts arranged upon the base in annular sets are disposed on lines radiating from the center.

The construction of the swivel-joint at the center is shown clearly in the enlarged sectional view.

In order to provide for the handling of a greater number of dynamos the system of contacts on the base could obviously be multiplied or extended and the contact portions of the switch arm might be increased, and the same pivoted switch lever still be employed.

Departure in Dynamo and Motor Construction.

It is the general, in fact, almost invariable, practice of dynamo and motor builders in designing machines to leave quite an appreciable air space between the armature body and the field poles. In other words, the armature is mounted on a shaft so that it may turn in proximity to, but out of contact with, the field poles.

Prof. Sidney H. Short of Cleveland, however, has concluded that he can dispense with the air space, and the accompanying cuts illustrate a machine in which he proposes to run the armature directly in contact with the field poles.

In the new machine, by dispensing with the air space and allowing the armature to run in contact with the fields, the magnetic resistance of the interpolar space is diminished, and through the increase of the relative number of the lines of force passing through the armature the field, magnets can be reduced in size and be excited with a less number of ampere turns, although exercising an equal effect in the machine.

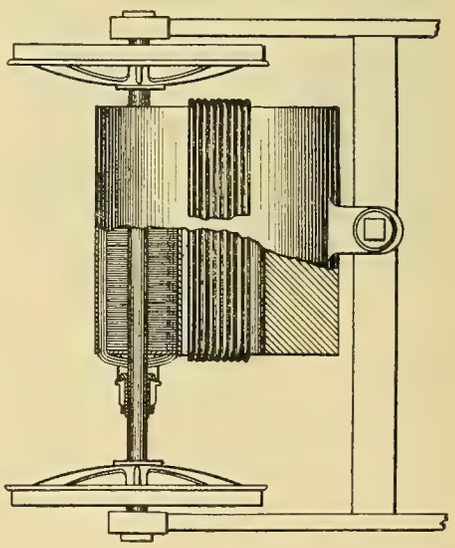
Referring to the diagrams presented herewith, Fig. 1, shows the details of construction of Prof. Short's machine.

The machine shown has the poles of the field magnet *A* presented to the periphery of a drum armature *B*, but the modification is applicable to other styles of machine, as for instance those with ring armatures and field magnets presented to the periphery, and to those with ring armatures and field magnets presented to the sides of the armatures. The field magnets are excited by the coils *C*. The armature *B* has a laminated toothed core composed of a number of soft iron plates 2, strung on a shaft 3 and pressed together by the nut 4, tapped on said shaft and forcing the plates against the head 5. The bobbins 6 are wound in the spaces between the teeth 7 on the plates 2. Outside the bobbins is the iron ring 8, which is fastened to the core by a central row of bare rivets 9 and is in close proximity to the ends of the teeth 7, but is separated electrically from it by the insulation 10. The core may be made solid and the ring 8 might rest directly on the ends of the teeth, or the teeth might project beyond the bobbins. The omission of insulation would, however, in the machine, as shown, establish circuits for eddy currents, and the interruption of the magnetic surface of the armature (as by having the teeth turn in contact with the field magnets) would tend to make the machine run less smoothly than with the continuous outside ring.

The armature *B* is journaled in a bearing constituted by field magnets *A*, the bearing being between the outer surface of the ring 8 and the adjacent surface of the field poles. The outer surface of the ring 8 is shown as provided with groves 11 for carrying lubricating material, which is supplied to the bearing by a felt 12, whose lower end dips into the lubricant cup 13 of non-magnetic material, and which is pressed against the ring 8 by a spring 14. The magnetic attraction holds the armature from end-wise motion.

The machine, it is claimed, can be run in any position, means being provided to prevent endwise motion of the armature when the magnetic attraction is insufficient to hold it in place in the field, or, when for any reason, such means are considered desirable. By using field magnets of the form shown or a similar form placed upright, so that the lifting of the armature tends to shorten the magnetic circuit, the magnetic attraction will act against gravity and gravity against the attraction, thus minimizing the pressure at the bearing between the armature and field magnets.

The invention has been shown embodied in a two-pole machine; but it is applicable, also, to machines with four or more poles. Instead of having the armature rotate in the field magnets, these could, of course, turn on the armature.



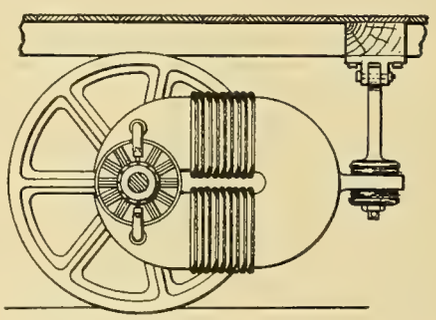


FIG. 2. DEPARTURE IN DYNAMO AND MOTOR CONSTRUCTION.

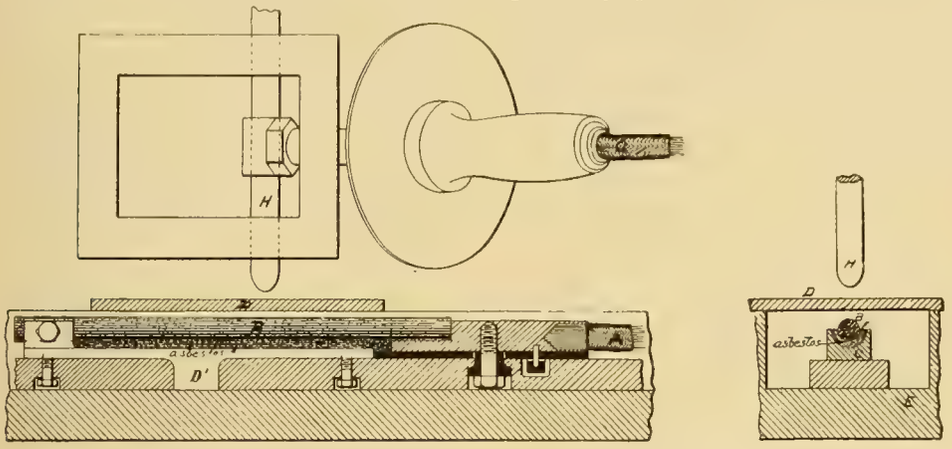
Prof. Short claims the journaling of the armature at the periphery has certain advantages over the ordinary arrangement of a shaft and bearings, irrespective of its utility in enabling the armature to turn in contact with the field poles. One advantage is that it brings the journal bearing in the space about the armature, so that the latter with its journal bearing takes up no more width than the armature itself.

Fig. 2 shows diagrammatically Prof. Short's application of his modified type of motor to a street car. From the data already given the reader will be able to understand the arrangement with but little explanation. In the street car motor the armature is mounted fast on the car axle. It is of the drum type and is composed of a number of

toothed plates of soft iron fastened together and wrapped with the bobbin wire. On the periphery of the armature is an annular iron shell, which is insulated from the toothed armature core which it surrounds. The outer surface of this shell is turned off, so that it may constitute the journal, and the shell turns in the polar extensions of the field magnets in contact with the poles of the magnets. By thus utilizing the outside of the armature for the journal bearing, not only is a long bearing secured, but no space for bearings need be left between the armature and the car wheels.

The Employment of Carbon in the Arc Welding Process.

In the last issue of the WESTERN ELECTRICIAN an extensive application of the arc welding process in the works of Lloyd & Lloyd, English tube manufacturers, was described. As this branch of the art will doubtless be introduced extensively in the United States, a study of one of the devices resorted to as an aid to the production of the best results will be of interest.



FIGS. 1 AND 2. EMPLOYMENT OF CARBON IN THE ARC WELDING PROCESS.

One of the latest improvements that have been devised was brought out by Henry Howard of Halesowen, near Birmingham, England. In welding with the electric arc, the work forming one pole and a pencil the other pole, Mr. Howard interposes in the circuit and in proximity to the work, a block of carbon or other comparatively bad conductor of electricity. This block of carbon, by reason of its greater resistance, becomes heated, and thus, in turn, heats the work by radiation. The positive pole of the source of electricity is connected to the block of carbon which may rest upon or be partially surrounded by asbestos, and the current is led away by a conductor to the work or to the support on which the work rests, while the negative pole is connected to a pencil of carbon on the other side of the work, an electric arc being formed between the pencil and the work. In this way the work is heated on one side by the arc and on the other by radiation from the heated block.

The cuts show the manner in which the carbon is employed: *A* is the conductor from the positive pole of the source of electricity. The end of this conductor is connected to a metal clip resting on an insulating piece. The other end of this clip is furnished with jaws, in which a rod *B* of carbon is held. The other end of the carbon rod is held in a clip as indicated. *D'* Fig. 1, is a conductor connecting the bar *C*, Fig. 2, to the work *D* or to the support *E*, upon which the work rests; *F* is a jacket of asbesto partially surrounding the carbon rod.

The carbon in operating should be placed as near as practicable to the work; but care must be taken that the current is not short-circuited by forming an arc between the rod and the work. The length and sectional area of the rod must also be properly proportioned to the current employed. If too large, the rod will not become properly heated, while if too small it will become overheated and destroyed. A suitable current for a rod fifteen millimeters in diameter and 200 millimeters long would be about three hundred ampères at seventy volts.

The negative pole of the source of electricity is connected by the conductor *G* to the carbon pencil *H*, which is held in a support as shown, by which it may be moved over the work.

A company known as the Canada Power company will undertake to develop the power of Niagara Falls from the Canadian side. The company agrees to begin the work on or before May 1, 1897, and to have proceeded so far with it by November, 1898, that it will have completed water connections for developing 25,000 horse power, and have actually ready for use and transmission 10,000 horse power.

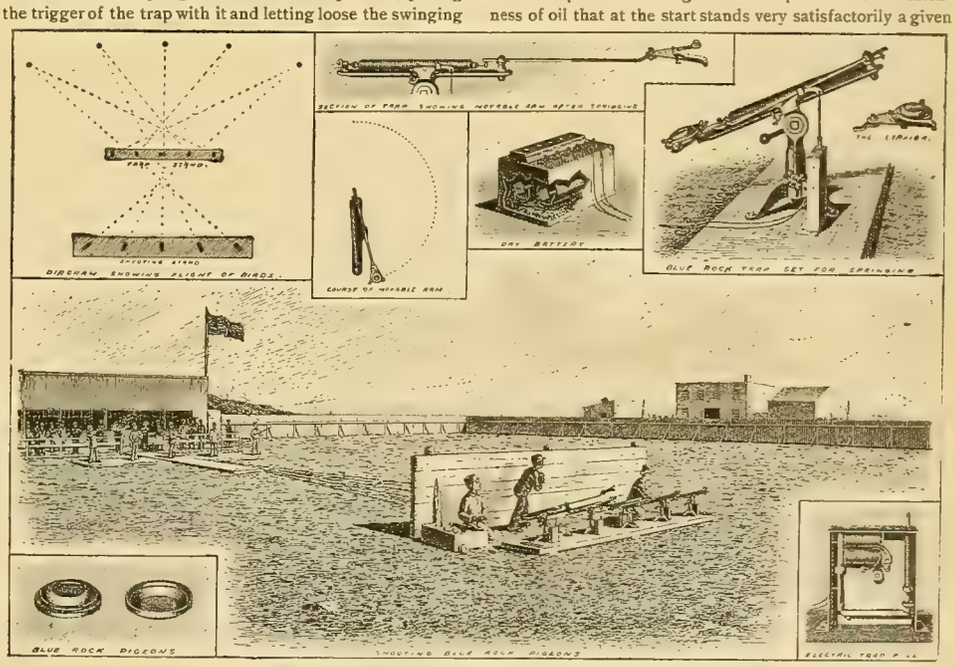
Springing Shooting Traps by Electricity.

Sportsmen will be interested in the mechanism illustrated in the accompanying cut. Trap shooting is becoming a great sport in this country, but the old way of pulling the traps with ropes is gradually being dropped, and improved electric mechanism substituted in its place. With the old way the ropes would very often get entangled, causing a great deal of delay. With the electric pull the trap is sprung instantly as soon as the shooter calls out "Pull!" The traps, according to the *Scientific American*, are made mostly of cast iron, about one foot in height. The elevation arm, containing the trigger, spring, and swinging arm with carrier, is about 2½ feet in length. This arm can be placed at almost any elevation, being connected by means of a movable bolt to the circular head of the upright post of the trap, which rests in a ball socket in the base or stand of the trap, and can be turned also at any angle. The spring is of steel, and is 1⅛ inches in diameter and about 9 inches in length, and has a pressure of about 250 pounds.

The traps are set and the birds placed in the carriers by boys. The trigger is connected to the electric trap pull by means of a leather strap, which is fastened to a bolt passing down through the top of the battery box, the lower end of the bolt resting on one end of a releasing lever. The other end of lever passes just under the edge of the lever at the side, which connects with the battery. When the current is on, the top of the side lever draws toward the battery, releasing the bottom lever, and causing the bolt with the spring attachment to drop down, pulling the trigger of the trap with it and letting loose the swinging arm, which throws the bird into the air. The electric pull is connected to a dry battery on the platform behind the shooters' stand, which is about 20 yards from the traps. The shooters and traps are numbered 1, 2, 3, 4, 5. When No. 1 is ready to shoot, he calls out "Pull!" The party in charge of the dry battery touches electric button No. 1, and No. 1 trap throws its bird in the air. Traps No. 1 and 5 throw their birds at an angle of about 30 degrees, traps No. 2 and 4 about 15 degrees, and trap No. 3 straight ahead. Shooters Nos. 1 and 5 shoot at the birds that fly at the greatest angle. Nos. 2 and 4 shoot at the next angle, and No. 3 straight ahead. The birds will fly about 60 to 70 yards from the traps and to a height of about 150 feet. The shooters fire at the birds as soon as they show themselves above the wooden screen, before they get too far away. This screen is made of heavy planking to protect the boys attending the traps from being shot.

The birds are made of a mixture of clay and coal tar, and are very brittle. The shooting surface when the bird is in the air, is about 1¼ x 1¼ inches. The birds are 4¼ inches in diameter and 1 inch in height and ⅛ of an inch in thickness. They weigh about 4 ounces each. The birds are saucer-shaped and fly with the convex side up. The tops of the birds are painted a bright yellow, giving the shooters a spot to aim at before firing.

The carrier is V-shaped, having on one side a raised slot, in which the flange on the bottom of the bird rests. On the other side is a movable arm, with a spring attachment. The bird is held firmly in place by the aid of the spring and rubber button on the end of the arm. The sudden stoppage after the trap has been sprung forces the bird out of the carrier. The shooters generally use 12 gauge shells, loaded with No. 7 trap shot. The traps weigh about 5 pounds each.



SPRINGING SHOOTING TRAPS BY ELECTRICITY.

Prof. Elihu Thomson in Chicago.

Prof. Elihu Thomson of Lynn, Mass., made a flying trip to the World's Fair city last week. This was the first time since a visit ten years ago that Prof. Thomson had been in Chicago. As he expressed it to a representative of the WESTERN ELECTRICIAN, he had been working "with the western department at arm's length" and he was naturally desirous of a closer acquaintance, so the present trip, necessitated by private business, gave him the desired opportunity. Prof. Thomson would say but little in regard to his company's plans for the World's Fair, save that apparatus showing his experiments with oil insulation at high potentials and frequencies would be a prominent feature of the exhibit. In reply to inquiries as to what progress he was making with his investigations in this direction, Prof. Thomson said: "I find in tests on oil insulation with alternating currents, the frequency plays a most important part. We experiment with currents ranging in periodicity from 125 to 4,000 to 100,000, and where the current of a low rate of alternation is used the oil breaks down sooner. One inch of oil subjected to currents of very high frequency will stand an enormous pressure, and even alcohol will, when tested with currents of a similar character, stand up under a surprising difference of potential."

"The element of time," continued Prof. Thomson, "has a most important bearing in the experiments. A thickness of oil that at the start stands very satisfactorily a given high pressure will oftentimes break down after the current has been kept on for a time. It seems as though the molecules if given time set themselves in line like iron filings in a magnetic circuit. Of course this is only a theory, but I intend to investigate it by passing a jet or stream of oil from electrode to electrode and in this way make a test in which the molecules would have but little chance to arrange themselves."

Prof. Thomson left Chicago for home on Saturday last

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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WHEN the new quarters of the Chicago Electric club on the corner of Clark and Monroe streets are completely fitted up, the organization will have reason to be proud of its home, and will possess suitable rooms for the reception of its World's Fair visitors. The members of the electrical fraternity in this city and vicinity owe it to themselves to see to it that the club lacks neither moral nor financial support during the important era of its existence upon which it is now entering.

IN spite of the almost ceaseless litigation and scramble for fundamental storage battery patents, enough has been accomplished in the way of thoroughly practical results to enable even the most conservative to see that there is a great field for the storage battery if only the well-known obstacles were removed. One of the most interesting illustrations of storage battery development in the United States is described elsewhere in this issue. To thoroughly appreciate the work of the company owning this plant one must make a personal inspection of the system, but the description and illustrations of the installation presented in this issue will give a most excellent idea of the creditable results attained through an energetic exploiture of the much maligned but nevertheless valuable storage cell.

IN this issue there is presented an illustrated article descriptive of a novel arrangement of the armature in a dynamo and motor, that is proposed by Prof. Sidney H. Short. The construction is a departure in that the armature is designed to run in direct contact with the field poles; in other words, the pole pieces are to be the bearings of the dynamo or motor, and the armature body is to revolve against the pole face with only the lubricant between.

It would be interesting to hear from Prof. Short on the behavior at different speeds of machines of this design, fitted with armatures of large diameter.

SOME man who had the ability and time and an extensive exchange list of daily newspapers could produce a very amusing book by collecting the blunders in descriptions in which electrical terms enter. It is not strange that technical terms of this description are misused by newspaper writers, who are called upon to write intelligently on almost every subject under the sun, and the wonder is that there are not even more errors, considering the unexampled growth of electrical development in the cities of the United States. Nevertheless some of these mistakes are very funny, and one recently made in a leading Chicago daily will be entitled to a place in the collection, if one is ever made. The writer was describing an underground conduit electric railway system, and in doing so made use of this sentence: "The circuit is completely metallic, and thus the current sent out on the positive wire is returned to the dynamo on the negative without the loss of one ohm, it is said." We are not told what the resistance of the insulation was in megamperes.

RUMORS of a possible resignation of the position of the chief of the department of electricity, World's Fair, have been the cause of many pleasant allusions to John P. Barrett in the daily newspapers of Chicago recently. The *Evening Post*, for instance, says:

Professor Barrett is in the best sense a typical Chicago man. He partakes to the full in the liberal spirit that has made the city what it is. His best efforts have been devoted to the promotion of enterprises to make life worth living. He has made the city a partner of the benefits of his inventions. Chicago is proud of John P. Barrett and would not willingly part with him.

The *News* points out the fact that Prof. Barrett is the only department chief named from Chicago, and that "his appointment was made at the almost unanimous request of the great electrical manufacturers." The WESTERN ELECTRICIAN, it is hardly necessary to say, heartily joins its daily contemporaries in the hope that Prof. Barrett will finally decide to remain with the exposition. The chief is popular with the electrical fraternity, and his retirement would excite general regret.

THE Chicago Telephone company is entitled to commendation for the spirit it has shown in treating with the World's Columbian Exposition in relation to the telephone service at the World's Fair. Mr. Wilson, the superintendent, has promised to install the very best plant that he can devise; and it is altogether likely that long-distance telephoning to New York will form a feature of the exposition, as it is expected that the copper line from Chicago to the seaboard will be completed by that time. The prospect of being able to talk to a person a thousand miles distant will and should form one of the greatest attractions of the fair. It is a greater triumph of human ingenuity than the erection of the Eiffel tower. The company has been liberal in its offer of 300 free telephones to the exposition authorities, and it is doubtful if the revenue it will obtain from commercial instruments and pay-stations will reimburse it for its outlay. In times past the Chicago Telephone company has been subjected to criticism not wholly undeserved, but the public spirit it has shown in relation to the World's Fair is worthy of nothing but praise.

IN New York city and Buffalo a determined effort is being made to break up the so called "turf exchanges" which abound in these cities. An interesting legal point was raised in regard to the transmission by telegraph of the bets from Buffalo to the track.

In their own behalf the keepers of the Buffalo "turf exchanges" say they simply received bets for transmission to the track and acted only as brokers and agents, the money not being actually placed on the horses in New York state but at the Guttenberg track in New Jersey.

Among the members of the Buffalo police force were several expert telegraphers. They were sent to the pool rooms and stationed so that they could hear the telegraph instruments perfectly. They were there for a week. The district attorney sent a man to the Guttenberg track. He was to watch the second race on Friday with great care. On that race the police telegraph operators were to make small bets and then listen sharply to determine whether or not the bets were transmitted. The *Buffalo Express* says:

Needless to say they were not transmitted. They listened to the instrument all the afternoon and not a bet was sent to the track. These men had watched the tickers all the week and had not heard a bet transmitted, and after they had bought their tickets they went before the grand jury and swore to what had happened. The man who was at Guttenberg swore that the horses actually ran the race and that he saw them, and the indictments were the result.

Since that time the "brokers" have been telegraphing all bets to the track at the expense of the person making the wager.

THE Fraukfort-Lauffen project continues to furnish interesting data for experimental work. The German government has recently made known the results of several tests conducted by the postal telegraph authorities with a view of ascertaining the effects of circuits carrying polyphase currents upon telegraph and telephone lines. According to this report on the first four single wire telephone circuits selected, which varied in length from one mile to three and one-half miles, and which were at an average distance of ten meters from the disturbing circuit, a constant humming was heard, which in wet weather made it impossible to carry on conversation. Another test was made on two private telephone lines. One of these started at a considerable distance from the polyphase current wires, and crossed them at a given spot while the other ran alongside the Lauffen Frankfort circuit at a distance of from five to fifteen meters for over half a mile. Both lines were useless. On the Heilbronn-Mosbach circuit, eighteen miles long, telegraphic communication was exceedingly difficult and on several other telegraph circuits whenever 25,000 volts were applied to the Lauffen-Frankfort line, the armatures of the electro-magnets kept up a continual vibration. Experiments were also carried out on the Stuttgart-Heilbronn double wire telephone circuits 17½ miles long. With 10,000 to 15,000 volts on the Lauffen line a noise was heard which increased with the voltage until with 25,000 volts all conversation was rendered inaudible. These experiments established the facts that the influence of polyphase currents increasing with the voltage, was felt on lines traversed by telegraphic and telephonic currents and placed at an average distance of ten metres from the disturbing circuit, for stretches ranging from one-half to eighteen miles, and that lines that merely crossed the Lauffen-Frankfort wires were disturbed, as well as complete metallic circuits.

A NEW storage battery has made its appearance in the West and its features are explained in another column by a gentleman prominent in this line of electrical work. This gentleman makes extraordinary claims for the new cell which will doubtless be subjected to severe tests. No doubt the new battery will attract much attention, at least until its practicability or failure is established. In view of the complicated condition of the affairs of companies now controlling what are believed to be fundamental storage battery patents, it might be considered almost a judgment should the control of the business escape the companies which have so long been fighting over it, and have done so much to retard its development.

There is no question but that it is this interminable litigation which has held down the storage battery system and prevented its introduction to the extent that would have enabled its advocates to demonstrate its efficiency and reliability. As an illustration of the present state of affairs it may be stated that a prominent institution now in course of construction in an eastern city contemplated the use of storage batteries for lighting. An effort was made to secure estimates of the cost of construction, together with data relating to the maintenance and life of the plant and also the cost of replacing the cells, but the most diligent inquiries for information only produced circulars setting forth the claims of the several companies, abstracts from the decisions and opinions of judges favorable to the patents exploited by the company in question—in a word, no practical information was furnished, but instead, a flood of "opinions" and "decisions" in which no one but the contestants were interested.

It can readily be seen that the appearance of a new battery in the field, and one too that in no way infringes the patents of the present companies, as is claimed by those who have examined it, would be a great relief to these who are tired of hearing the old story rehearsed, and are looking for intelligent work and practical results in this line.

Inspecting a Telephone Exchange.

The New York Electrical society has been engaged in practical missionary work in connection with the present agitation in the metropolis over the question of telephone service. It is generally believed that the opposition to the telephone companies is due largely to a misconception on the part of the general public and that the daily papers are in a great measure responsible for this condition of affairs. It was thought that an actual inspection of a representative telephone exchange would do more in the way of removing popular errors than any amount of argument or mere statement of facts. Accordingly the society arranged with the Metropolitan Telegraph Telephone company, for a meeting at the Cortlandt street exchange to which the members might invite their friends. The opportunity was accepted by many persons interested in the agitation which has been stirring New York for several months, and on the evening of April 21st a large party gathered at the headquarters in Cortlandt street.

The visitors were received by J. J. Carty, electrician of the Metropolitan company. Mr. Carty first described the outfit employed at the subscriber's station. He alluded to the fact that the public had been told that a telephone cost $1.45 to make and that the rest of the apparatus was proportionally cheap. The subscriber would thus be led to figure out how many times he paid over and over again for the instrument during the year. The public gave no thought of the army of engineers and electricians employed in the building and repairing of lines, the laying down and testing of cables, and the equipment of exchanges, to say nothing of the staff of inspectors and the wire men who set up instruments and trace out the maze of wires running through the exchange from the ends of the cables to the switch-board. The subscriber was too busy to gauge exactly the value of such facts as that, in addition to other appliances, the telephone service necessitated the use of 10,000 small dynamos in various parts of the city, that 30,000 cells of battery were employed, that these 30,000 cells have to be renewed every eleven weeks, and that in New York alone, the company had over 30,000 miles of wire underground. It has been the fashion, Mr. Carty said, to imply that other nations were better off in the matter of telephone service than America, while as a matter of fact no other nation is so well supplied. Representatives of corporations from the principal countries in Europe, and even from Japan, had visited New York to study the working of the telephone system. Both in technical equipment and general organization the Metropolitan Telegraph & Telephone company was recognized as a model, not only by other companies in this country but by all the continental governments of Europe. It was very suggestive of the state of the telephone service in England as compared with our own, that in that country the parsons are taking an active part in the agitation for better service on the ground that it will materially reduce the national profanity. There are in New York city alone more underground telephone wires than there are in the whole of Europe. No expense has been spared by the company to bring the service to the highest state of efficiency. Within the last five years every single wire, cable and switch-board in use by the company haa been removed in order to permit the use of metallic circuits. It was found that with wires put underground on the old system there was constant and confusing induction, and it was impossible to utilize the instruments of increased efficiency which progress in telephony had developed without intensifying the trouble. The result of using the new instruments with the old wires would be that everybody could hear what everybody else was saying. To overcome this difficulty metallic circuits were adopted, and as two wires then became necessary instead of one, the heavy cost of wire throughout the system was doubled. All the metallic circuit subscribers, the only ones now taken by the company, are equipped with the highest type of long-distance apparatus, which will enable the subscriber to talk not only to any part of New York city, but to any part of the eastern section of the United States, i.e., to Buffalo, Pittsburg, Washington or Boston, and to the most distant points that are now reached or ever will be reached. With one of these instruments Mr. Carty made connection with Boston, and 40 additional instruments were connected, so that the members of the society could listen in relays of 40 to the conversation. And thus for a while the Gothamites held pleasant communion over the wire with the telephonic representative of the City of Culture; whistling, whispering and vigorous denunciation were all distinctly audible. Connection was also made to Boston over an instrument which was supplied with current from a thermopile. By means of this appliance, the use of which for this purpose is in the initial stage, an efficient current of electricity can be generated by the heat from a gas flame. The visitors were next conducted to the operating room on the eighth floor of the exchange, and Mr. Carty described the operation of the enormous switch-board, which alone entailed a cost of $350,000. In his remarks Mr. Carty showed that, aside from its technical interest, the switch-board furnished an interesting paradox in the laws of trade, in that it illustrates how the telephone business, unlike other branches of industry is vastly more expensive under wholesale than retail conditions. A switch-board sufficient to install 100 subscribers would cost, at the very outside, $500, but where 100 subscribers are added to an existing 5,000 the additional expenditure necessitated would be over $5,000. The cause of this is that in the first instance facilities are required for the inter communication of only 100 stations, but in the second the connection of fifty one hundred stations is necessary. And thus the expense of new installations "rolls up," as Mr. Carty expresses it, "like a snowball running down hill." After following the course of the 12,000 wires throughout the switch-board, the visitors passed into the long distance room and investigated its many remarkable features. A descent was then made to the basement, where bewildering ranges of lightning arresters, cable terminals, and distributing racks gave further evidence of the tremendous upheaval that the change from grounded to metallic circuits involved. By the time the tour of the building was completed the visitors, although astounded at the magnitude and complexity of the plant, were able to form a very intelligent idea of the operation of the exchange. The company provides one operator fo every nine subscribers, so that each subscriber may know that one man in the telephone company does an hour's work for him in some way or other every day. This proportion of operators to subscribers is larger than in any other city in the world. This is due to the fact that New Yorkers are notoriously impatient of delay, and the company seeks to give them the highest class of service. Considerable surprise was expressed when not long ago a quantity of American cutlery was sent to Sheffield, the cutlery fastness of England, but a still more remarkable industrial innovation has lately been recorded in the shipment of American telephone cables to London, the home of the cable manufacture. This is a gratifying recognition of the fact that in telephone cables, as well as in all other telephonic appliances, this country leads the world. An inspection of the costly and perfectly appointed Cortlandt street exchange, in which the utmost resources of engineering and ingenuity are drawn upon to furnish service that is unequaled, should convert the veriest carper to the belief that he is getting excellent value for his money, even though he may not be able to go so far as did an eminent lawyer, who publicly stated, a month ago, in England, that if he paid $60,000 a year for his telephone, it would be cheap at the price.

Love Electric Underground System Sold.

It is reported that the long-pending negotiations between the North Chicago Street Railroad company and the Love Electric Traction company were consummated on Saturday of last week. The former company took possession of the Love company's North Side loop at noon. General Manager Wheeler of the Love company is reported to have said: "This transfer means that if the road stands the racket Superintendent Roche will subject it to, the North Side company will put the Love system in on its lines which are not cabled. We are not afraid of the result. Every conceivable test has been made by us, and we believe there is not a defect left. We can afford to give the North Side company the road we have built for nothing if they will adopt the system, because that will mean their indorsement." It is said that if the system stands the severity of the North Side company's trial it will be adopted first on the line running over Dearborn street bridge.

The St. Louis Electric Larceny Case.

Reference has previously been made in this paper to the case of G. A. Tempel of St. Louis, who, it is charged, attempted to defraud the Missouri Electric Light company by stringing a "jumper" wire across the meter to prevent the current from passing through the registering apparatus. Partly because the nature of the case was entirely novel in law, and partly because it was sought to make it a test case, a charge of petty larceny was preferred against Tempel. His register had shown, according to the business previously done with the electric company, a deficiency of 320 amperes of electricity on the amount of his bill, which at the regular rate, would be $3.20, a sum for the theft of which only petty larceny could be charged. His lawyer, however, interposed the defence that as at common law electricity was unknown, and could not, under the code, be made a subject of larceny, and as no statutory law had been passed making it a felony or misdemeanor to steal electricity, for the reason that its character was not known, and that it was not subject to asportation as personal property, his client could not be convicted of larceny. The case was argued several times. At the last moment the defendant's attorney finding himself beaten on the legal proposition because of the authorities submitted showing that gas, also unknown at common law, was susceptible of being stolen under the general provisions of the statute relative to personal property, raised another point to the effect that the act of Tempel was rather a fraud, or deception, than larceny. There is a section of the Missouri statutes which makes an attempt to perpetrate a fraud of this kind in the larceny or theft line, a felony, and Judge Harvey caught the cunning attorney of the accused in the net he had set for himself by simply accepting his final plea, and had the defendant bound over to the grand jury in the sum of $500.

Chicago Electric Club.

The annual meeting of the Chicago Electric club was held at the old rooms on Adams street, on April 21st. The polls were kept open from 4 to 6 P. M., but as there was no contest the vote was light. The following named gentlemen were selected for the ensuing year:

President, B. E. Sunny; first vice-president, F. B. Badt; second vice-president, Alex. Kempt; third vice-president, M. A. Knapp; fourth vice-president, W. B. Pearson; secretary, W. A. Kreidler; treasurer, F. S. Terry; managers, F. W. Parker, chairman, Geo. C. Bailey, E. Biggott, J. P. Barrett, W. J. Buckley, F. W. Cushing, F. E. Degenhardt, E. R. Gilman, J. J. Nate, C. H. Wilmerding; membership committee, C. C. Haskins, chairman, T. G. Grier, Geo. Cutter.

The old quarters on Adams street, which have been occupied during the last two years, will be deserted on May 1st, when the club will take possession of its new rooms on the northeast corner of Clark and Monroe streets. These rooms are now being fitted up, and they will possess every advantage desirable. Owing to the removal of the club, it was found necessary to close the restaurant service temporarily Saturday night, April 23d. When the new rooms have been fitted up, the service will be resumed.

Chicago Arc Light & Power Company.

About May 1st the Chicago Arc Light & Power company will begin to serve its customers from the old site, at the Washington street bridge. This station, as readers of the WESTERN ELECTRICIAN will remember, was burned on November 30th last, and since then the service has been kept up from about a dozen temporary plants. The building has been entirely rebuilt, in the most substantial manner, and is now pronounced absolutely fire-proof. The floors consist of iron beams, with corrugated iron arches, filled in with concrete, the whole faced with rock asphalt, and designed to carry a weight of 500 pounds to the square inch. The building has been cut down to four stories, and will be entirely devoted to the uses of the Chicago Arc Light & Power company. Several new dynamos have been purchased, and the old ones have been rebuilt. The new plant will have a capacity of 2,400 arc lamps, 400 horse power in motor service, and 3 000 incandescent lights. This will be in addition to a capacity of 500 arcs in outside stations that were in use before the fire, and which will be retained. When in complete running order the new station will be one of the largest and best equipped in the country. Superintendent Wilmerding is proud of it.

Chicago Board of Trade.

The Chicago Board of Trade decided at its meeting on Saturday, April 23d, to send out quotations. The question of disposing of the right to handle the quotations has not yet been decided. One faction is in favor of selling the quotations outright to the Western Union Telegraph company for a term of years. This faction thinks that if quotations are to be given out, the Western Union is as good an agent as any, but it insists that the company shall pay a big price. Another faction thinks that while the telegraph company would make a good distributing agent the board should not bind itself by contract.

The Westminster-Vancouver Tramway company of British Columbia has recently put in new engines of 300 horse power. Another pair of engines, which will furnish 500 horse power, making a total of 800 horse power, has been ordered, and will be in place and running within the next sixty days. With this machinery the company will be able to make all the speed desired. Work on the extension has been commenced. The contract for the poles has been awarded, and an order has been sent to the East for the wire for the overhead system.

The Trolley System for Chicago.

At the last literary meeting of the Chicago Electric club, April 11th, the subject considered was the "Trolley System for Chicago." Frank L. Perry and Alex. Dow read papers in support of the proposition to introduce the overhead system in Chicago's residence districts and E. E. Keller and St. John V. Day opposed the project. The papers read by these gentlemen, which were presented last week, provoked an interesting discussion in which the following named gentlemen participated: A. G. Wheeler, B. J. Arnold, E. A. Sperry, F. E. Degenhardt, J. K. Pumpelly, F. W. Horne, George Cutter, F. S. Terry, Charles G. Armstrong, C. T. Page and W. H. Applegate. Following is a summary of the discussion:

A. G. Wheeler: It is not to be expected that expensive construction of any character can be put in the outlying districts of cities like Chicago. In such districts the overhead line should be built, while in the central part of the city, where a few years ago the general public was strongly in favor of taking down harmless telegraph and telephone wires, the conduit system would be received with favor. We have a conduit system now in operation in Chicago which we built in the winter and through the damp season when the moisture was coming out of the ground. It is a success as far as it has gone.

E. A. Sperry: So far as the adoption of either the trolley system or the conduit system by the city of Chicago is concerned, there are a number of points that are most decidedly in favor of the trolley system. The cost is certainly in favor of the overhead construction. When a wire is placed underground, and especially when it is placed in close proximity to an iron structure, as is necessary in the case of the underground conduit, the points of support of that conductor must be very close together; that is, the conductor must be held in a very rigid way, so that the pressure of the traveling contact will not deflect it sufficiently to bring it in connection with the return wire or with the iron structure. I can say from experience, that the installation of a wire in a conduit working even at a low voltage, is among the big problems for the electrical fraternity to solve to-day. It does not seem to me that for widespread use, and especially at any high voltage, the conduit is by any means an assured success. The single instance that we have on the Continent of Europe, and the one which Mr. Wheeler has referred to to-night, I understand are both operated at low voltage, in fact about the voltage which I have seen in operation in mines. In the case of the mines we have to support the wires at very frequent intervals, and the only way we found to overcome the effects of the moisture was by using oil insulators, which were at best rather cumbersome and troublesome to keep up in such places. I should judge that so far as the engineering features of the conduit system are concerned they are far from being solved. The conduit has, as we all know, received attention from the very best engineers in this country and has not yet been adopted extensively at all. When the West End people in Boston assailed the question there was a great deal of money, time and engineering skill put into it, but they were compelled to abandon the scheme, and Boston took the lead of a number of large cities in adopting the trolley system in preference to the conduit. Brooklyn and Baltimore have thoroughly examined the subject through the engineers employed in those cities, and they have at last decided in favor of the trolley system as against the employment of the conduit system. The trolley systems in Boston and Cleveland are certainly grand successes in every way. They have solved the question of rapid transit. The cars undoubtedly may be said to operate much in excess of the limitations of the ordinances and so on, but the people like it. The public holds up both hands in favor of the trolley system.

Not long ago there appeared in one of the leading papers of Cleveland an editorial which was the result of a great deal of investigation and a large number of interviews with the most prominent people in that city in reference to an installation that had been in operation there about eighteen months. The editorial was called out by a visit of a number of Toronto people who were investigating the trolley system and its operation. The editorial was most satisfactory, especially to those interested in the success of the trolley system of electrical distribution. It gave the general impression that there was nothing more to be desired in any way; that the traffic had been perfectly satisfactory and successful, and that rather than experiment with anything in the line of conduits or storage batteries the city would have more of the trolley and have its lines extended in every direction.

B. J. Arnold: There is one point in which the electric cars were attacked in which I think the statement was incorrect, and that was the oscillation of the car. The cause that was given I believe for that was that the center of gravity of the car was so high that when it once commenced to oscillate it continued to do so. It is said by people who have ridden upon both cable and electric cars that the electric cars run much the smoother. I think that oscillation is occasioned entirely by imperfections in the track.

Advantages in almost all of our large cities are found with the trolley system. We have about a hundred miles in St. Louis, about two hundred miles in St. Paul and I believe something like 250 miles in Boston, all operating through the crowded portions of the city and giving the best kind of satisfaction. They are handling heavy traffic every day, and I see no reason why it should not be so here in the city of Chicago.

F. E. Degenhardt: Mr. Sperry has referred to the action taken by Boston and other cities. I want to ask Mr. Sperry if it is not true that those negotiations were conducted a year and a half ago or two years ago, and whether it is not equally true that while in the rapid advance of the art something can now be done that two years ago was not feasible.

Mr. Speery: That is barely possible.

Mr. Degenhardt: I think we all recollect that when they commenced to construct telephone lines the telegraph men said it would not be a success. They said the insulation was no account, and yet the telephone has been phenomenally successful. The same thing applies, I think, in this case. We are aware that the construction of underground conduits has become not only feasible, but is quite general and that you can insulate wires and put them under ground. We started underground work in Chicago, and have furnished practical means for accomplishing it. We have pursued it diligently, and to-day this city is the Mecca of people in search of information on the subject of underground work.

F. W. Horne: At the present time we have 400 electric roads in operation in the United States, and not a single failure We have had two underground systems, one in Albany and one in Boston, and they are not in existence to-day; therefore we think that the trolley has got the field.

As for the cable system it had full sway until the time the trolley system appeared. Since then the cables, with their millions of dollars invested, have been abandoned and the trolley system put in their places. The cable road in St. Louis, the first one put in operation, is now equipped electrically, and it is a financial success while it was a failure as a cable.

I believe there are places for each system. The cable system on a straight line where there is continuous heavy travel that will warrant expending 75 to 80 per cent. of the power in propelling a rope, is a good system. But when you try to adapt it to the numerous curves and loops, it is a failure.

In regard to the oscillation of the car I think that is due occasionally to bad joints, and when there is only one motor on a car it bobs up and down, because it is unevenly balanced. Put two motors on a car, and eight wheels instead of four, and you will have a car that will run steadily.

Geo. Cutter: I do not think as electrical engineers we are right at all in stating that the conduit cannot be built. When they really want it we can furnish it. I do not think that the American engineer will hesitate to furnish it when really demanded. I think it is merely the question, is it needed? The trolley is proving such a success in the densely populated American cities that it is convincing the American people that the conduit is not needed. We know very well that we can build it, and it is not a very difficult problem either.

I agree with Mr. Perry most decidedly that we should build the trolley system neatly, æsthetically, for that matter, so as to do away with public prejudice against the trolley wire. I feel that the trolley wire is entitled to the same consideration as hundreds of those wires that you may see, now, telephone wires, electric light wires, telegraph wires, etc., though it is not necessary to have those wires above the ground.

F. S. Terry: The trolley system is not very objectionable, so far as appearance is concerned. I think we cannot, in a well constructed overhead system, find anything objectionable. The trolley system runs each car independently, and the car can catch up when it gets behind; it has every advantage that the cable system has and some advantages that the cable does not possess.

Chas. G Armstrong: In the present state of the art there is no conduit system that is in commercial operation, while there are a great many successful trolley roads. The introduction of any underground method, contact on wheels between the rails, or any of those methods in which the trolley is not used, is altogether on paper or simply theory to-day, excepting perhaps a successful experiment which is being tried on the North Side. But that is only an experiment.

In regard to the danger of the trolley, I have heard the argument advanced by Chief Swenie that the firemen could not handle themselves well with the trolley system here. From the character of the systems that he had seen his position was perhaps correct. He had seen the kind where span wires ran clear across, and where the construction was not of the best; but with a system like that they have in Indianapolis particularly, which is a very handsome system, with the trolley wires confined entirely to the center of the street, I can see no reason why a fireman should be injured by the current. Besides, automatic cut-offs are provided, by which, when the trolley wire breaks, the line is disconnected; switches can be placed on every third or fourth pole, as in Milwaukee, so that the current can be cut off from the feeders entirely.

Now there is another point, with reference to the falling of small wires across the trolley wire. It is not necessary to have the telephone or telegraph or any of the smaller wires overhead. It is necessary, in the present state of the art, to have the trolley wire overhead. Put your little wires underground, where they have got to go and where they can go, and put the trolley wire up, where it should kill nothing except birds. I have had occasion myself to wrestle with a 500 volt current, and while it was not exceedingly pleasant I am still here to worry you.

W. H. Applegate: I have been working about three years trying to put this trolley wire under ground, and I think I have accomplished it. The time is not far distant when the overhead trolley will be a thing of the past We have solved the problem of putting electric light and telephone wires under ground, and it will soon be demonstrated to be just as practicable and easy to place the wires for electric cars under ground. In my underground system I have not only excluded the water but the air. I make it air-tight, and I would like to know why it won't work. I think you will all agree with me that the overhead system is but a temporary affair, and will only be used for a short time, until we get something better. I think it is not right for you to oppose the underground systems. You ought to give us a chance. It was the cry a year or two ago that the electric cars made too much noise. They did make a great noise, and you could not have them running through the streets. To-day they are less noisy than the cable cars, and it has been brought about by the constant introduction of improvements, and we have not yet found the ideal cars. It will take time and the sleepless nights of the inventor to accomplish the desired result, but it is going to be done very soon.

C. T. Page: I live in a district where we need some help in this direction, and the city ordinances that have been passed in favor of the South division railway cover the section that I am interested in probably more than any other. I am satisfied that we want the trolley put up here as it is in Indianapolis, and I think it is the idea of the South Side company to utilize the ordinances that have been passed in its favor in some such manner, and it should be supported and encouraged in doing so. The company that I represent has about a hundred miles of wire in use. We have been operating about three years and a half, and we have had two accidents by breakage of our wires. One was occasioned by the long distance telephone company cutting the wires, and they fell. That was caused by pressure under high wind, and our attention was immediately called to it by the police. The other one was caused by an accident from a tree. That is all the trouble that we have had in our primary wires, something over a hundred miles in length, in three years and a half.

F. H. Soden: I wish to say that for the last five or six weeks there has not been a day when the current has not been on the line of the underground system of the Love company on the North Side loop, and during that time there have been snow, ice, a cyclone and a rain that flooded the street so that you could not see the track, rushing in through the conduit, in spite of which the current was on during the whole time. There has been rain, I think, almost continuously for a week. I think that goes to show that at this particular season of the year the underground electric conduit system can be maintained. I know that I am speaking here to gentlemen that may be somewhat prejudiced against a system of that kind on account of past experiences; but I simply wish to let the members of the club know what has been done and what can be done in that line. I do not wish especially to speak for the Love system, although it is the main point of their system that they have been able to maintain this current.

The hue and cry this evening has been about live wires. I say that a wire in the heart of the city of Chicago without any current on is dangerous, and there is no getting around it, from the fact that the firemen must be able to get at the buildings in the heart of the city quickly when there is a fire, and therefore some system of an electric type can be utilized to great advantage, let it be on an elevated road or any other style.

There has been a great amount of money expended on the North Side loop. It is not an experimental track. It is a system that takes the place of horses on a horse car line Some eighteen or twenty cars run on this loop from 5:30 in the morning till 12:30 at night, and this system is put in there to take the place of horses on that line.

Methods of Electrically Controlling Street Car Motors.[1]

By H. F. Parshall.

Part I.

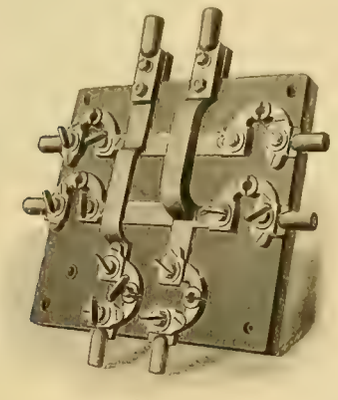
While in many respects the controlling apparatus for street car motors and the general requirements of the same do not differ greatly from some other cases, there are some features that demand the closest attention if the car is to be handled either efficiently or comfortably so far as the passengers are concerned. While the number of methods proposed and tried in times past has been great, at the present time there seems to be sufficient agreement between the principal designers and sufficient data at hand to warrant the writing of a fairly comprehensive paper on the subject.

The problem of controlling the motors is probably the most difficult one in the whole range of street car work, and in no small degree determines the electrical design of the motors, or, to be more specific, to start a car under any given conditions of track a certain torque is required. Beyond a certain limit, fixed largely by the convenience of passengers, this torque cannot be exceeded. The smaller the current with which the motor is able to develop this torque, the smaller the rheostat or other starting devices may be and the more efficient the car equipment. Should the motor, therefore, be incapable of developing a comparatively powerful torque per ampere, the amount of energy dissipated either in the magnetic windings, armature windings or rheostat becomes excessive, the results being the more or less rapid deterioration of these parts.

It may not be out of order just here to discuss the design of the motor with reference to getting this torque most efficiently. The average horse power exerted by a street car motor at the car wheel probably does not exceed 20 per cent. of the maximum it is expected to do in starting the car under the various conditions encountered. Now to get the highest efficiency from a motor run under these conditions, it is necessary to get the highest possible efficiency at that horse power at which the greatest amount of work is to be done, and inasmuch as the loss in the conductors for this average horse power is necessarily low, (otherwise the motors would burn out in doing the maximum work to which they are subjected), the question does not resolve itself into how to get the least possible motor resistance of armature and magnets, but, rather, how to minimize the constant loss of hysteresis, eddy currents and friction. While all of these losses vary somewhat with the speed in series wound motors, the variation of these losses is not great, since for an increased speed there is in general a diminished intensity of magnetization and pressure. To render these losses a minimum, and at the same time to get the requisite torque to handle the car efficiently, there is but one solution, that is, to put the maximum number of turns on the armature compatible with good running as to heating and sparking.

1. Read before the American Institute of Electrical Engineers April 19, 1892

While the truth of these statements may be more or less apparent to all when stated in plain terms, but little attention was paid to this matter in the earlier motors designed. The numerous measurements made, however, have so uniformly been in favor of motors with comparatively a large number of conductors on the armatures that the importance of this matter is now pretty generally understood. This agreement as to the general design of motors has in no small way been influential in bringing electricians into agreement as to how the motor should be controlled, since with an armature of a comparatively large number of turns, less turns are required in the field magnets to produce a given torque with a given number of amperes. The function of the magnets, therefore, has become of less importance. It is always, however, to be borne in mind that, other things being equal, the motor



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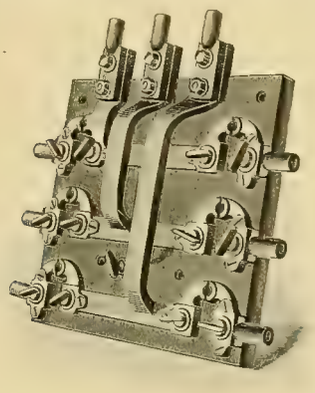
with the greatest number of turns in the magnets will develop the greatest torque for small currents. With a given electromotive force acting on the armature circuit, and a given torque developed by the armature per ampere, it does not matter, so far as efficiency is concerned, whether the difference in electromotive force at the armature terminals and the line is due to drop in external resistance or to drop in the magnets. This point determines, once for all, that motors with commutated fields are not necessarily more efficient than other motors.

The particular advantages of the commutated field method are that with a limited number of pounds of copper, or,in the case of street car motors, with the limited space available for field magnet windings, it is possible to adjust the magnetizing force of the field coils so that the rate of doing the work of the motors may be made to correspond with the rate this work is required by the car for the various speeds and conditions of track. This adjustment may be made for any size of motor with any required degree of precision by varying the number of magnetic coils. To increase the range or precision it is only necessary to increase the number of coils. In practice it has been found that this number could not be very great, otherwise the car wiring becomes too complicated and too expensive. This also holds true of the controlling switch. Three magnet coils or sets of magnet coils seem to be the practical limit, since there is a general agreement between street railway managers that the present number of magnet connections (6) should not be increased, and even with this number there is occasional trouble with broken wires or terminals. With a 15 horse



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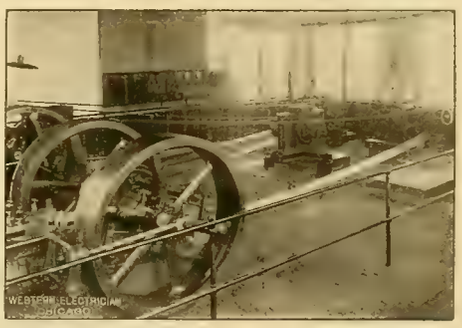
power motor it is possible with three sets of coils to run under most conditions met with in practice without employing external resistance. It is occasionally necessary, however, when the car is to be run at two or three miles an hour, to make use of the resistance coil that is ordinarily used only when starting. With 25 horse power motors it is necessary, with three sets of magnet windings, to make use of this resistance coil very considerably in ordinary practice, since without this it is not possible to get a speed of less than one-third the maximum speed of the car, which is generally taken to be about 18 miles an hour.

The range of speeds without the use of a rheostat is determined by the limit to which it is safe to heat the magnets. The temperature of the magnets should not in any case exceed 65 C. This would put the increase of temperature at about 30 C. This increase corresponds to an average loss in the magnets of about 0.3 of a watt per square inch of radiating surface. For few the seconds generally taken to start the car the loss may be as high as two watts per square inch without dangerous heating. Experience, however, has demonstrated that to exceed this limit, even for very short periods, there is considerable risk Having the maximum number of watts that may be dissipated in the magnets, the series resistance of the same may be calculated from the properties of the motor on the supposition that each ampere taken by the motor produces a certain number of pounds pull at the periphery of the car wheel. In a well designed motor with commutated fields it is easy to get from 35 to 40 pounds' pull at the periphery of a 30 car wheel with the coils in the series position. These coils are either wound side by side or one on top of the other, according to the necessities of the case as determined by the general design of the motor. Experience has shown the advisability of winding these coils in independent spools whenever the general design will permit, since in case of trouble it is cheaper and easier to replace the damaged coil, and there is less liability of crosses between the coils. As an example of a design that has been found to give general satisfaction in practice, I give the following figures from a series of tests made on a Sprague No. 6 street car motor, the magnetic data of which have already been published by myself: [1]

EFFICIENCY OF STREET CAR MOTOR NO. 6.

Brake H.P.	Efficiency.	Speed.	Remarks.	Res.
14.3	87 per cent.	1110	3 coils in parallel	0.8
11.8	87 "	1174	3 " "	.8
11.4	86 "	1184	2 " "	1.4
9	84 "	1309	2 " "	1.4
8.25	82 "	958	2 in parallel, 1 in series	3.24
6.35	70 "	1040	2 " 1 "	3.24
4.9	72 "	1070	2 coils in series	4.80
3.9	70 "	1013	3 " "	7.42

It is to be noted especially that it is possible to get an approximately constant speed with a wide range of loads and yet have the energy dissipated in the magnets remain



DUPLEX LIGHTING PLANT IN THE ERIE CITY IRON WORKS.

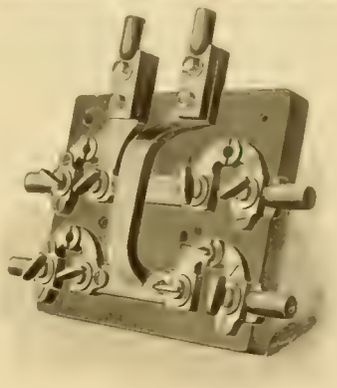
approximately constant, and that it is possible to get a torque corresponding very approximately,over a wide range, to that required to propel a car under conditions met with. This is the solution of the question, how to get the highest efficiency. For instance, suppose a car is to be run between two points in a given space of time. and this is not an unfrequent requirement, and that the magnet windings of the motor are such that either the car runs the distance in too short a time or in too long a time, it will be necessary then to accelerate the car for a time beyond the limit required, then to allow it to slow down, then to accelerate it again, or go through some such cycle of operations to get the required results. More power will be required with such windings than when such a torque can be had at the motor that will produce the required speed by approximately uniform acceleration. To get the same results given above for the No. 6 motor, with the magnet coils arranged in loops instead of separate coils would require upward of three times as many pounds of copper as was used in the present case (110 lbs.) This motor was designed to give a maximum car speed under ordinary conditions of from 12 to 15 miles an hour. At present it is thought advisable to have a maximum car speed of from 18 to 20 miles an hour,[2] since numerous measurements have shown the economy of running street cars at as high a speed as the conditions of track, etc., will permit. In a series of measurements made by myself it was found that the watt hours per car mile decreased very considerably with the speed of the car up to 30 miles an hour. To get this high speed (20 miles per hour) it has been found necessary to vary the proportions of the magnet coils from that given in the above for the No. 6 motor. Thus for a single reduction 15 horse power motor the resistance of the last coil to be turned from series to parallel is only 15 per cent. of the total resistance of the magnets, and the turns of this coil only 20 per cent. of the turns in the other two coils. The reason for putting this low resistance coil inside, is to get the greatest number of turns when the coils are all in series and the least resistance when the coils are all in parallel. Further, under ordinary conditions this coil has the least expenditure of energy in it, and the least radiating surface. With a winding of this proportion. it is necessary with 15 horse power motors to use an external resistance of four ohms. With 25 horse power motors an external resistance of from 10 to 12 ohms is required. The resistance must be so subdivided that there is not more than 20 volts electromotive force between adjacent contact pieces, and so proportioned that the increase of temperature is not in any case above 150 C.

1. Transactions, vol. 7., p. 218.

2. All car speeds are quoted for straight and level tracks. These when calculated for a new motor are determined from the speed and H. P. curve of the motor, assuming the resistance to be 30 lbs. per ton. The methods of measuring these speeds are in general such that the probable error is too great to determine the percentage slip of the wheels.

The Duplex Lighting Plant in the Erie City Iron Works.

From all accounts the Duplex Electric company, limited, of Corry, Pa., has materially added to its reputation by the thorough manner in which it has carried out its con-



EDISON SAFETY CATCH HOLDERS.

tract with the Erie City Iron Works, which claims for itself the distinction of being the largest boiler manufactory in the United States.

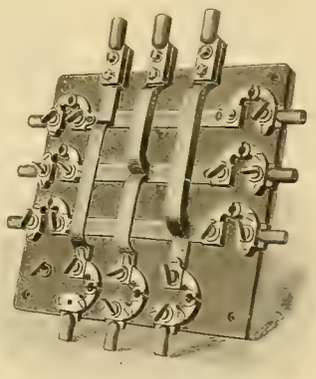
This plant was installed last October and has just been accepted in a complimentary letter to General Manager Swift of the Duplex company.

The equipment consists of two 40-light Duplex arc machines, sixty Duplex arc lamps and one United States 325 light incandescent dynamo. Power is obtained from two Erie City Iron Works automatic engines of a capacity of 75 horse power each. The cut gives an excellent idea of the plant. Two features claimed for the Duplex outfit are the entire absence of resistance coils in connection with the arc generators and the advantageous construction through which any coil of the armature of the arc machine may be removed without interfering with the others.

This plant is said to be the largest isolated arc plant in Northwestern Pennsylvania.

Edison Safety Catch Holders.

It is often necessary, in wiring a large building, to run a main line from the dynamo room or street service wires to some point as a center of distribution from which smaller taps can be taken. Heretofore, a number of porcelain cut-outs or ordinary safety catch holders of large capacity were used. As the capacity of the ordinary device of



EDISON SAFETY CATCH HOLDERS

this type was not sufficient to meet all requirements, the construction of a special device became necessary to carry the heavy current and distribute it through the building. The center of distribution safety catch holders illustrated herewith were devised to facilitate the control of the electric wires in large bulldiags as well as to guard them against accidents.

Each branch of the device has a capacity of 250 amperes, and thus one of the appliances can be used where formerly several were needed. These devices are mounted on slate bases. The lugs are so constructed that they can be easily detached from the appliance, and when the necessary wires are soldered in them, they can be returned to their places and screwed fast.

A small plug is employed which, when inserted in its

place, carries a current around the safety catch. This short circuiting plug is not intended for use for any length of time, and is only employed when changing the fuses in order that danger from arcing may be obviated.

If it is necessary to have light after one fuse has blown the use of the short circuiting plug still leaves a single pole protection on the line, but as one plug only is furnished with each device, it would be impossible to have more than one safety catch short circuited at one time.

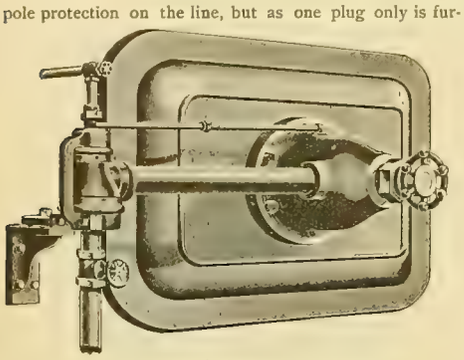


FIG 1. COLLIN'S CRUDE OIL BURNER.

The thumb screws are provided with large flat heads in order that they may be operated by hand, pliers or a monkey wrench. The specially designed washer under the head rises with the screw without turning on it, and the annoying operation of raising the washer with a screw-driver is eliminated.

The center of distribution safety catch holder need not be set up outside of the dynamo room, nor where the meter is attached to the street service, as it is frequently necessary to run two or more separate mains from this point to sub-centers of distribution in other parts of the building where these appliances could be placed.

These holders are made in four sizes—two for the two-wire system and two for the three-wire system,—for two and for three branches.

Two Types of Victor Turbine.

The electrical transmission of power over long distances is a demonstrated commercial success, and this fact gives an immediate value to water powers which have hitherto remained unimproved because of their being located at points more or less remote from transportation lines, or because the local demand for power was not sufficient to justify the expense. Turbine manufacturers generally have awakened to an appreciation of the increasing demand for water wheels. Among those firms that have done good work in developing their machinery to suit the needs of the power station, may be mentioned the Stilwell & Bierce Manufacturing company of Dayton, Ohio. For more than twenty years this company has occupied a prominent position as a manufacturer of turbines, and its Victor turbine is used in all parts of the country.

Hitherto the Stilwell & Bierce company has furnished the Victor turbine with a "register gate" only, and in the great majority of instances that style meets all the requirements, and is preferred on account of its simplicity, ease of operation, quick regulation, etc. However, there are situations where a "cylinder gate" is preferred, and to enable customers to select either style of gate, and with a commendable determination to meet all reasonable demands, the company has perfected and put upon the market the cylinder gate turbine.

This type of Victor turbine has been carefully tested in the Holyoke testing flume with gratifying results, a high efficiency being developed. The tests showed, it is stated, a remarkably high efficiency in all stages of the gate opening from one-half to full gate.

Both styles of this turbine are herewith illustrated, Fig. 1 representing the register gate Victor turbine and Fig. 2 the cylinder gate type.

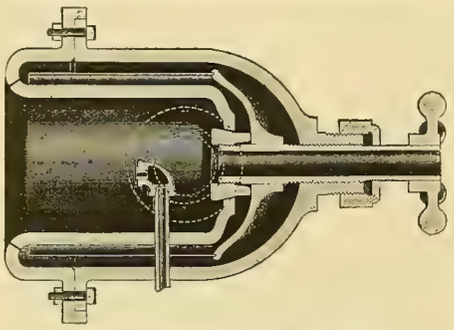


FIG. 2. COLLIN'S CRUDE OIL BURNER.

These turbines are built in sizes ranging from six to sixty inches in diameter, on vertical or horizontal shafts, and are designed for use in a great variety of establishments, from the simple country mill requiring fifty horse power or less, up to the mammoth cotton mills, paper mills or electric plants, consuming many thousand horse power. The Stilwell & Bierce Manufacturing company is provided with a very complete line of patterns of all kinds of modern appliances for transmitting power, and makes a specialty of complete water power plants for all purposes.

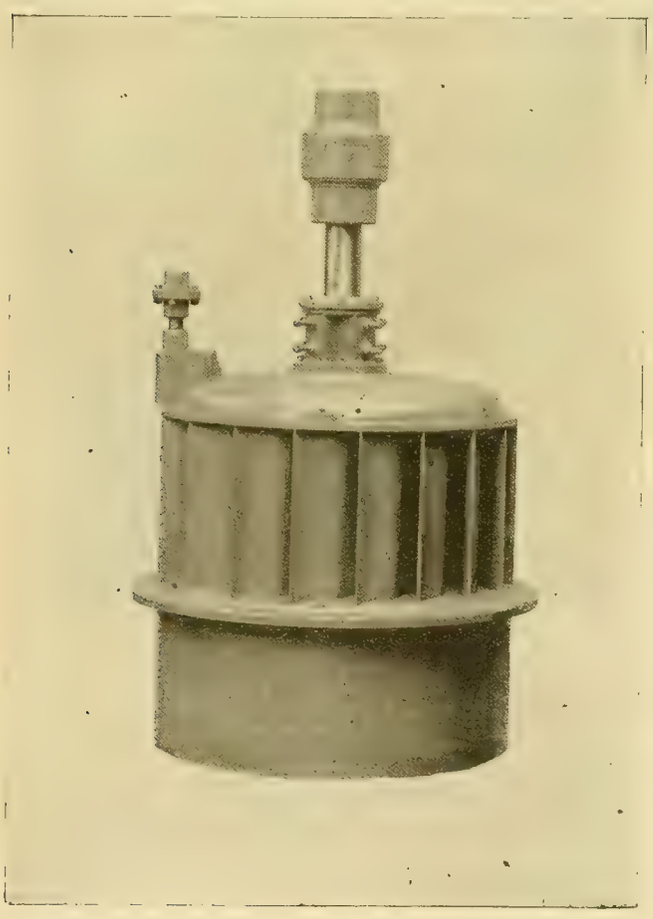
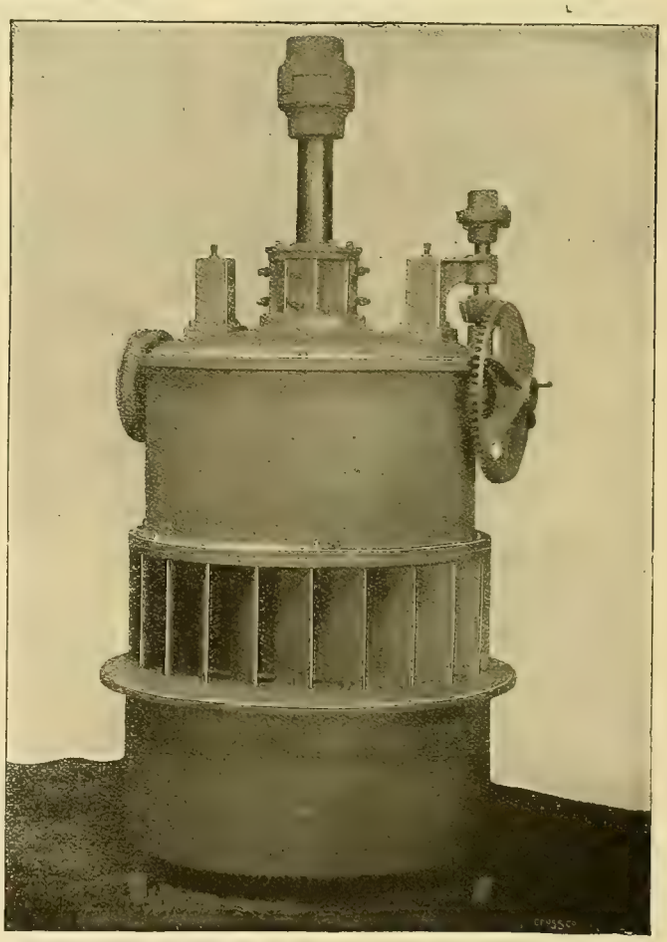


FIG. 1.



TWO TYPES OF VICTOR TURBINE.

FIG. 2.

Collins' Crude Oil Burner.

The accompanying illustrations show how boilers can be fired with crude oil with good results without any change of boiler setting. Burners of this type are in service at the wagon works of Studebaker Bros at South Bend, Ind., and have been used by this firm for three years.

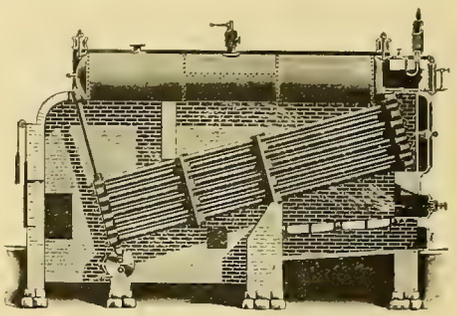


FIG. 3. COLLIN'S CRUDE OIL BURNER.

Fig. 1 shows the burner bolted to the boiler front so that it may swing out of the way and not interfere with the furnace doors. This feature is a great convenience where other fuel is used, as a change from oil to coal or other solid fuel can be made in one minute.

Fig. 2 is a sectional view of the burner. The dotted lines represent the steam inlet. The steam must pass around the shell to the point of the burner and travel down the inside wall before it passes out at the combustion valve. The combustion valve is regulated by the hand wheel on the tube. The small oil pipe passes into the center of the bulb where the steam, oil and inflowing air are mixed in the proper proportions to burn. This arrangement makes a thorough atomizer, and it is not necessary to throw the oil against a pile of fire brick to atomize it, for it is all done in the burner.

Fig. 3 shows the application of this burner to a water tube boiler.

This burner which has, it is said, been indorsed by the Hartford Steam Boiler Inspection and Insurance company, is the invention of Master Mechanic C. M. Collins of the Studebaker Bros. Manufacturing company, South Bend, Ind. Studebaker Bros. are manufacturing the device for the trade.

A California Electric Transmission Scheme.

The Redding, Cal., *Democrat* describes a plan to develope the water power of the Sacramento river at that place. The Redding Water company and Electric Light company — the two concerns are practically under the same management —are behind the project. They propose to take the water out of the river at the lower end of Turtle Bay, and convey it through an open cut or ditch across the old Oliver land to a point on the river near the free bridge. The water right has been located and recorded and the survey for the ditch has been made. The survey revealed the fact that at the point on the river where the company expects to erect the power plant it will get 14 feet fall at low water and 7 feet fall at high water. It claims that it can develop anywhere from 800 to 1,000 horse power with the 7-foot fall. This, too, during the flood or high water stage of the river. Already the company has put up a capital of $20,000 to commence development work, and has also purchased a large amount of 12-inch main pipe which will be laid to connect the reservoir on the hill with the new power plant. The company will run the water works and the electric light plant with this power, and will also furnish electric power to anybody who may want it. In connection with this enterprise ano her company proposes to connect with the ditch and carry it on down to Cottonwood for the purpose of irrigating the bottom lands between Redding and Cottonwood.

Mary Griep and the Telegraph Company.

A Cincinnati dispatch of April 20th gives the following curious story: Mary Griep sat down hard on the Western Union Telegraph company to-day. This morning men employed by the company dug a hole in the sidewalk in front of the house of the young lady's father for a telegraph pole. Mrs. Griep asked the men to stop digging. Mary noticed the indifference with which her mother was treated, and she placed a chair over the hole in the sidewalk and sat down. With great composure she folded her arms and dared any one to touch her. Policeman Potts tried to get the young lady to give up her seat. She politely told the officer that there was no law compelling her to move from a seat on her own sidewalk, and warned him not to interfere. A crowd of many hundreds gathered and dared him to molest the young lady. Chief of Police Deitch and Mayor Mosby were appealed to, but after consultation decided that the girl had a right to sit there as long as she wished. After several hours Miss Griep held a whi-pered consultation with her brother, who owns the property. He disappeared and when he came back in the afternoon Mary was still on the chair, but he brought an order from the court directing the Western Union to put no pole in that hole.

Tropical Telephone Company.

To the Editor of the WESTERN ELECTRICIAN:

We have noticed an item in one of the New York electrical papers stating that the Western Electric company has purchased a controlling interest in the Tropical American Telephone company.

This statement is entirely incorrect, having no foundation whatever in fact. The Western Electric company has not purchased, and never has owned any of the stock of the Tropical American Telephone company.

The Western Electric company has had suits pending against the Tropical American company for infringement of patents, and for the collection of indebtedness. The Tropical American company paid the indebtedness for which suit was brought and discontinued the manufacture of infringing apparatus, and ceased defending the infringement suits. Further than that, the Western Electric company has no interest in the Tropical company.

C. D. CRANDALL.

Chicago, April 22, 1892.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 23.—In last week's letter mention was made of the fact that the bill for the incorporation of the General Electric company had passed the Assembly. Governor Flower has since signed the bill. The New York *Sun* characterizes the governor's approval of the act as "a triumph of good sense and genuine statesmanship over popular prejudice and delusive misconception."

Governor Flower is quoted as saying: "The measure is approved, because it is claimed that its effect will be to keep within the state a corporation which professes to be ready to invest a large amount of capital, and which, without the concessions allowed by its proposed charter, would be incorporated under the laws of New Jersey."

The governor, doubtless, understands very thoroughly that the United States is a large territory and in it there are many states ready and anxious to welcome colossal enterprises such as the General Electric company.

It is understood that, now the new company has laid a substantial foundation, $4,000,000 of 30 year 5 per cent. gold bonds will be issued to retire the floating debts of both the Edison and Thomson-Houston companies. The bonds will be offered to the stockholders of the General Electric company at 95 and will be convertible into General Electric stock at 120.

Before long, perhaps, your Eastern correspondent will be able to "talk" his news to you on Monday morning instead of mailing it on Saturday, for the wires of the long distance telephone company are now rapidly closing in upon Chicago. "We are going to Chicago as rapidly as we can," said Francis L. Hovey of the American Telephone & Telegraph company on Monday. "There will be no trouble in talking over the wires with our present appliances, etc., because we have already established good talking circuits 1,500 miles in length. The Chicago line will be only 1,000 miles long. Telephone experts are now engaged in experimenting with telephone repeaters, which will enable us to relay messages."

From Buffalo, N. Y., and Pittsburg, Pa., the wires have been strung respectively to Sharon, Pa., and to New Castle, Pa., and thence the Pittsburg wires have been strung through Youngstown, and Ravenna to Cuyahoga Falls, O., a short distance below Cleveland. Some difficulty has been experienced in getting into Cleveland, but the telephone officials are confident of soon overcoming this difficulty. The Buffalo lines run from Sharon to New Castle, thus closing a complete metallic circuit between Buffalo and Pittsburgh. At present there are only leased wires between Sharon and Youngstown. From Cleveland to Chicago, poles will be put up and wires strung as rapidly as the route can be laid out by the telephone officials. A line will also be constructed to Detroit. As it stands now, the American Telephone & Telegraph company has three distinct metallic circuits in the West, all ending for the present at Cuyahoga Falls. One goes by way of Albany, Utica, Syracuse, and Buffalo; another by way of Jersey City, Easton, Pa., Wilkesbarre, Pa., and thence up through southern central New York to Syracuse and Buffalo; and the third by way of Philadelphia, Harrisburg, Pa., and Pittsburg, paralleling the Pennsylvania Railroad company's tracks.

The long distance telephone lines now reach south only as far as Washington, and there is no immediate prospect of their being extended in that direction. To the East the long-distance wires go to Boston, and beyond Boston the New England Telephone and Telegraph company has metallic circuits as far as Portland, Me., and Franklin Falls, N. H.

The affairs of the New York Electric club took a happier turn last week. Not long ago it appeared certain that the club would be compelled to give up its present home at 17 East Twenty second street, and get along with two or three rooms in some less expensive quarter. The latest news is, however, that sufficient money has been pledged to wipe out the club's indebtedness, and a number of members have promised to guarantee the rent of the clubhouse for the coming year. It is probable that the club will continue in the house which it now occupies.

John L Osmond, the man who shot and killed his wife and her alleged paramour, John C Burchell, and who was found guilty of murder in the first degree on a trial for the murder of his wife, has been sentenced by Judge Ingraham to be taken to Sing Sing and electrocuted in the week beginning June 6th.

Opponents of the overhead trolley system will probably not be pleased to hear that the New York *Evening Post* recently stated that "the increase of travel on the street railroad between Newark and Orange has been so great since the overhead electric system went into force that the company cannot comfortably accommodate passengers, especially on Saturdays and Sundays. All the available cars have been put on, and several new ones have been ordered."

Of course the system is "objectionable," etc., but the people will have it.

W. F. O.

Cincinnati, O.

CINCINNATI, April 23.—The question of electric lighting for the city streets has been occupying considerable attention. On April 12th the bids for lighting the central portion of the city with about 300 lights of 2,000 candle power, as a starter, with the prospect of extension of the lighting to 2000 lamps, for a period of ten years, were opened by the light committee and found to be as follows:

Jones Bros. Electric company, $112 Cincinnati Electric Light company, $93 75 Cincinnati Edison company, $84.90	Lamps burning all night and every night.

Without any consideration of the bids the committee adjourned to Friday afternoon, at which time it was expected to formulate a recommendation to be presented to the Board of Legislation in the evening. As is usual in such cases the daily press was full of the claims of the contesting companies, but no one was prepared for the bomb that was exploded at the meeting Friday afternoon.

Promptly at four o'clock the committee met and its first act was to read a long letter from the president of the Cincinnati Electric Light company. Briefly, this was to the effect that in consideration of the rejection by the committee of all bids and a readvertisement for a period for thirty days, the Electric Light company would pledge itself, and supplement its pledge by a bond of $[illegible],000 to file a bid to perform the required service at a price not to exceed $[illegible] per lamp per year. As 2000 lamps are eventually to be placed under this contract this is estimated as saving to the city $[illegible],000 during the life of the same. For two hours this proposition was argued by eminent legal council of the respective bidders, in which arguments they dwelt upon the legality of the move, the saving to "the citizens of so much money," etc., etc., all to result in another adjournment to enable the committee to consider the questions involved before submitting its report to council.

Another city contract has been settled during this week at Wilmington, O., where the city is going to erect and operate its own lighting plant. The contract has been awarded to the Fort Wayne Electric company for $11,475 for electrical apparatus. The bid accepted was a considerable reduction from the first that was put in.

In the excitement of the fight over the city lighting the daily press failed to make any special comment upon an occurrence early Thursday morning at the Court street, market place. At the west end of this space the single trolley line of the Main street railway and the double trolley line of the Colerain avenue railway come together and run for several squares on the same overhead construction.

The market place was filled with early morning market stands loaded with fresh fruits, vegetables and flowers. Wagons were standing here and there loading and unloading, thrifty housewives, bent on bargains and the first pick of the season, thronged all sides—when with a horrid, startling "blat," there was a flame of fire as the trolley wheel of a Main street car became involved in the frog where the three lines crossed, resulting in an electrical display rarely seen at so early an hour. Soon the flame burned the frog out and wires dropped into the street with a flash and snap which created additional excitement and uproar.

It was only another illustration of the disadvantages of the double trolley system. It is to be regretted that such accidents, together with the clumsy overhead construction of this system of work, tends to increase the cry of "Bury the wires."

The telephone company is pushing work on the remodeling of the Albany building for the new exchange, and laying its own system of subways. These are of the terra cotta type, laid in cement, and are to be put down in all the principal streets of the city. I. P. McKnistry, general manager of the Cleveland Telephone company, and F. G. Beach of Chicago were in the city this week in consultation with Vice-president Stone of the City & Suburban Telephone company, relating to underground work and long distance telephone service, so there is a prospect of soon being able to talk from lake to lake, and during the summer months get a breath of fresh air by 'phone.

The bill authorizing the Cincinnati Street Railway company to purchase all or a part of the capital stock of the Newport and Covington street railways became a law on Friday. It is now a question whether this comes "too late," as these roads only lately passed into the control of Cleveland capitalists.

Another new suburban residence district tributary to Cincinnati, but this time over among the Kentucky hills, will be opened up by the building of the new electric railway to Erlanger and Woodside. Strong business men are reported as backing this road, which is to cost not less than $150,000. It is to enter the city over the magnificent Huntington bridge, from which it will be an easy matter to run into the heart of the city over existing railway tracks—always provided the new company secures the necessary franchises.

The trouble between the city of Covington, Ky., and the electric railway company, over the quality of the ties to be laid under the tracks along the streets to be paved with asphalt, has waged hot and furious during the past week, but has ended in an agreement to arbitrate the differences. So peace once more has settled over the Kentucky hills, and the work of relaying the tracks and paving with asphalt will be pushed forward without further delay.

The Hamilton and Lindenwood electric road has placed a number of new cars on the Cemetery line, adding greatly to the accommodation of its patrons in this part of the city.

The light committee of Lockland, O., has reported the location of the new electric lights on the streets of the city. When these are placed it will add greatly to the attractions of this prosperous place.

From Columbus it is reported that all of the street railroads in the city excepting the West Broad street line have been purchased by a syndicate of New York and

Philadelphia capitalists. The capital stock is $1,250,000, and the road is electrically equipped. Emerson McMillan of St. Louis is reported to have consummated the deal.

Bills have passed the Assembly authorizing Pomeroy to issue $50,000 bonds for extending a dummy railway; also authorizing the commissioners of Hamilton county to widen to eighty feet all roads in that county having electric, cable or steam railway lines in operation. This will be of great benefit to those who, for pleasure or necessity, have to drive along some of the narrow roads more than half occupied by the railway lines.

Bills have been introduced in the senate authorizing Wapakoneta to issue $20,000 bonds, and Chicago Junction to issue $15,000 bonds to build electric light plants.

All who are interested in electrical mining will be pleased to know that State Mine Inspector Hazeltine has been reappointed for a four year term by the governor.

F. W. Cushing visited this city last week, looking after the interests of Kerite wire. C. S. Knight, general agent of the Fort Wayne Electric company, also spent a few hours in the city.

Mr. Deweilus of the Cincinnati Electric Elevator company is hard at work upon a new device for electric elevators, which, it is claimed, will revolutionize the application of electricity to this class of work. The model is reported as working very satisfactorily, and while the patents on the device are not sufficiently advanced to allow of its exhibition, those who know predict great prospects for the device when put on the market.

Work on the plant of the Grand hotel is being pushed night and day by the Central Thomson-Houston company. The wiring is to be done on the double circuit plan, which will insure one-half of the lights burning in case of safety fuses blowing at any time.

PERSONAL.

W. R. Mason, of the Railway Equipment company, Chicago, was in New York last week.

Augustus Allen Hayes, for some time secretary of the Brush Electric company, died in Paris on April 17th.

D. B. Dean, New York, eastern manager of the McGuire Manufacturing company, is in Chicago.

At the recent election in Little Rock, Ark., gerald E. Fish, formerly of Chicago, was unanimously reelected city electrician.

General Manager F. S. Terry of the Electrical Supply company, Chicago, was a visitor at the New York office of the WESTERN ELECTRICIAN last week.

Treasurer John W. Hull of the Hine Eliminator company of New York has just returned home from a six weeks' business and pleasure trip to Mexico.

Superintendent Alex. Churchward of the Riker Electric Motor company of Brooklyn severed his connection last week with the Riker company to accept a position with the Eastern Electric company of Brooklyn.

C. M. Howell, president of the Illinois Electric Lamp company, spent several days at the company's office in this city during the past week. Mr. Howell is prosecuting attorney for Gogebic county, Mich., and his investment in electricity is a divertisement.

J. S. Gustin, J. F. Macartney and C. E. Wilson, formerly with the Electric Merchandise company, have resigned to accept positions with the Railway Equipment company. The first named will be purchasing agent and the others traveling salesmen for the new company.

Eugene H. Cowles died on April 21st at El Paso, Tex., of hemorrhage of the lungs. Mr. Cowles was 38 years of age. He was a director and secretary of the Cleveland *Leader* Printing company and manager of the Cowles Electric Smelting & Aluminum company of Lockport, N.Y. Together with his brother, A. H. Cowles, he developed the process of reducing aluminum by means of electrical heat.

NEW INCORPORATIONS.

Pasco Union Land company, Pasco, Wash.; capital stock, $750,000; street cars, water works, electric light and gas works; R. Olney, Pasco, Wash.

Thermo-Electric company, New York, N. Y.; capital stock, $500,000; manufacturing and selling engines; J. P. Lowrey, 32 Nassau street, New York City, N. Y.

Columbian Electric company, Camden, N. J.; capital stock, $200,000; to manufacture. sell and lease electric lighting, heating and power; T. P. Curley, Camden, N. J.

Wichita Falls Electric Light & Power company, Wichita Falls, Texas; capital stock, $30,000; for purposes indicated in its corporate name; Edwin Fish, Trinidad, Colo.

Muncie Electric Street Railway company, Muncie, Ind.; capital stock, $100,000; to operate an electric line or street railway in the city of Muncie and territory contiguous thereto.

Hamburg Electric Light and Power company, Hamburg, Pa.; capital stock, $15,000; supplying light, heat and power by electricity to Hamburg; J. E. Miller, Hamburg, Pa.

Chester & Media Electric Railway company, Chester, Pa.; capital stock, $100,000; operating an electric street railway in Chester, Delaware Co., Pa.; Geo. B. Lindsay, Chester, Pa.

Liberty Avenue Street Railway company, Pittsburg, Pa.; capital stock, $50,000; operating an electric street railway in Pittsburg, Pa.; G. C. Lewis, 110 Diamond street, Pittsburg, Pa.

Central & West End Passenger Railway company, Williamsport, Pa.; capital stock, $18,000; operating an electric street railway in Williamsport, Pa.; W. C. King, Williamsport, Pa.

New England Electric Therapeutic & Alarm company, Biddeford, Me.; capital stock, $100,000; to manufacture and deal in electric and other appliances and apparatus; Henry I. Lord, Biddeford, Me.

Mauston Electric Light & Power company, Mauston, Wis.; capital stock, $15,000; operating, buying and selling mills, water power, electric light plants, power plants; E. V. Benjamin, Mauston, Wis.

Electric Protection company, Jersey City, N. J.; capital stock, $100,000; to manufacture and supply the apparatus necessary for equipping houses, etc.; J. N. Bruns, 218 Fulton street, New York City, N. Y.

Manor Electric company, Manor, Pa.; capital stock, $6,000; supplying light, heat and power or any of them by electricity to the public in the burrough of Manor, W. H. Klingensmith, Greensburg, Pa.

Rochester & Beaver Electric Street Railway company, Beaver, Pa.; capital stock, $60,000; operating a street railway from Bridgewater to Rochester Borough, Beaver Co., Pa.; Buchanan & Read, Beaver, Pa.

Tuna Creek Land & Water company, Los Angeles, Cal.; capital stock, $100,000; to deal in water, water rights, maintain water works, pipe lines, generating and supplying electricity; T. H. Ward, Los Angeles, Cal.

Silver Bow Electric Light & Power company, Butte, Mont.; capital stock, $200,000; carrying on general electric lighting, heating and manufacturing business and power, acquiring water and water rights in connection with said business.

Catasauqua & Northern Street Railway company, Catasauqua, Pa; capital stock, $50,000; operating an electric railway from Catasauqua to and through the villages of Stemton and White Hall in Lehigh county; R. E. Wright, Allentown, Pa.

La Grange Light & Water Works company, New York, N. Y. (incorporated in W. Va.); capital stock, $125,000; constructing and operating electric light and waterworks at La Grange, Ill.; Moffett, Hodgkins & Clarke company, Syracuse, N. Y.

Electric Power & Transmission company, Baker City, Ore.; capital stock, $150,000; generating by water or steam power electric currents to be used for any and all purposes for which electric or steam power can be used; B. W. Levens, Baker City, Ore.

York Cliffs Improvement company, York, Me.; capital stock, $300,000; owning, building improving and selling hotels, casinos, houses and wharves, steamboats and vehicles, water, gas or electric light works; Adrian Vermeule, Jr., 71 Broadway, New York, N. Y.

National Automatic Fire Alarm company, Chicago, Ill.; capital stock, $300,000; to construct, own, maintain and operate line or lines of electric fire alarm telegraphs, with annunciators, alarm signals, thermostats, electric valves, call boxes, etc., to carry on an automatic fire alarm and fire extinguishing system; Monk & Elliott, 1012 Chamber Commerce, Chicago, Ill.

ELECTRIC LIGHTING.

The aldermen of Jamestown, N. D., are wrestling with the problem of electric lighting.

The Columbia Electric Light company of Philadelphia has been given permission to extend its conduits.

The new electric light plant at Ukiah, Cal., has been completed, and the current was turned on recently. The plant is substantial, and cost about $12,000.

The council of Norristown, Pa., has decided not to erect a municipal plant and will contract with the Norristown Electric Light & Power company for 55 arc lamps at $100 each per year.

M. H. Kelly, superintendent of the electric light plant at Moscow, Idaho, was seriously injured about a week ago by accidentally receiving the full current of a large dynamo. He is now recovering.

The corporation of Glasgow, Scotland, is about to erect a generating station large enough to supply 40,000 incandescent lamps. The total expenditure for the work will be between $300,000 and $350,000.

An infernal machine filled with powder, eighty Gevelot cartridges and a quantity of scrap iron, with burning fuse attached, was found in an electric lighting shed of the Compagnie du Nord at Lisle, France, a few days ago.

Appleton, Wis., will be extensively lighted by electricity, the common council having under consideration a resolution to advertise for bids for 100 electric lights, and favorable action will probably be taken. The Street light committee will recommend the adoption of the resolution.

It is probable that the Thomson-Houston company will be given the contract to furnish 60 arc lamps to the city of Burlington, Iowa, at $100 per lamp per year. Probably a number of 20 candle power incandescent lamps for street use will also be furnished at $16 each per year.

The Central Market House, Cleveland, O., is to be lighted by electricity. This is the building in which the occupants of stalls refused to pay rent to the city unless the authorities agreed to remove the oil lamps installed on the refusal of the gas company to supply gas at 60 cents per thousand.

The electric light plant in Hammond, Ind., has just been sold by M. M. Towle to the Northern Lighting company of Chicago. This company has been incorporated with a capital stock of $30,000, and is headed by W. W. Hutchinson. The present plant at Hammond includes sixteen miles of wire and poles, with 100 arc and 800 incandescent lamps. The entire plant is to be refitted and extended.

The number of arc lamps employed in lighting the Frankfort exhibition amounted to 880, with 15,740 incandescent lamps. Inside the exhibition 10 tons of bare copper and 20 tons of cables were laid down. In connection with the Palmgarten installation, 88 tons of bare copper and 20 tons of cable were used. In the Offenbach transmission 8 tons of bare copper, and in the Lauffen transmission, 60 tons of bare copper were used.

W. H. Schott has recently completed for the Western Electric company, Chicago, the installation of an arc and incandescent system in Forest City, Ill., a town of only 900 population. At present there is a demand for 20 arc lights for street illumination and 100 incandescent lights for commercial purposes. The plant has been built for the city authorities and under the present contracts the incandescent lights will pay the entire cost of operation. The apparatus consists of two generators built by the Western Electric company and a 40 horse power Russell engine.

ELECTRIC RAILWAYS.

There will be nearly 13,000 poles in Philadelphia when the proposed trolley lines are finished.

It is estimated that about 30,000 horses were ousted from street car service last year by electricity.

The Washington street electric line of Portland, Ore., is to be extended four miles to Cornell Mountain Park.

The plant of the Keokuk Electric Street & Railway Power company was sold at commissioner's sale on April 21st to S. P. Townsend of Hartford, Conn., for $21,000.

A party of Toronto officials recently rode over the North Side loop of the Love underground conduit electric system in Chicago, and its members expressed themselves as satisfied with the test.

Mayor Washburne of Chicago, having failed to send a veto of the Jefferson and Urban ordinance or of the Evanston Electric ordinance to the city council within the prescribed time, both have become laws under the charter without his signature.

The Edison company has secured the contract for equipping the electric line between Rockland and Camden, Me., which is to be nine and a half miles long. The contract calls for the completion of the work by July 1st. It will be one of the heaviest and best built roads in the country.

The Intramural Transportation company of Chicago has been incorporated. The company is formed for the purpose of developing a new underground conduit system for an electric railway. The inventor, J. B. Odell, claims to have discovered a method which will do away with many of the difficulties previously encountered.

A company has been formed for the purpose of exploiting an electric railway in Dedham, Mass. The line will be six and a half miles long and have a gauge of four feet eight and a half inches. It will commence at or near the courthouse, thence through the town of Hyde Park, and through Boston to a point at or near the Forest Hill depot.

Work has been begun on the Telegraph avenue electric line in Oakland, Cal. The ties for the new road will be laid in concrete from Oakland to Berkeley, making the most expensive and most permanent road-bed in the state. On top of the concrete bitumen will be laid. Work on the power-house at Temescal is being pushed.

An electric railway for the highest city in the United States—Leadville, Colo.—is now in prospect. Dr. Law and Col. Goodell of that city, in conjunction with eastern capitalists, are to build and operate an electric street car line. The use of water power is contemplated, and it is intended to furnish power for the operation of mines in the vicinity, thus doing away partially with the enormous coal bill.

The West Side Street Railway company of Chicago has filed an application for permission to lay tracks on Twenty second street from Grove street to Johnson street and from May street to Crawford avenue, with the right to connect the road between May and Johnson streets with the 350 feet north or south of the center of Twenty-second street; also in Lawndale avenue from Twenty-second street to Thirty-fifth street, making six miles of road. The application states that the company has decided on using the overhead system of electricity and will use, if permitted, an eighty pound girder rail.

The Rapid Transit railway, of Leavenworth, Kan., operated at present by dummy engines, is to be turned into an electric road. General Manager Erb, of the Kansas City, Wyandotte and Northwestern road, which owns and operates the Rapid Transit, recently made the announcement. Plans for changing the system will be made at once. The engineer for the road proposes making a double track through the Soldiers' Home and Fort Leavenworth reservation, the same as at present through the city,

and will run a single track to the State Penitentiary at Lansing. The present mode of operating the road is very unsatisfactory to the citizens of Leavenworth, and they will welcome the change to an electric system.

The Short Electric Railway company, Cleveland, is shipping to Siam the equip nent for the first electric tramway in that country. The name of the Siam company is the Bangkok Tramways company, and the road is six miles long, with a track of 30 inch gauge. The line is practically level and most interesting throughout its entire length, crossing fourteen of the many canal bridges in Bangkok. Teakwood poles will be used, in fact all wood used in connection with the installation will be teakwood. Twenty-inch generators will be used and there will be two steam plants complete, together with six car equipments and extra parts to last for six months. This order is the outcome of a visit to the United States of Aage Westenholz, who made a thorough examination of electric railway apparatus, both in Europe and in this country, visiting all the large manufacturing companies and the most successful of their plants.

Regular trips are now made on the "loop" equipped with the underground system by the Love Electric Traction company in Chicago. The line is operated in conjunction with the North Side cable service. It runs west on Fullerton avenue, from the intersection of Lincoln avenue and Halsted street, to Racine avenue, south on Racine avenue to Webster avenue, east on Webster avenue to Halsted street, and north on Halsted street to the point of starting. The trailers on the Lincoln avenue trains are uncoupled at Halsted street and taken in tow, two at a time, by the electric motor car. They are hauled around the loop to Halsted street on Webster and then by horses to Lincoln avenue, where they are again coupled to the Lincoln avenue trains and go down town. So far the line has proven satisfactory to the street car company. The trip is made much more quickly than with horses, and the cars run smoothly, and with little noise.

TELEGRAPH.

The negotiations regarding the transfer of the Vienna Private Telegraph company to the state are progressing, the government having appointed Herr Sternischtie as manager to the company.

In predicting a decided rise in Western Union stock, the *Daily Financial News* says: "It should be remembered that Western Union has a very small bonded debt while it owns a great deal of real estate and property which has enhanced very much in value, and it is therefore not unreasonable that the company should be able to make excellent returns to its stockholders."

In order to secure more direct cable service between South American countries and Europe a new company has been formed which embraces all the South American and English companies of the southern continent. The companies entering into the syndicate are the Eastern, the Brazil Submarine, the Western and Brazilian and the West Coast lines, and capital has been raised for the construction of an independent overland line from Valparaiso to Buenos Ayres. The contract for the construction has been awarded and the materials are being shipped from England. The line will pass through, instead of over, the Andes, thus avoiding the interruptions and breaks which might result from the heavy snows so frequent in those altitudes. There is an overland line at present between Chili and Buenos Ayres, but it was bought from the Chilean company which owned it when the Central and South American Cable company extended its lines to Valparaiso.

TELEPHONE.

The work of rebuilding the telephone lines in Racine, Wis., is progressing favorably.

A recent fire caused considerable damage in the battery room of the Duluth, Minn., exchange.

Telephonic communication is about to be established between Antwerp, in Belgium, and Holland.

Fire in the Chicago Telephone company's paint shop at Kingsbury and Michigan streets caused a loss of $500 a few days ago. The explosion of a can of benzine started the blaze.

The twelve existing telephone exchanges in Paris are to be consolidated into four, thus causing a reorganization of the whole system. This is estimated to cost ultimately $1,600,000.

A Washington dispatch says: Three patents on what is known as the carbon contact will be issued on May 3d to Edison, who has assigned them to the Western Union Telegraph company, which has sold them to the Bell Telephone company. The patents are regarded as very important.

The Wabash City, Ind., council has ordered the immediate removal of all telephone poles and wires from the streets and alleys of that city. The lines have been neglected ever since local service was discontinued several years ago, and several accidents have occurred by the crossing of the wires with the electric light wires.

MISCELLANEOUS.

An electric tannery has been started at Verviers, Belgium.

A semi-annnual dividend of 25 cents per share has been declared on Thomson-Houston securities, series D. It is payable April 30, 1892, to stockholders of record at the close of business April 23, 1892.

The plant at Hermosa belonging to the insolvent estate of the Belding Motor & Manufacturing company was sold in the County Court at Chicago last week for $71,800. The title is subject to a $40,000 mortgage. T. F. Indermille was the purchaser. The Belding Motor & Manufacturing company failed last May, leaving an estate worth about $100,000 net. It had been engaged in the manufacture of electric motors, but a series of fires in the factory reduced the company to insolvency.

A number of electric motors are employed in the new Leiter building in Chicago, occupied by Siegel, Cooper & Co., as a department store. Two 15 horse power motors are used to drive C. & C. fans, and 7½ horse power is distributed about the building for smaller fans. A 10 horse power motor made by the Detroit Motor company is used to drive machinery in C. W. Jackson & Co.'s fringe works on the top floor, while a one horse power Edison motor operates the coffee mill in the grocery department of the store.

The Myers voting machine, which has excited much interest in New York state, was used at the official election in Lockport, N. Y., a week or so ago. By this device the voter indicates his choice by pushing various buttons, thus making electrical contact, by means of which the vote is registered. A dispatch from Lockport describing the election says: "No man remained in the booth longer than a minute, although the average voter required only from ten to fifteen seconds to register his ballots for between fifteen and twenty candidates. The time usually required for an accurate count of the ballots in this town is from three to four hours. With the Myers system the correct report of the result was given out ten minutes after the closing of the polls."

TRADE NEWS.

W. L. Adams has closed a contract with the West Side Street Railway company, of Rockford, Ill., for overhead line equipment.

The Chicago office of the Electric Construction & Supply company has been moved from the Phenix building to the Unity building.

General Manager C. J. Swift of the Duplex Electric company, limited, of Corry, Pa., is building a Duplex focusing lamp for the Erie City Iron works. This lamp is to be used for making blue prints and will be run from the Duplex plant which lights the Erie City boiler works.

The Bradbury-Stone Storage Battery company of Lowell, Mass., is sending out to the trade a very neat 36-page pamphlet, finely illustrated, and entitled "The Ideal Storage Battery." In this little book the company quotes clippings from electrical journals, and gives formulæ for calculating the number and capacity of cells required for lighting installations.

The Premier Electric company of Brooklyn moved into its new factory last week and has now increased facilities for the manufacture of motors, batteries and novelties. The working force has been increased. A novelty which this company has just offered to the trade is the "No. 3" motor with two fans for use on dining tables, double desks, etc. The company states that it has already shipped a number of these handy little machines.

J. L. Somoff of New York has added to his many styles of miniature incandescent lamps a four lens theatrical torchlight from 6 to 10 candle power, each lense being a different color. He now makes also a crystal lense ¾ inch in diameter. The lens is made in different sizes and can be used in microscopes. Mr. Somoff is at present treating with two large companies who each desire the right to handle exclusively his lamps in Chicago.

The Hine Eliminator company, New York, reports good business thus far this month. Among those to whom the eliminators have been sent to be used as a separator of water from live steam are the Consolidated Electric Railway company, Los Angeles, Cal.; the Kearney Lumber company, Kearney, Ark.; Penn Steel company, Stockton, Pa.; Vinton & Co., Detroit, Mich.; New York Steam company, New York; Thos. H. Dallett & Co., Philadelphia; Rix & Birrell, San Francisco; Wm. Kirkup & Son, Cincinnati, O., and L. H. Prentice & Co., Chicago. In addition to the above orders a number have been sent out for extracting oil from exhaust steam.

The Shawmut Fuse Wire company of 85 Water street, Boston, has purchased of the Massachusetts Electrical Engineering company its fuse wire business, including all machinery, apparatus, etc., used in the manufacture of fuse wire and links. It is the intention of this company to devote itself exclusively to the manufacture and sale of different forms of fuses used for electric lighting, street railway and telephone purposes, and it has arranged with the Massachusetts Electrical Engineering company to test its entire product under the exact conditions in which the devices are used in practice, so that one may be assured of a thoroughly reliable fuse. A signed certificate of test will accompany each spool of wire and lot of links sold.

The use of graphite for electrical purposes is now becoming more general. The value of graphite for electrical service depends mainly upon its purity and the careful selection and preparation of the proper quality to suit special work. The Jos. Dixon Crucible company of Jersey City, N. J., the well known manufacturer of Dixon's lead pencils, owns the Ticonderoga mines, and makes a specialty of graphite for electrical work. This company makes to order graphite rods of various diameters and lengths, ranging from 1½ ohms to 500 ohms resistance. The rods are made straight or curved as desired. Dixon's pure graphite rods have been used with great satisfaction on motors in place of the regular copper brushes. The rods do not cut or scratch the commutator, but, on the contrary, keep it smooth and bright. The Dixon company handles graphite paint also. Some idea of the value of this paint can be gained from the company's assertion that graphite is impervious to heat, cold, acids, alkalies or any known chemicals. The company claims that, weight for weight, graphite paint will cover two to three times more surface and last four or five times longer than any lead, mineral, or metallic paint, and it recommends this paint, therefore, for roofs, electric light poles and iron work.

Somebody has said that we "Yankees" are "smarter than chain lightning," and the thought that we have, indeed, to a great extent circumvented that very nimble and useful element is suggested by the perusal of the illustrated catalogue, No. 23, of electric light and power supplies, issued by the Electrical Supply company, Chicago. The 500 splendidly illustrated pages that are between the gold embossed covers contain a fund of information that entitles the volume to a more pretentious name than 'catalogue," as that word is usually applied. It is rather an encyclopedia of electrical information such that with its assistance even a novice could equip an electric light and power plant. Everything from an electric button to a full sheet flash of lightning is carefully and compactly listed in the book, but while every page appears to be charged and illuminated with things electrical, there is not in the whole work, from the frontispiece, which is a fine engraving of the company's business block, through the ramifications of the context, to the illustrations of the factories in Ansonia and Chicago, a single line to shock the most fastidious; on the other hand there is a delightful though terse description of the thousands of devices necessary in harnessing and bridling this capering filly. It is not amiss to say that there is not a "granny" in the whole book. Every article is a type of its class and represents the latest and best achievements in its line. The antiquated and experimental have found no place in these pages, the scimitar of selection has been laid to with unerring discrimination. F. S. Terry is to be congratulated upon the consummation of this work, which must have entailed weeks and months of careful research and comparison. The ample proportions of the volume give another evidence indicative of the great growth of this business, and its careful and intelligent preparation shows the attention that is being given to the matter of supplying the wants along these lines of the world's progress. The volume, which is a model of its class, fairly represents the progressive establishment that issues it.

BUSINESS.

Partrick & Carter's catalogue contains illustrations of many styles of cases for their patent needle annunciator.

The Brush Electric company of Cleveland, Ohio, will on May 1st remove its general eastern offices, at present located in the Boreel building, 115 Broadway, New York, to 42 and 44 Broad street, rooms 1, 2 and 3, fifth floor.

Secretary and Treasurer A. H Pease, of the Hart & Hegeman company of Hartford, Conn., spent several days in New York and vicinity last week, and secured a number of large orders for the Hart & Hegeman switch.

Messrs. Chandler and Firman will move the local office of the Gamewell company on May 1st, from 118 La Salle street, Chicago, a building occupied by them for nearly ten years, to rooms 901–3 in the new Ashland block.

The New Equitable building at Des Moines is to be lighted by electricity, and contracts have just been placed with the Chicago office of the Pond Engineering company for one 25 and one 60 horse power Armington & Sims engine.

The Electric Construction & Supply company of New York is receiving a large number of orders for its new ornamental arc lamp, which is especially designed for low ceilings, and possesses all the advantages of the Ward lamp. It burns eight hours.

The Goodrich-Coleman Electric company, 33 South Canal street, Chicago, is just arranging to manufacture on a large scale a new dry battery to be known as the "Tempest." The battery is the result of a series of experiments carried on during the year, and is claimed to be a "new departure."

The Warrenton, Mo., Electric company writes the Ball Engine company of Erie, Pa.: "We started the engine purchased from you for our electric plant last night, and the way it moved off was beautiful to behold. It is certainly a very fine and powerful piece of machinery. No vibration, no noise; in fact and in short, it is perfect in every part and way. The satisfaction it gives is a pleasure to us, and it must be gratifying to you."

The Union Electric Works, Springer building, Chicago, have purchased the patents and good will for the Crowdus primary battery and motor, until recently manufactured by the Crowdus Electric company of Memphis, Tenn. Under this arrangement the Chicago company will manufacture the battery both dry and fluid, on an extensive scale. The motor for battery current will be manufactured in sizes from one-twentieth to one-eighth horse power for fan and other purposes.

The Illinois Electric Lamp company, 171–173 South Canal street, Chicago, is turning out 500 incandescent "Jewel" lamps a day—running to about one-half the capacity of the factory. This lamp has been extensively advertised and the new company is securing unsolicited a large number of orders. J. F. Schaefer, superintendent of the factory, is an experienced lamp maker; his name alone assuring to the users of this lamp a good article. The company is under good business management, and will undoubtedly take front rank among the lamp manufacturers of this country.

The Short Electric Railway company has just succeeded in making a very important opening for its railway apparatus

in the New England states. Edward J. Wessels of the New York office of the company, has recently secured orders from the Norwich Street Railway company, the New Haven and West Haven Horse Railway company of New Haven, Conn., and from the Natick street Railway company of Natick, Mass. The New Haven and West Haven Horse railway will have nineteen single equipments of twenty-five horse power single reduction motors, and seven double equipments of the same type. The order for the engines and generators for this road has been placed with Westinghouse, Church, Kerr & Co., who will supply three large sized direct connected engines and dynamo units. Norwich, Conn., will have fifteen twenty-five horse power single reduction motors. It is expected that all three roads will be using their summer apparatus early in June.

The Eickemeyer & Osterheld Manufacturing company of Yonkers, N. Y., has just issued the second edition of its catalogue. In the Eickemeyer-Field apparatus all the weight of both motor and car is supported on springs, the motor forming part of the car body and moving with it, so that the wear of the motor on the track is no greater than that caused by a loaded horse car, while the motor in turn is so cushioned on springs that the passage over irregularities of track or ordinary street obstructions results in no perceptible jar to the mechanism, nor to the rails, the motor being absolutely rigid in the direction of travel and cushioned on springs vertically. Among the many parts of apparatus illustrated is this company's reversible carbon brush, consisting of four carbon pencils attached to the extremities of a divided blade spring, each carbon having independent motion, with a minimum of pressure on the commutator. When one side of the brush is worn down it can be reversed.

The Stearns Manufacturing company of Erie, Pa., has acquired by purchase, the remaining franchises of Woodbury, Booth & Pryor and the Woodbury Engine company of Rochester, N. Y., including all patterns, patents, special tools, trade marks, good will, etc., etc. This puts into the hands of the Stearns company, not only the sole ownership of the Woodbury high speed automatic engine, which they previously purchased, but also the Woodbury medium speed automatic engines, and the means of producing both. The name "Woodbury" has been for forty years synonymous with good steam engines, and with something over three thousand of the two classes here named, all bearing the "Woodbury" earmarks as references, the Stearns company ought to be satisfied that it has made no mistake in adding the medium speed automatic Woodbury to the Woodbury high speed, which it has already pushed to the front rank of its class.

The Electric Engineering & Supply company of Syracuse, N. Y., was incorporated in 1890 and from a modest beginning, has grown until now the "E. E. & S." specialties are found throughout the country. The secret of the company's success is in the character of the goods manufactured. The facilities of the concern for manufacturing goods for electric lighting and railway use are unsurpassed. Porcelain insulation of the best quality is utilized wherever possible as displayed in the well known sockets, switches, rosettes, main and branch cut-outs, etc., sent out from the factory. Among this company's specialties is the "E. E. & S." lamp socket which is adapted for use with the Thomson-Houston, Edison and Westinghouse systems. One of the chief features wherein this socket differs from others is that the insulating parts consist entirely of air spaces, and a peculiar quality of porcelain so tough that the parts may be riveted to it. There is no fiber used. The "make" and "break" arrangement in the key socket are governed by a cam which throws the phosphor bronze spring, producing a wiping contact. Another entirely new feature is the china porcelain key, trouble having been experienced through the softening of hard rubber handles when exposed to high temperature.

The Heisler Electric company, Philadelphia, has adapted alternating current apparatus for parallel distribution for short distance service and isolated plants. Owing to the employment of the alternating current it is possible for the consumer by this system either to burn his light at full brilliancy, or to reduce it to any point that may be desirable. This graduation is accomplished without inserting resistance in series with the lamps. It is also practical to operate arc lights from the same circuit and apparatus, and so greatly increases the flexibility of the system. The Heisler alternating current apparatus for long distance series distribution requires but little attention, as it is provided with an automatic regulator. The circuits are not complicated by transformers in series or other combinations; in fact, nothing further than the automatic regulator and standard ammeter is necessary to maintain the proper balance upon the circuits. The automatic regulator, it is claimed, takes care of external conditions as closely as would be the case with a compound wound apparatus. All that is required for the installation of the lamps is the combination automatic cut-out and lamp socket which is so constructed that the circuit cannot be opened accidentally and in the event of a lamp filament burning out, the circuit is automatically closed. The street and indoor fixtures are constructed to hold any lamp from 10 to 150 candle power. The most valuable feature claimed for the system, is that it is cheap to install, simple and economical to operate, efficient and reliable, and enables the purchaser to furnish satisfactory service at a minimum of cost to the consumer. In the manufacture of long distance apparatus the Heisler company adopted the 32 candle power lamp for the reason that it considers this size of lamp to be the most popular size, and of higher efficiency. The Heisler system is now in use in central stations and isolated plants throughout the United States, Mexico and Canada, aggregating a capacity of 200,000 32 candle power lights. The company also has under construction a very complete transformer system that has been very carefully worked out in both mechanical and electrical details.

ELECTRICAL STOCK MARKET.

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, April 23d, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	100	101
Edison Illuminating company of New York	81½	82
" " " Brooklyn	78	80
" " " Boston	110	115
" " " Chicago	130	140
Edison Ore Milling company	15	20
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomson-Houston Electric company	59	60
" " " Preferred	28½	29
Westinghouse Electric company	28	29
" " Preferred	43	44
North American Phonograph company	5	8
New York " "	2½	5
Automatic Exhibition company	4	7

ELECTRICAL PATENTS.

Issued April 19, 1892.

472,982. Conduit and Trolley for Electric Railway System. Charles W. Carll and James W. Phillips, Trenton, N. J.

472,983. Signaling System. Henry A. Chase, Boston, Mass.

473,003. Heating and Welding by Electricity. Henry Howard, Halesowen, near Birmingham, England.

473,024. District Telegraph Box. Charles Selden, Baltimore, Md.

473,042. Electric Clutch. Peter W. Willans, London, England

473,044. Conduit for Electric Wires. Charles H. Wilson, Chicago, Ill.

This invention consists of a tube made up of joints adapted to be screwed together, and a small rod inclosed in the same, which is also composed of sections adapted to be screwed together and carrying an expansible loop, the loop being adapted to be withdrawn within the head of said tube or to be extended beyond the same and expanded.

473,045. Lightning Arrester. Montraville M. Wood, Chicago, Ill.

473,061. Electric Lock. Charles H. Crockett and Chancellor C. Allen, Boston, Mass.

473,066. Ore Separator. Simon G. Elliott, Quincy, Mass.

473,076. Electric Arc Lamp. Octave Patin, Paris, France.

473,077. Armature Core for Electric Motors. David Pepper, Jr., Philadelphia, Pa.

473,078. Armature Ring. David Pepper, Jr., Philadelphia, Pa.

473,089. Testing Apparatus for Trunk Lines of Telephone Exchanges. Charles E. Scribner, Chicago, Ill.

This device is designed for the purpose of enabling the operator wishing to connect with a trunk line to make a quick test to determine what trunk lines are free.

473,105. Electrolytic Apparatus for Separating Gold and Other Metals from Their Ores. George J. Atkins, London, England.

473,121. Electrical Annunciator. Thomas W. Lane, Boston, Mass.

473,123. Machine for Making Insulated Magnetic Coils. Charles E. Lipe, Syracuse, N. Y.

This invention relates to machines and apparatus for making insulated coils, and especially to those in which insulating material is composed of mica wound in between the different successive layers, and also between each and every successive coil as the same is wound.

Claim two reads:

"In a machine for making insulated magnetic coils, the combination, with the winding-shaft and means for rotating it, of a tool comprising a shank, a pressure-roller, and a shearing cutter mounted contiguous to the winding-shaft."

473,132. Electric Switch. Francis H. Soden, Chicago, Ill.

This electric switch consists in a universally adjustable yoke provided with contacts and having its arms separately held by universal joints, said arms being at their outer ends connected by a link with joints between the link and said arms.

473,133. Electro Therapeutic Heating Pad. Francis H. Soden, Chicago, Ill.

473,134. Electric Switch. Francis H. Soden, Chicago, Ill.

473,146. Secondary Battery. Harry E. Dey, New York, N. Y.

This method consists in filling a form or mold with an active material such as litharge, treating the same, and then removing the plate thus formed from the mold, and compressing it laterally to form solid edges.

473,147. Secondary Battery. Harry E. Dey, New York, N. Y.

473,158. Hanger for Electric Wires. Thomas Imeson, Lewis D. Tibbets and Charles L. F. Kellogg, Seattle, Wash.

Claim three is given:

"In an electric conductor or trolley wire support, two interlocking jaws, a plate upon which said jaws articulate, and means for causing said jaws to close upon and bind the wire."

473,174. Electric Indicating System and Instrument. Harry J. Haight, New York, N. Y.

473,190. Railway Signal. Uriah S. Jackson, Ossipee, N. H.

473,195. Commutator Brush. George Meyer, Indianapolis, Ind.

The holder has a series of pencils secured therein composed of a metal rod surrounded by carbon; a wire runs from the upper end of each of said rods to the holder.

473,208. Incandescent Electric Lamp. Augustus C. Carey, Lake Pleasant, Mass.

The fifth claim reads:

"A tubular coupling for uniting the carbon and the circuit wires of an incandescent electric lamp, constructed with a notch to afford anchorage for the cement used to unite the carbon and the coupling."

473,209. Rheostat. Augustus C. Carey, Lake Pleasant, Mass.

A peculiarly constructed resistance medium is adapted to be interposed between an electric generator and a lamp or other consumer of the electric current, and is made adjustable to increase or diminish the resistance to the flow of the current, and thereby vary its effective force in the consumer.

473,222. Ship's Log. Reynold T. Hall, Merchantville, N. J.

473,228. Electric Switch. Edward H. Johnson, New York, N. Y.

473,236. Attachment for Type Writing Machines. Charles J. Reed, Orange, N. J.

473,237. Attachment for Type Writing Machines. Charles J. Reed, Orange, N. J.

473,240. Lamp Shade and Holder for Incandescent Lamps. George F. Seavey, Boston, Mass.

473,253 Converter System for Electric Railways. Mark W. Dewey, Syracuse, N. Y.

473,256. Telephone Receiver. Edwin C. Hess, Camden, N. J.

473,267. Electric Cable. William H. Sawyer, Providence, R. I.

In an electric cable, a series of wires interbraided with fibrous material into tubular form to provide a base or core for the reception of successive series of similarly braided wires thereon.

473,282 Cut-off for Electrical Machines. James P. Wooley, Simcoe, Canada.

473,283. Electric Arc Lamp. Thomas E. Adams, Cleveland, O.

In an electric arc lamp, the combination, with a friction clutch, of a balance rod and a contact plate.

473,288. Electric Railway Signal. John M. Brasington, Morven, N. C.

473,351. Electric Cable. William H. Sawyer, Providence, R. I.

Claim one reads:

"An electric cable composed of a flexible tube or core formed of the two wires of a metallic circuit coiled spirally together and the wires of one or more metallic circuits interbraided with fibrous material upon said flexible tube or core."

473,352. Electric Cable. William H. Sawyer, Providence, R. I.

The object of this invention is the production of a cable of low inductive capacity and high insulating properties, which shall be light and flexible.

473,353. Electric Cable. William H. Sawyer, Providence, R. I.

Claim three is quoted:

"In an electric cable, the combination of one or more metallic circuits interbraided with fibrous material into tubular form with a successive series of metallic circuits similarly interbraided, and an inclosing sheath or other suitable covering."

473,361. Multiple Arc Railway System. Sidney H. Short, Cleveland, O.

473,362. Trolley Switch. Sidney H. Short, Cleveland, Ohio.

This trolley switch consists in the combination with ribs depending from the switch plate, and a yielding trackway on which the trolley runs, of a flange for engaging the trolley and causing the latter to impart lateral movement to the yielding trackway,

473,363. Armature for Dynamo Electric Machines. Sidney H. Short, Cleveland, O.

The twelfth claim reads:

"An armature core consisting of a continuous strip of ribbon wound into superimposed layers and a row of bare or naked rivets or pins extending through such layers and located on a line of equipotential."

473,364. Armature for Dynamo Electric Machines. Sidney H. Short, Cleveland, O.

Claim four is given:

"The joint for electric conductors, formed of bared portions of the wires inclosed in a split conducting-sleeve soldered on and wrapped with tape or non-conducting and binding material."

473,365. Gearless Motor for Electric Railway Cars. Sidney H. Short, Cleveland, O.

Of the nine claims the eighth is given:

"The combination, with the driving-axle of a car, of a casing encircling the axle and inclosing the propelling motor therein, said motor comprising field magnets attached to the casing, an open center armature journaled at its periphery in the field-magnets, and a driving connection between the axle and armature core.

473,366. Armature for Electric Generators or Motors. Sidney H. Short, Cleveland, O.

473,367. Dynamo Electric Machine. Sidney H. Short, Cleveland, O.

473,368. Gearless Propelling Mechanism for Electric Railway Cars. Sidney H. Short, Cleveland, O.

473,373. Incandescent Electric Lamp Socket. Craig R. Arnold, Sharon Hill, Pa.

473,378. Electric Stop Motion for Looms. John C. Brooks, Paterson, N. J.

473,386. Electric Battery. James E. Emley, Laredo, Tex.

473,393. Electrode. Paul L. T. Heroult, Shaffhausen, Switzerland.

473,435. Electric Switch. Ernest P. Warner, Chicago, Ill.

This invention relates especially to the circuit-changing device, which consists of two pairs of springs, the pairs being mounted on the opposite sides of an insulating block, whereby either pair may be separated from the lamp circuit terminals, respectively, and connected together through the shifter, while the other pair closes upon said terminals, respectively.

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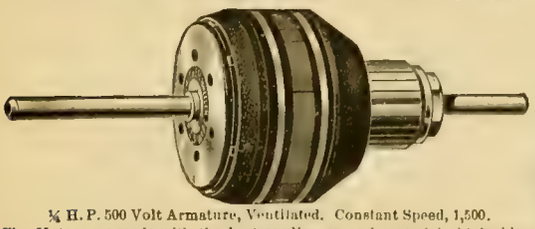

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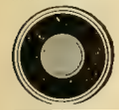

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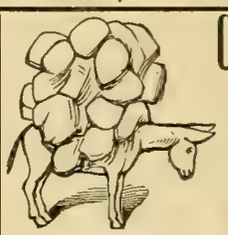

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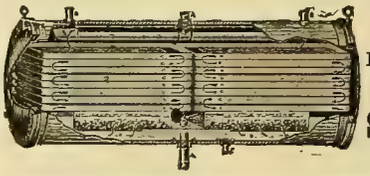

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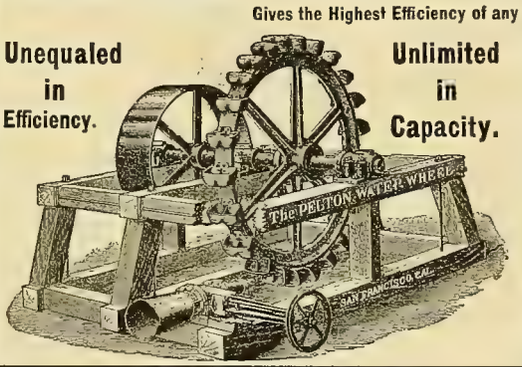

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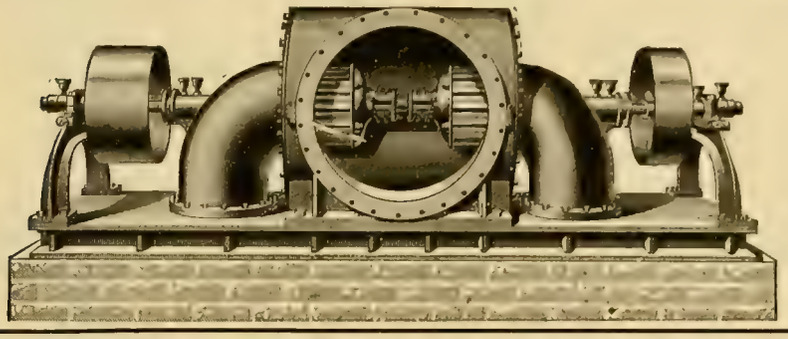

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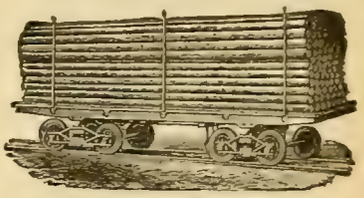

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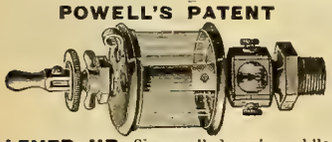

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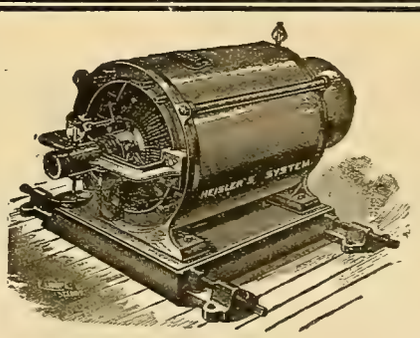

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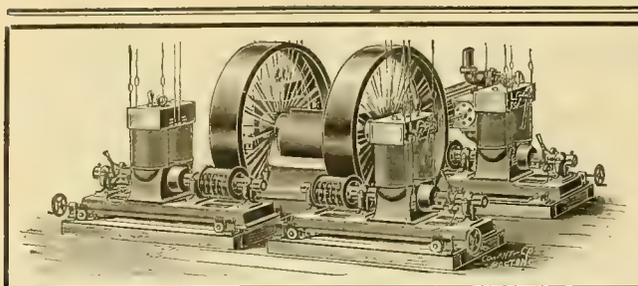

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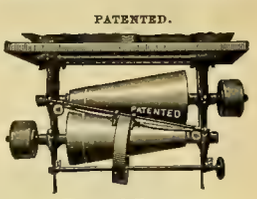

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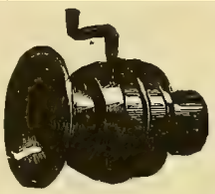

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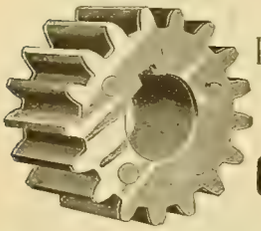

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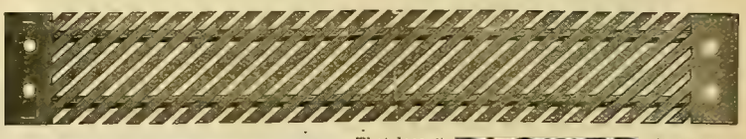

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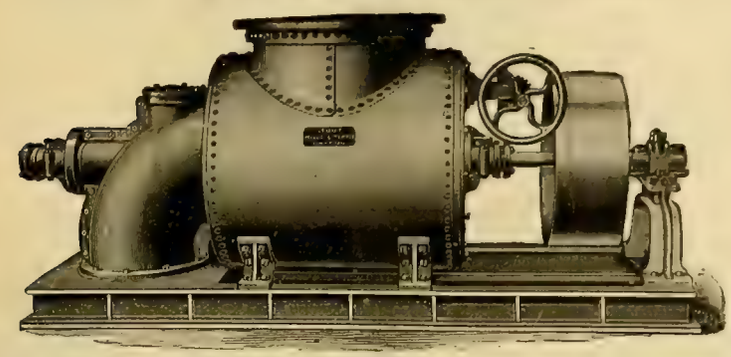

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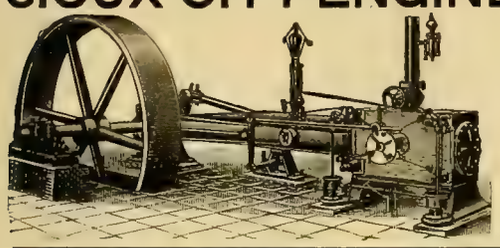

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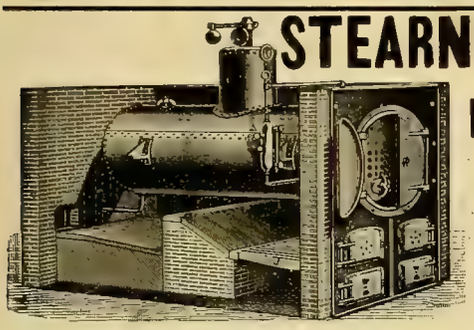

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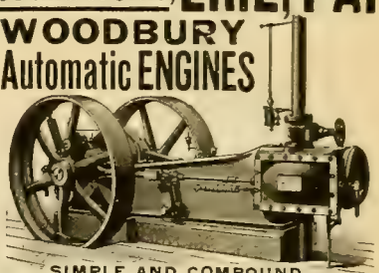

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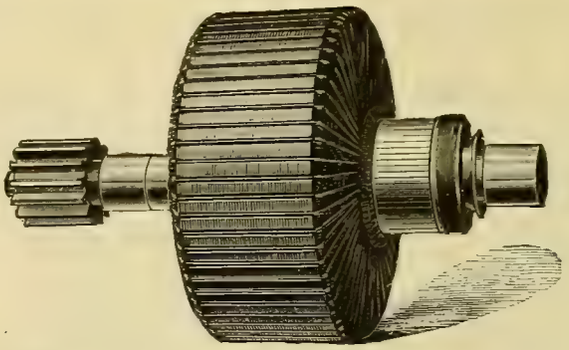

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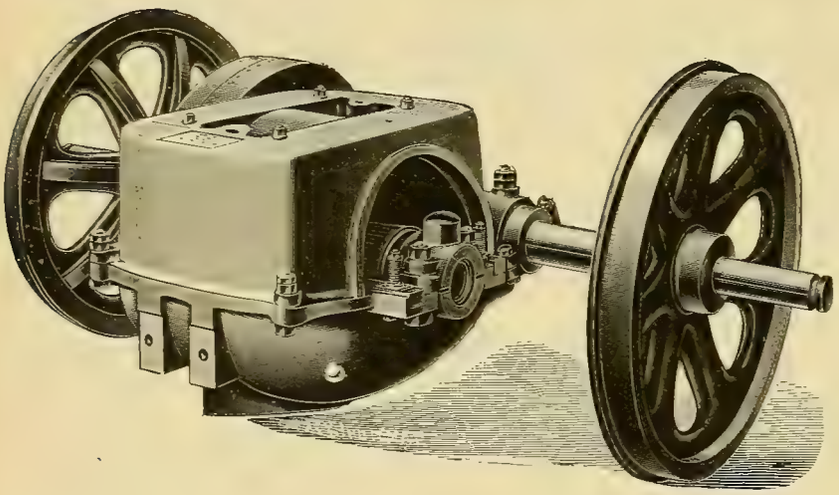

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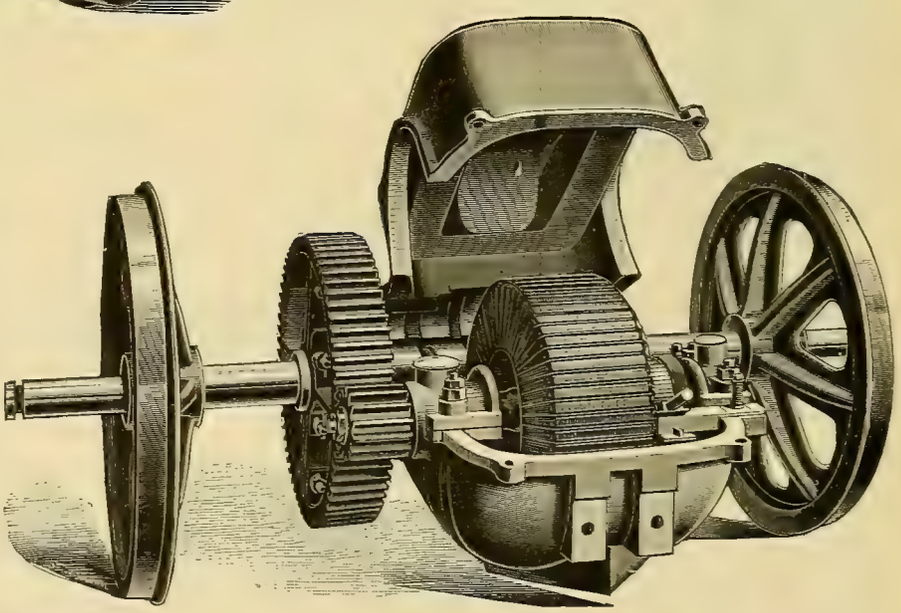

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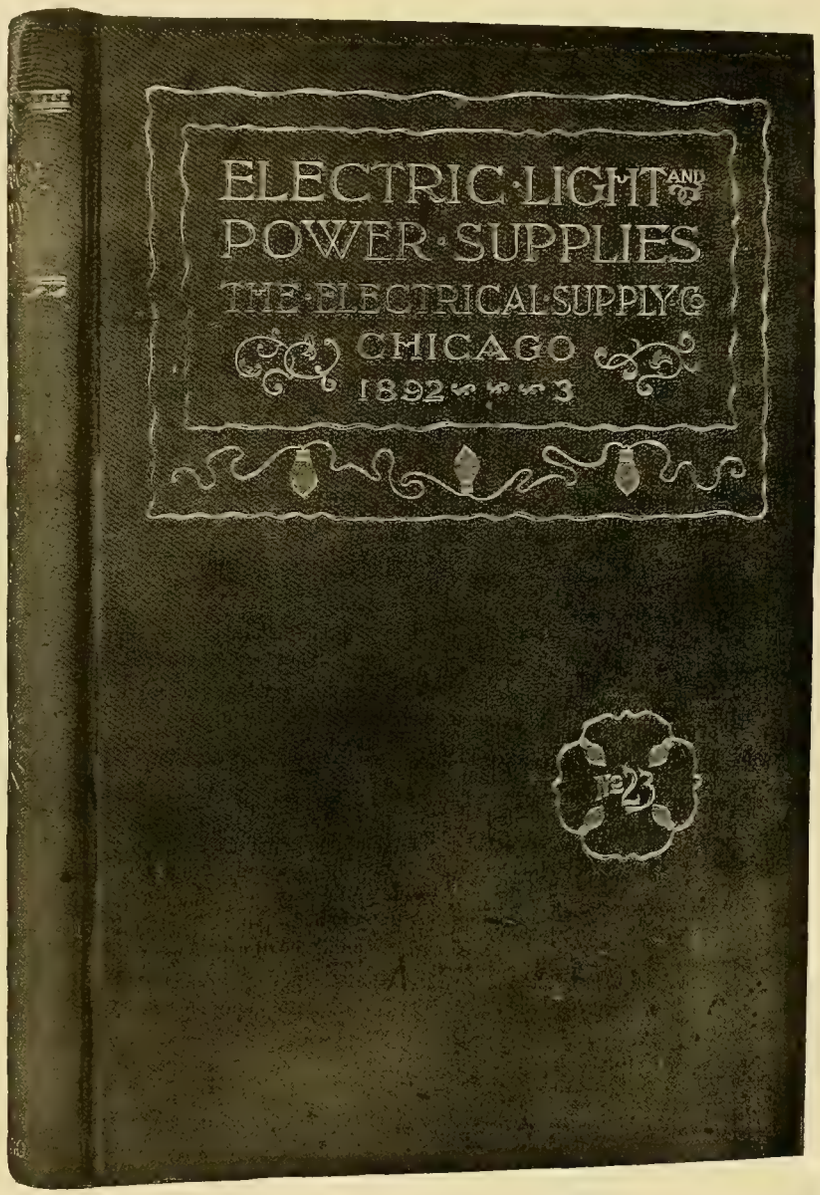

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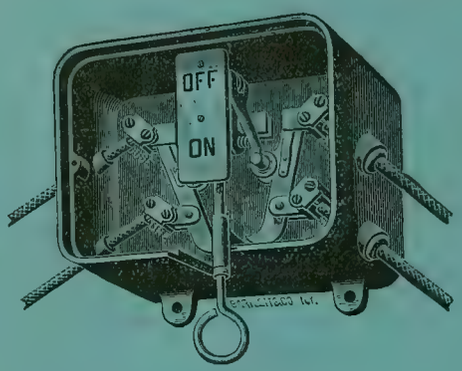

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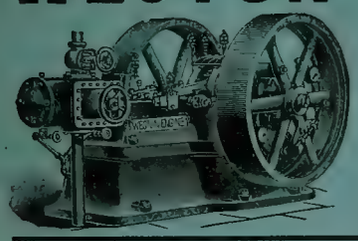

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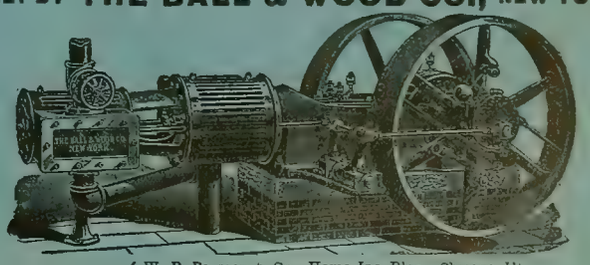

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CLASSIFIED LIST.

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Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.

Arc Lamps.
Beggs, J. E., Mfg. & Supply Co.
Brush Electric Co.
Duplex Electric Co., Ltd.
Electric Cons. & Supply Co.
Fort Wayne Electric Co.
Great Western Elec. Supply Co.
Rose Electric Light Supply Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Knapp Electrical Works.
Samson Cordage Works.

Batteries.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co.,The.
Greeley & Co., The E. S.
Hirlimann, C. J.
Law Telephone Co.
Partrick & Carter.
Premier Electric Co., The.
Pumpelly, J. K.
Western Electric Co.

Battery Jars.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Hemingray Glass Co.
Hirlimann, C. J.
Law Telephone Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co., W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Detroit Electrical Works.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Chicago Rawhide Mfg. Co.
Jewell Belting Co.
Link Belt Machinery Co.
Page Belting Co.
Shultz Belting Co.

Boilers.
Lane & Bodley Co.
Stearns Mfg. Co.
Weston Engine Co.

Books, Electrical.
Electrician Publishing Co.

Brass Goods.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cross-Arms.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Loud, H. M. & Sons Lumber Co.
Railway Equipment Co.
Schindel & Schindel.

Cables, Electric, (See Wire Insulated), **Copper, Sheet and Bar,**
Roeblings Sons Co., J. A.
Western Electric Co.

Clutches, Friction.
Hill Clutch Works.
Lake, J. H. & D.

Cordage.
Samson Cordage Works.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Washington Carbon Co.
Western Electric Co.

Construction and Repairs.
Andrae, Julius.
Chicago Electric Motor Co.
Electric Cons. & Supply Co.
Electrical Construction Co., The.
Knapp Electrical Works.
Rae, Frank B.
Smith, Thos. G. Jr.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
American Engine Co.
Ball Engine Co.
Ball & Wood Co., The.
Brush Electric Co.
Detroit Electrical Works.
Diamond Electric Mfg. Co.
Edison General Electric Co.
Electric Cons. & Supply Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Keller & Degenhardt.
Lake Erie Engineering Works.
Lane & Bodley Co.
La Roche Electric Works.
Morse & Co., A. M.
Pearson & Co., W. B.
Racine Hardware Mfg. Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Short Electric Railway Co.
Sioux City Engine Works.
Smith, Thos. G. Jr.
Taylor Engine Co.
Thomson Houston Electric Co.
Waddell-Entz Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Weston Engine Co.
Williams Engine Works.

Copper Wires and Tapes.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cutter, Geo.
Detroit Electrical Works.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Roebling's Son's Co., J. A.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cut-Outs and Switches.
Andrae, Julius.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Electric Engineering & Supply Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Perkins Elec. Switch Mfg. Co.
Star Electrix Co.
Van Nuis, C. S.
Western Electric Co.

Drop Forgings.
Wilcox & Howe Co.

Dynamos.
Brush Electric Co.
Detroit Electrical Works.
Diamond Electric Mfg. Co.
Duplex Electric Co., Ltd.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
La Roche Electric Works.
Lovell Mfg. Co., Ltd.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Rose Electric Light Supply Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Waddell-Entz Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Lava Gas Tips.
Smith, A. T.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Rae, Frank B.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical and Mechanical Engineers.
Pierce, Josiah Jr.
Rae, Frank B.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
La Roche Electric Works.
Queen & Co.
Union Electric Works.
Western Electric Co.

Electrical Specialties.
Andrae, Julius.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Electric Engineering & Supply Co.
Fletcher & Fletcher Electric Co.
Hussey & Co.
Ries Electric Specialty Co.
Sioux City Electrical Supply Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.

Electrical Intelligence.
Keller & Degenhardt.
Rae, Frank B.

Elevators.
Link Belt Machinery Co.

Engines, Steam.
American Engine Co.
Ball Engine Co.
Ball & Wood Co., The.
Ide & Son, A. L.
Lake Erie Engineering Works.
Lane & Bodley Co.
Morse & Co., A. M.
Pearson & Co., W. B.
Racine Hardware Mfg. Co.
Smith, Thos. G. Jr.
Sioux City Engine Works.
Stearns Mfg. Co.
Taylor Engine Co.
Weston Engine Co.
Williams Engine Co.

Fan Outfits.
Chicago Electric Motor Co.
Edison General Electric Co.
Emerson Electric Mfg. Co.
Premier Electric Co., The.
Stanley Electric Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Furnace Grate Bars.
Kelly Bros.

Fuse Wire.
Electrical Supply Co.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

Gas Lighting, Electric.
Detroit Electrical Works.
Fletcher & Fletcher Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.

General Electrical Supplies.
Andrae, Julius.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Cons. & Supply Co.
Electric Engineering & Supply Co.
Electrical Eng. & Supply Co.
Electrical Supply Co., The.
Fletcher & Fletcher Electric Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Sioux City Electrical Supply Co.
Western Electric Co.

Globes and Electrical Glassware.
Brookfield, Wm.
Hemingray Glass Co.
Phœnix Glass Co.

Graphite Specialties.
Dixon Crucible Co., Jos.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Andrae, Julius.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Cushing, F. W.
Edison General Electric Co.
Electric Engineering & Supply Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Hemingray Glass Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Partrick & Carter Co.
Railway Equipment Co.
Standard Paint Co.
Sioux City Electrical Supply Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables, Magnet Wire.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing, F. W.
Cutter, Geo.
Day's Kerite Insulation.
Detroit Electrical Works.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
New York Insulated Wire Co.
Roebling's Sons Co., J. A.
Sperry Elec. Mining Machine Co.
Waddell-Entz Electric Co.
Western Electric Co.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Edison General Electric Co.
Electric Engineering & Supply Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Co.
Illinois Electric Lamp Co.
Knapp Electrical Works.
New York and Ohio Co.
Sawyer-Man Electric Co.
Somoff, J. L.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Mechanical Machinery.
Ferracute Machine Co.

Medical Batteries.
Detroit Electrical Works.
Partrick & Carter Co.

Mica.
Bowers Bros.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mine Signals, Electric.
Detroit Electrical Works.

Mining Apparatus, Electric.
Edison General Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

Motors.
Brush Electric Co.
Crocker-Wheeler Electric Co.
Chicago Electric Motor Co.
Detroit Electrical Works.
Diamond Electric Mfg. Co.
Edison General Electric Co.
Electrical Eng. & Supply Co.
Emerson Electric Mfg. Co.
La Roche Electric Works.
Lovell Mfg. Co., Ltd.
Porter Leavitt Electric Motor Co.
Premier Electric Co.
Rockford Electric Manufactoring Co.
Royal Electric Co.
Stanley Electric Manufacturing Co.
Thomson-Houston Electric Co.
Waddell-Entz Electric Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Becker Mfg. Co., John.

Office Furniture.
American Desk & Seating Co
Andrews & Co., A. H.

Oil Cups.
Powell Co., The Wm.

Oil Purifiers.
Gravity Purifier Co.

Pins and Brackets.
Central Electric Co.
Electrical Supply Co., The.
Loud, H. M. & Sons' Lumber Co.
Railway Equipment Co.
Schindel & Schindel.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The.
Lefmann, Julius.
Loud, H. M. & Sons' Lumber Co.
Milliken Bros.
Railway Equipment Co.
Schindel & Schindel.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Pulley Blocks.
Sioux City Electrical Supply Co.

Push Buttons.
Detroit Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co.

Securities, Electrical.
Perry & Noyes.

Separators, Steam.
Hine Eliminator Co.

Silk Braid.
Boston Braid Mfg. Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway.
Detroit Electrical Works.
Railway Equipment Co.
Schindel & Schindel.

Tapes, Insulating.
Andrae, Julius.
Central Electric Co.
Cushing, F. W.
Crescent Ins. Wire & Cable Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Standard Paint Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Detroit Electrical Works.
Western Electric Co.

Test Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.

Transformers.
Diamond Electric Mfg. Co.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Detroit Electrical Works.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Stilwell & Bierce Mfg. Co.

Universities.
Institute of Technology.

Water Wheels.
Leffel & Co., The Jas.
Pelton Water Wheel Co.

Wire, Bare.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Railway Equipment Co.
Roebling's Sons' Co., J. A.
Sperry Elec. Mining Machine Co.

Be suspicious of any Company that is anxious to lose money in order that you may have the best equipped electric railway in the country.

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Workmanship, Efficiency and Successful Operation Guaranteed.

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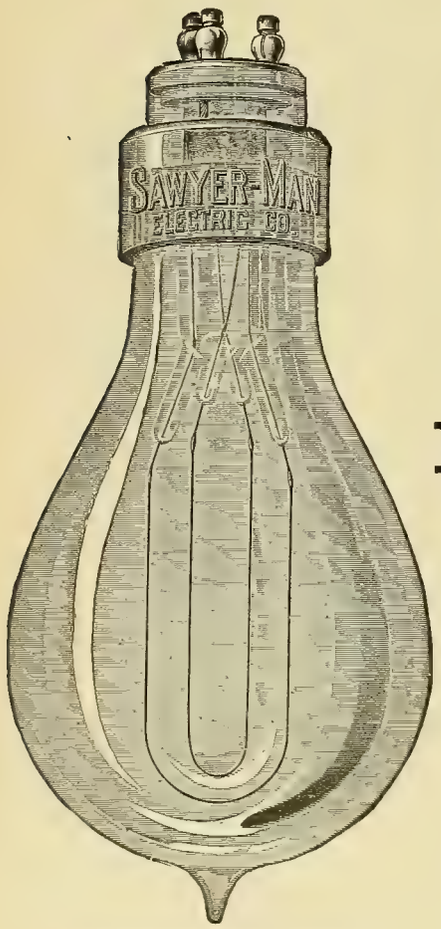
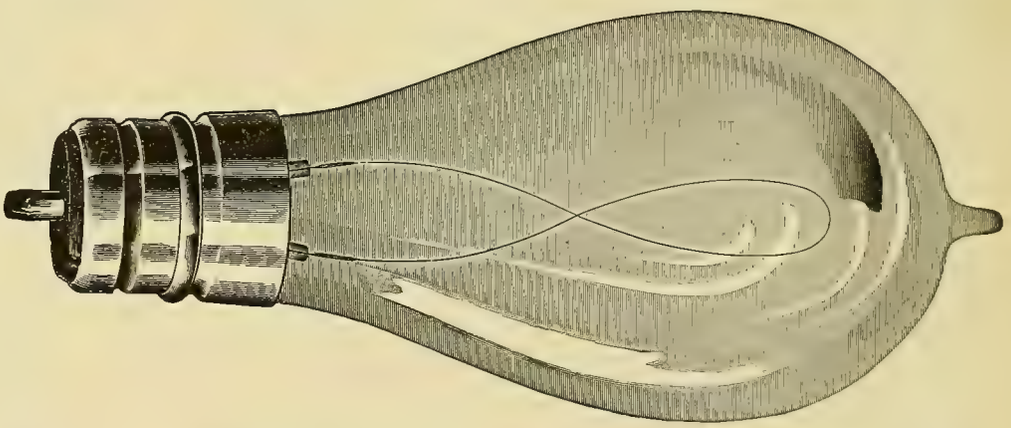


(SHOWING LAMP HALF SIZE.)
100 c. p. and 150 c. p.



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HIGH GRADE STOCK.

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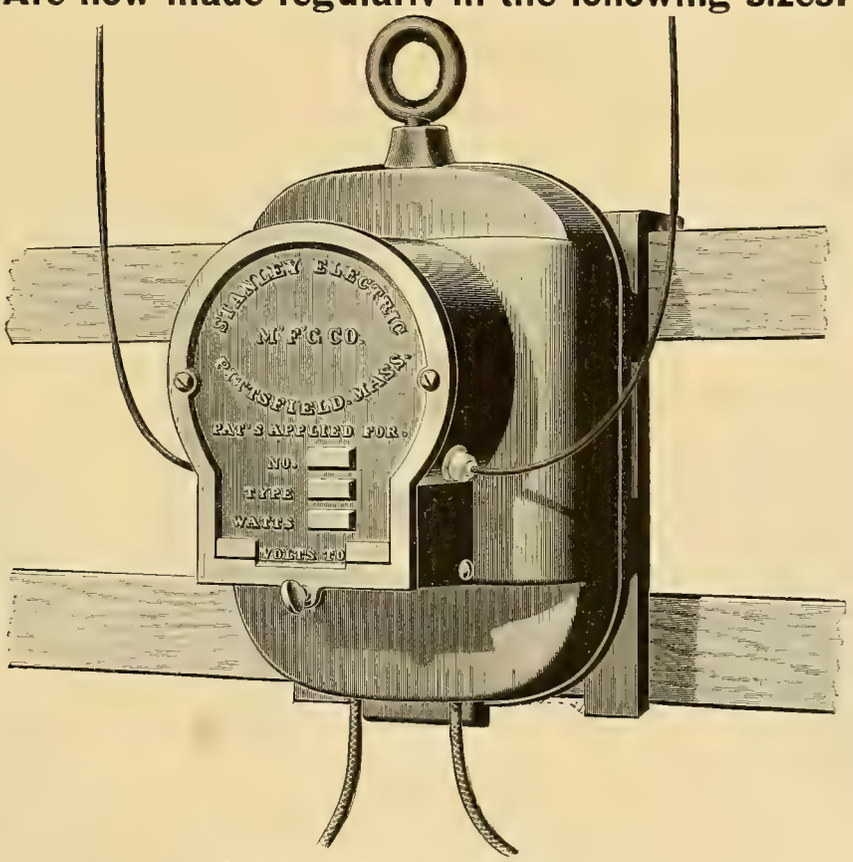
Are now made regularly in the following sizes:

5,	16-C. P.	Lamps.
10,	"	"
15,	"	"
20,	"	"
30,	"	"

40,	16-C. P.	Lamps.
80,	"	"
100,	"	"
150,	"	"
200,	"	"
300,	"	"



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Write to

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CARBON TRUST IS A FAILURE!

(You may thank us for it), and indications are it will soon fall apart, each fellow pulling for himself. Then

Your Harvest Will Come,

So don't make Long Time Contracts, ONE YEAR IS LONG ENOUGH. We booked orders last month for

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And this month, (up to the 16th inst.), have sold 1,871,000, and indications are, demand will run

AHEAD OF LAST MONTH.

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Electrical Supply & Construction Co.,
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Standard Electrical Works,
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Central Electric Co.,
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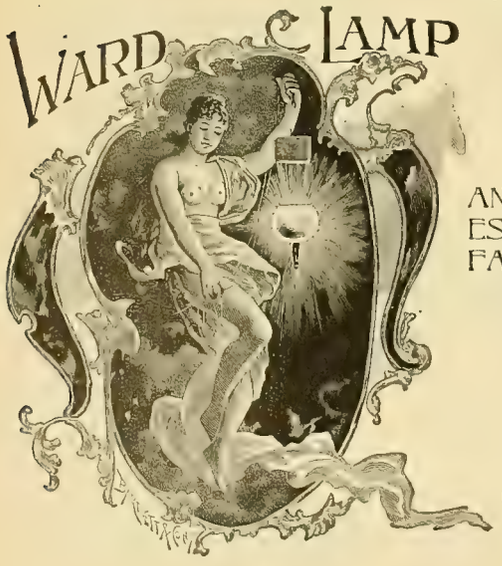

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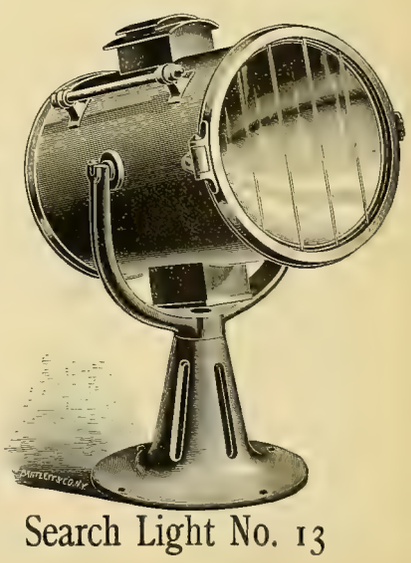

Search Light No. 13

SUPT OFFICE

HEAD QUARTERS,

FIRE DEPARTMENT.

* CITY TELEGRAPH. *

Chicago, Mar 21st., 1887. 13

C. B. Hotchkiss. Esq. [redacted]

Gen'l Agent Days Kerite.

New York.

Dear Sir:-

I send herewith a piece of Kerite Wire cut out of service on account of construction of manhole. The wire, two pieces of about 3000 feet each, was placed in one inch common gas pipe and buried beneath the pavement about thirty inches, on Cass Street from Chicago Avenue to Erie street, thence to Pine street. This work was done in the summer of 1877 and the wire has been in continuous, and is now in service, without interruption of any kind. I see no perceptible change in the material and congratulate you upon the record.

Yours respectfully,

J. P. Barrett Sup't.

P. S. This piece was removed March 14th, 1887.

April 18, 1892.—This wire is still in service after 15 years' use.

DAYS KERITE

No other rubber covered wire in this country can show such a record as this, as none of them were in existence when this wire was laid.

DAYS KERITE

W. H. ECKERT,
Gen'l Agent,
16 Dey St., NEW YORK.

F. W. CUSHING,
Gen'l Western Agent,
225 Dearborn St., CHICAGO.

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ELECTRIC RAILWAY SUPPLIES

EXCLUSIVELY.

Everything for complete equipment and maintenance of electric roads of all systems.

PROMPT SHIPMENTS. **LOWEST PRICES.** **WRITE FOR QUOTATIONS.**

W. R. MASON,
General Manager.

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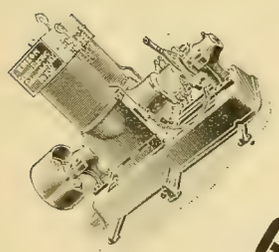
Chicago, U. S. A.



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GENERATORS, **APPLIANCES,**

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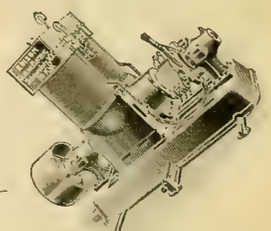
Street **Railways.**

UNDER-GROUND TUBES, **MOTORS,**

WIRE.



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EASTERN: Edison Building, Broad Street, New York. ROCKY MOUNTAIN: Masonic Building, Denver, Colo.
NEW ENGLAND: 25 Otis St., Boston, Mass.
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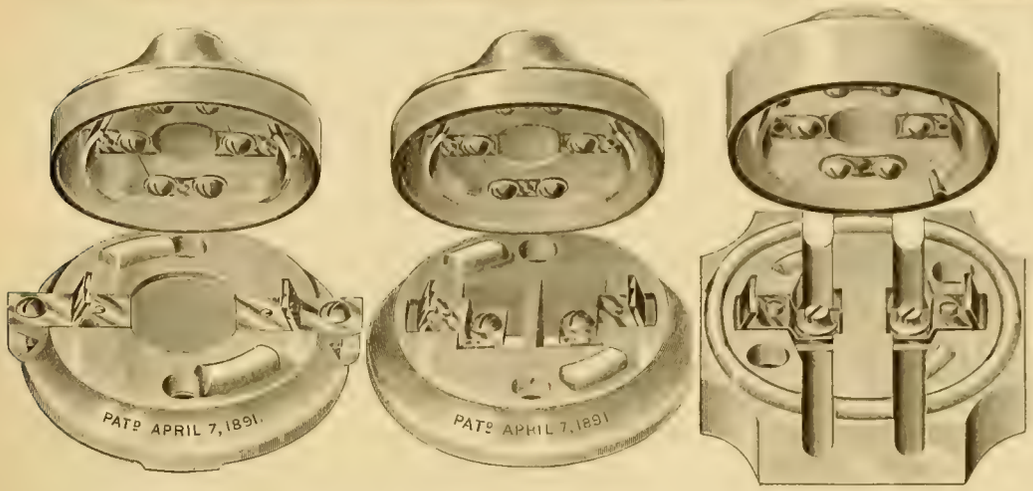

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CEILING CUT-OUT.

The Cap is adjusted without the use of a screw-driver. Broad Contacts. Accidental Disjunction Impossible.

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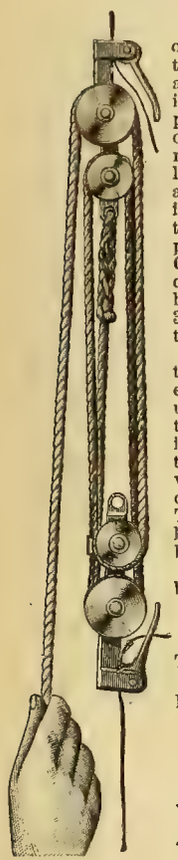
The Perkins Electric Switch Mfg. Co.,
P. O. BOX 816 HARTFORD, CONN.

CLARK'S
PATENT PULLEY BLOCKS.
The Very Latest Device for Putting Up all Kinds of Wire.


No. 1.

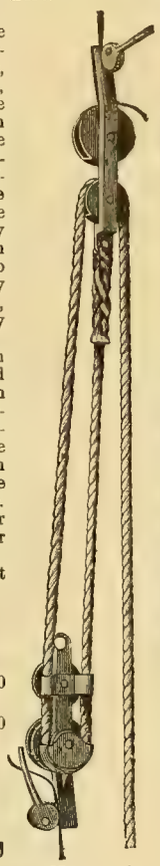
The blocks will not injure the wire, nor injure or strip the insulation. It combines all the virtues of the old style pulley block and come-along, and none of their disadvantages. The weight, including rope, is only three pounds, and the purchase is so great that an ordinary telegraph or telephone wire can be pulled asunder by one man. No time lost with long rope, as the pulleys being open, the need of long rope is obviated, and therefore fifteen to twenty feet of rope is ample for any purpose. You can at pleasure throw the rope over enough pulleys for a heavy pull, as in Cut 1, or for a light pull, as shown in Cut 2, without loss of time for adjustment, so common and tedious with the old style pulley blocks, as the pull requires. You can use 1, 2, 3, 4 or 5 pulleys, doubling your strength every time you add a pulley.

The Pulley Block will hold the wire when tight; the coupling is made by fastening unused end of rope to pulley block so the lineman can use both hands to make his coupling. The direction of the pull can be changed at will by throwing the rope on or off a pulley, a great advantage to a man on a pole. This is the only tool with which a lineman can, unaided, tighten up a line or take the sag out of a line on top of a pole. The weight is so small that it is no burden for lineman to carry. No parts to wear out or break.

For sale by all Supply Houses. Samples sent by express, prepaid, on receipt of price.

PRICES:

Telephone or Telegraph size (will grip Wire Nos. 8 to 16) $5.00
Electric Light size (will grip Insulated Wire Nos. 0 to 10) 6.00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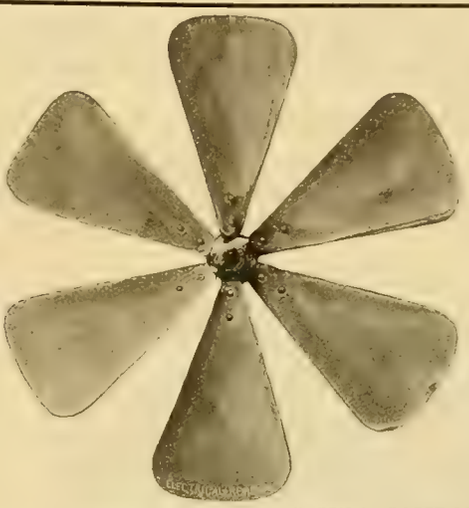

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A LOCK SWITCH
For all Fine Work—Nickel, Bronzed, Plain, Engraved, or to Match any Finish.

SIMPLE, PRACTICAL, NEAT.
Do not fail to inquire about this.

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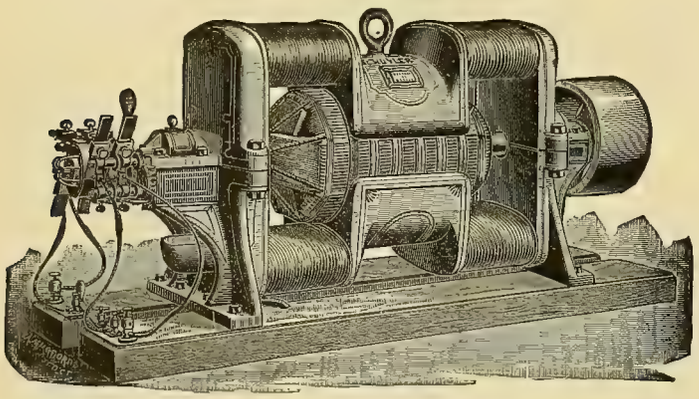

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A Pure White Steady Light.

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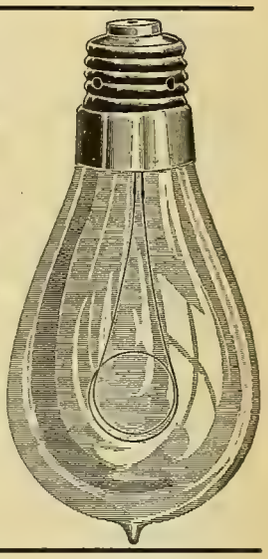
The special coiled filament, as shown in cut, used in all lamps of high voltage.

Guaranteed not to droop against the bulb.

A trial will fully convince you that the "Buckeye" is efficient, and of long life.

Is acknowledged to be the handsomest lamp in use.

Write for catalogue and prices.



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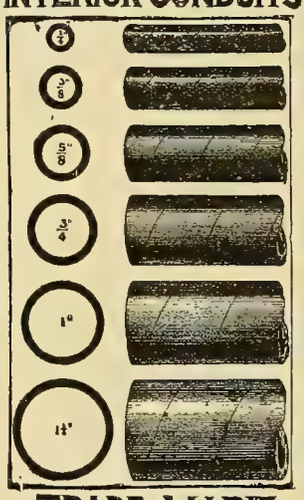

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The Solution of the Problem of Safe Guarding
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Wherever and for whatsoever purpose employed, is to be found in the
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WESTINGHOUSE ELECTRIC & MFG. CO.

NOTICE!!!

The Westinghouse Electric & Manufacturing Company will at its own cost and expense defend any and all suit or suits that may be instituted by any party against purchasers for the alleged infringement of patents, when such alleged infringement shall consist in the use of apparatus manufactured and sold by it.

We call the attention of users of electric railway and lighting apparatus to the attempts being made by the Edison-Thomson-Houston electric combination, or Trust, to secure, by threat and otherwise, a monopoly of the electric lighting and power business, which they are not entitled to, and cannot secure by means of their patents. If they could succeed in frightening users into entering into contracts binding them to take only the apparatus supplied by the Trust, then such users would be subject to a contract, which they might have some difficulty in setting aside.

A proposed contract submitted by the Trust to one of our customers indicates that they intended to bind such customer to use exclusively apparatus manufactured by the Trust, and on such terms and for such prices as the Trust might name from time to time; and it is a fair presumption that the Trust would exact a margin of profit greatly above what is generally considered a fair manufacturing profit, in order to pay dividends on their immense capitalization (fifty million dollars capital stock, ten millions of which is preferred) and the interest on the proposed issue of ten millions of bonds.

The users of electric lighting and power apparatus, however, by refusing to purchase, except upon the terms and conditions on which they ordinarily purchase machinery, i. e., with the right to go into the open market unhampered to purchase their future supplies, or repairs, or alterations (as they should do), will always be free to select the best apparatus and details

The Westinghouse Electric & Manufacturing Company sells all of its apparatus and makes all of its contracts on the above basis, and has never done otherwise, relying for future sales upon the merit of its apparatus.

We suggest the following as worthy of your careful consideration :

1. Enter into no contract with any electric light or power company except with respect to each purchase, and see that there are no hidden limitations or unreasonable provisions.

2. See that every contract contains a clause substantially as follows, for your protection as to patent matters, which clause is inserted in all of our contracts:

"The company shall at its own cost and expense defend any and all suit or suits that may be instituted by any party against the purchaser for the alleged infringement of a patent or patents, when such alleged infringement shall consist in the use of any apparatus, machinery or device, or parts thereof, manufactured or sold by the company, for which the purchaser shall have made all payments when due, provided that immediate notice of the institution of such suit or suits be given in writing by the purchaser to the company, and that the purchaser shall permit the company, through its counsel, to defend the same, and shall give all needed information, assistance and authority to enable the company to do so, and thereupon, in case of an award of damages in such suit or suits, the company shall pay such award, but the company shall not be bound to defend any such suit or suits, nor to pay any damages therein when the same shall arise by reason of the use of parts not furnished by the company."

3. Bear in mind that the agents of the Trust and its stockholders are numerous, and that spacious arguments may be advanced, and threats used, to induce you to bind yourself to purchase apparatus only of the Trust.

4. If users of electric apparatus will act judiciously, then no Trust or Combination can expect to receive a higher price for apparatus than is warranted by fair competition.

When the Westinghouse Electric and Manufacturing Company entered upon the manufacture of railway apparatus, the price charged by the present members of the Trust was about $3,500.00 per car equipment. One-half of the above figure is the asking price to-day, and this reduction has been brought about by competition.

WHAT THE TRUST WOULD CHARGE IF THERE WERE NO COMPETITION.

The members of the Electric Trust (Thomson-Houston, Edison General, Fort Wayne and Brush Companies) made bids for the incandescent lighting of the World's Fair, in each instance amounting to about $1,800,000.00, and they have since offered to do the same work for $550,000.00, the result of our competition.

We invite the co-operation and support of all users of electrical apparatus, who desire to have the benefits of competition.

Pittsburg, Pa., April 29, 1892. **WESTINGHOUSE ELECTRIC & MFG. CO.**

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MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

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They make a number of Presses especially adapted for ALL KINDS OF ELECTRICAL WORK.

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FOR SALE CHEAP.

We have a number of Dynamos and Motors nearly new, which we will sell at a low price, among the number being **two 650-light, 1,000 volt Alternators.**

WANTED TO BUY:

Second-hand machine, from 50 to 200 lights, 110 volt.

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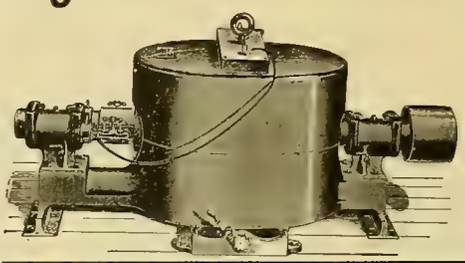
Dynamos and Motors.



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ELECTRIC GAS LIGHTER

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Never fails to light.
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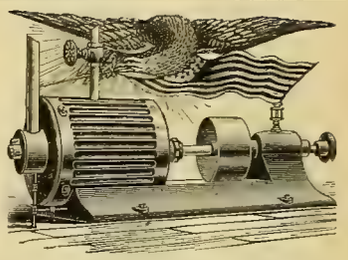

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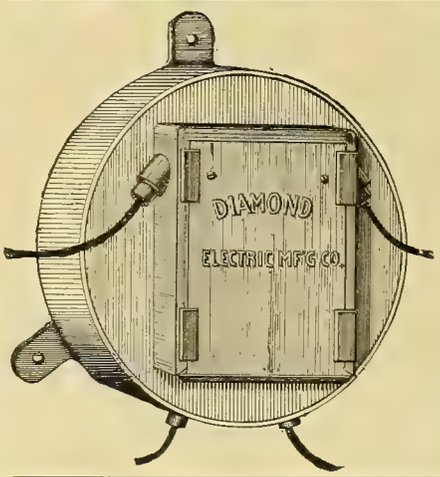

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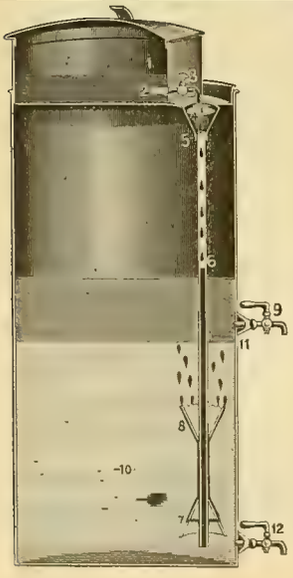

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ONE GALLON OF OIL RUNS A DYNAMO 200 HOURS.

This filter will save its cost in a short time, and does the work perfectly. Just clean the movable screens, Nos. 2 and 4, occasionally, and it will do the work.

LIMA, OHIO, April 20, 1892.

THE GRAVITY PURIFIER CO., Decatur, Ind.

GENTLEMEN:—We have used two of your Purifiers for about one year, and find they are all you claim for them, and we would not be without them.

Yours truly, LIMA ELECTRIC LIGHT CO.,
C. J. Diehl, Supt.

They are Guaranteed and sent on 30 Days' Approval.

No. 2 (Stock Size) Holds 8 Gallons Clean Oil. Price, $15.00 Net. No Discount.

Filtering capacity from 3 to 10 gallons per day, according to quality of oil. Other sizes made to order and charged accordingly. Large sizes made with two or more tubes to increase filtering capacity. Send for one and give it a trial, and you will be well pleased.

Write for descriptive circular.

THE GRAVITY PURIFIER CO.,

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The Waddell-Entz Electric Co.,

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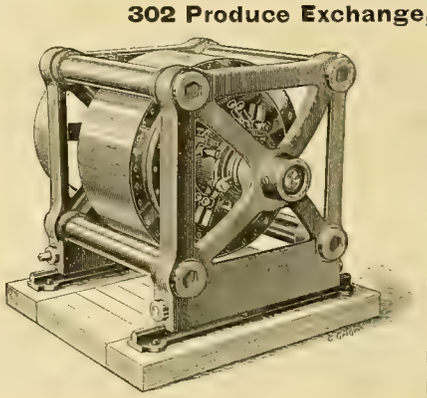

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Slow Speed Generators for Electric Lighting and Power. Low Running Expense.

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Insulated Wire. Cables

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Special Machines Designed.

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CHICAGO, 438 "The Rookery." **BUFFALO, 50 Terrace.**

Western Electrician.

EVERY SATURDAY.

Vol. X. CHICAGO, MAY 7, 1892. No. 19

Electricity at the World's Fair.

In the series of illustrations that the WESTERN ELECTRICIAN is from time to time presenting to show the progress of the work on the electricity building at the World's Fair, the picture, Fig. 1, given on this page, represents a new step in construction. It is a reproduction of a photograph taken on April 26th, and shows the northeastern corner of the electrical building, taken from the great manufactures building. In the foreground a portion of the lagoon to the north of the electricity building is seen, while glimpses of the mining and transportation buildings are visible to the westward. The picture is of especial interest from the fact that it is one of the first showing the process of applying the staff covering to the wooden framework of the electrical building. The staff is a sort of white plaster compound, manufactured by Italians, and it is easily moulded into beautiful geometrical and sculptured figures. A number of striking designs have been prepared for the adornment of the building and several have been illustrated in this journal.

It is announced that hereafter Frederick Sargent, electrical engineer of the construction department, will have charge of the mechanical engineering department also. Inasmuch as by far the greater part of the steam plant at the exposition will be used for supplying power for electric lighting and motor service, it has been thought best to have the entire installation under the charge of one man. The position thus created is a very responsible one, and it is highly complimentary to Mr. Sargent that he should be selected to fill it. He has had much experience in mechanical engineering, and no one who knows him doubts that he will perform the exacting requirements of the place satisfactorily. The work of laying out the plan for the engines of the power plant is already under way.

The framework of the electrical subways is entirely completed. Last week the contract for supplying the cast-iron uprights to hold the cross-arms in the conduits was let to the Dearborn Foundry company of Chicago for $2,700. The specifications enumerated 608 of these uprights. The contract for the cross-arms, wedges and pins will soon be let. Two thousand five-pin oak cross-arms will be required. The 10,000 pins must be of locust.

Specifications are out for the conductors for the arc light circuits for the World's Fair, and the wire men are as busy as bees. Two kinds of conductors—insulated and lead covered—are enumerated. Bids for the former will be received in quantities from 10 to 100 miles and for the latter from 5 to 50 miles. The insulated wire must be of soft drawn copper, having a conductivity of 96 per cent., with a sectional area of equivalent to No. 8 B. W. G. wire, or not less than 27,225 circular mils. The insulation must be water-proof and of the kind known to the trade as "rubber covered wire." One half the amount must be furnished forty days from the signing of the contract and the remainder seventy days from the same date. The lead covered conductors must be made up of not less than seven strands of soft drawn copper wire, to have a combined sectional area of a wire of No. 8 B. W. G. The contractor must state in what lengths the conductors can be furnished. It is intended to use the large wire for the main circuits and the cables for the subsidiary ducts leading to the lamps.

Since the temporary electric lighting and power plant at the World's Fair was illustrated in the WESTERN ELECTRICIAN early in November last, several additions have been made both to the electrical and mechanical equipment, until the plant has reached the proportions indicated in the carefully drawn plan shown in Fig. 2.

There are now 167 arc lamps distributed about the grounds, and about 135 are burned nightly. About 600 incandescent lamps are wired in the service building, power station and fire engine house, but it is seldom that the load exceeds 250. The power transmission has given the greatest satisfaction, and all the contractors for the several buildings speak of motors in the highest terms. Many of them had never had experience before with electrically transmitted power, and thus the World's Fair has already accomplished much valuable electrical missionary work. One man who had a contract in the fisheries building was at first persistent in asserting that nothing but a steam engine would do for his sawmill. He was allowed to use one, but the smoke from the boiler did considerable injury to the staff, and the men in charge of that material made such an energetic protest that the contractor was at last prevailed upon to put in a motor. He is now one of the most enthusiastic advocates of electricity on the grounds. The following table shows the motors now in use and the work that they are doing:

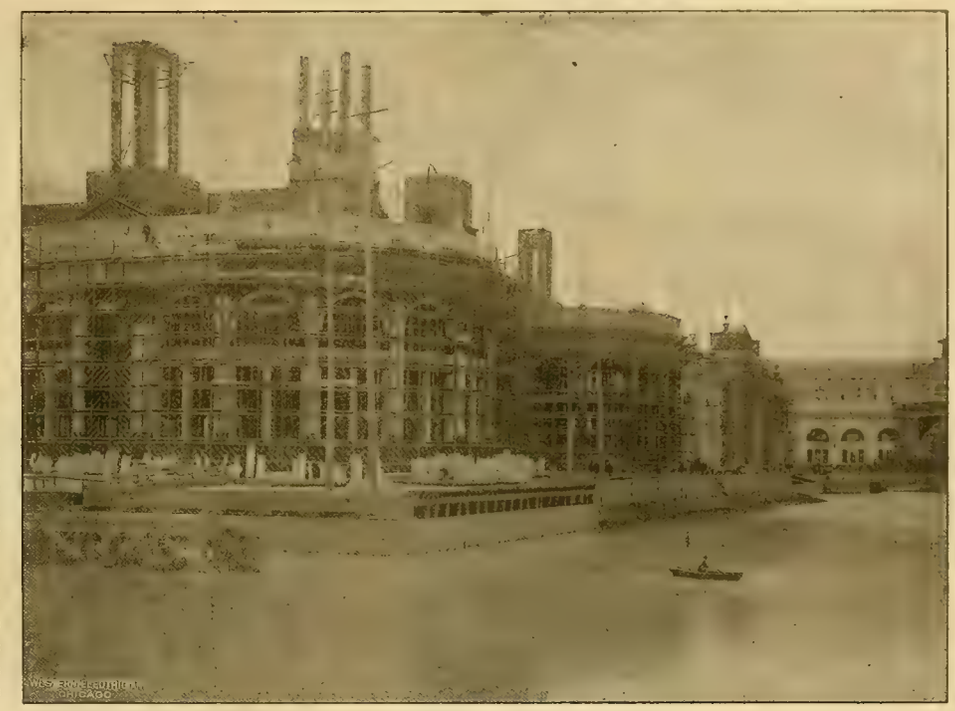


FIG 1. ELECTRICITY AT THE WORLD'S FAIR.

Location.	Capacity in Kilowatts.	Driven Machinery.
Illinois State building	15	Sawmill.
Illinois State building	5½	Hoist.
Government building	15	"
Government building	15	Sawmill
Fisheries	20	"
Manufactures and liberal arts	12	"
Electricity	12	"
Machinery hall	15	"
Agricultural	30	"
Agricultural	20	Hoist.
Forestry	5½	Drill press.
Blacksmith shop	6	Forge blower.
Clay crushing shop	12	Crushing machine.

In addition to these motors others were employed in the transportation, mining and horticultural buildings, but have been taken out, as the work for them is finished. All the motors now in service are of the Edison type. The electric plant is in charge of J. H. R. Ward, and L. A. Scovil is superintendent of construction.

The trouble over the incandescent lighting contract for the World's Fair is by no means over. At the time that the committee on grounds and buildings decided to give the work to the Thomson-Houston-Edison company at its last offer of $5 95 per lamp, nearly everybody considered the matter as settled. But the contract was not signed, and when Mr. Westinghouse reappeared on the scene the whole subject was left to the discretion of Mr. Higinbotham, vice-president of the Exposition company, and chairman of the committee on ways and means.

On Tuesday morning, May 3d, Mr. Higinbotham made up his mind as to his duty in the matter. To a representative of the WESTERN ELECTRICIAN he said: "I have come to the conclusion not to comply with the recommendation of the committee on grounds and buildings and sign the contract. I shall do my duty in the matter by reporting to the committee this afternoon in favor of re-advertising for bids. I do not consider that there exists such an emergency as would justify me in signing the contract. I do not care to say anything in relation to the merits of the controversy, but merely wish to state the position that I occupy. I think that the committee on grounds and buildings should begin all over again." Mr. Higinbotham's position means, undoubtedly, that the whole matter will be re-opened, and it is reported that Electrical Engineer Sargent is preparing new specifications for the incandescent lighting.

C. A. Terry of Pittsburg, the secretary of the Westinghouse Electric & Manufacturing company, arrived in Chicago on Monday. Mr. Terry courteously but firmly refuses to talk about his company's connection with the World's Fair contract, but it is currently reported that he brought with him to Chicago a check for $50,000 to guarantee that if new bids were solicited, his company would offer to do the work as low as, or less than, an average rate of $5.50 per lamp. It is further reported that the Westinghouse company has executed a bond in the sum of $500,000 that it will carry out its agreement at that rate, if awarded the contract. It is also asserted by those who should be in a position to know that Mr. Westinghouse has offered to furnish either direct current or alternating apparatus.

B. E. Sunny, western manager of the Thomson-Houston company, characterizes the proposition to re-advertise for bids as "extraordinary," and says: "The matter was settled three weeks ago by a formal resolution of the grounds and buildings committee. We were given the contract, and it does not seem to me possible that the committee can go back on its action. Such action would be contrary to all business principles. I do not know what we shall do in the event that the committee takes action with a view of reversing its decision."

There appears to be but little doubt that, whatever the result to the electric companies, the World's Fair will get its incandescent lights at a very cheap rate. One feature of the situation is the possibility that the Edison company may seek legal means to prevent the World's Fair from using incandescent lamps of other than its own manufacture, if the Westinghouse company should get the contract.

The new telephone line from Belfast to Dublin, in Ireland, has been formally opened. The new line, which is worked on the metallic return principle, also makes connection with Drogheda and Dundalk.

Central Station for Washington Park, Chicago.

A contract which has been the subject of much sharp competition was awarded on Thursday of last week by the South Park Commissioners of Chicago. It was for the arc electric lighting plant that is to be erected in Washington Park and from which Drexel, Grand and Oakwood boulevards, Garfield boulevard east of State street, Washington Park and the streets surrounding it are to be lighted. The specifications required the contractor to furnish a generating capacity of 264 lamps. The dynamos must be set up in the station and switchboards provided. The contractor must furnish the conductors, laid under ground in lead-encased cables inclosed in steel pipe. The bids included all the construction work, posts and double carbon lamps. The work is to be completed within four months from the date of signing the contract.

The commissioners rejected the first bids, which were much higher than those subsequently received. The second set of bids was as follows: Fort Wayne company, $64,700; Abbott Bros., $66,500 to $79 500, depending on cable used; Brush Electric company $63,250, for any rubber or fiber cable; Standard Electric company, $60,074 to $64,439, depending on the cable used; Thomson-Houston company, $66.790; Western Electric company, $60,140 to $66,725, depending on cable used. The contract was awarded to the Brush company, which is also to furnish the steam plant, for an additional compensation of $22,743. This includes a Corliss engine, boilers, etc. Work on the power house will be begun soon. The station will be near Cottage Grove avenue and Fifty-fifth street.

Decatur, Ill., has a new electric light company.

The Use of Electrical Expressions.

By D. W. J.

Has it never struck you as remarkable that electricity has made such progress in common speech and in literature? Have you ever considered how frequently we employ expressions that are electrical in nature; how often public speakers resort to electrical phenomena for their material for simile and metaphor; how frequently our writers employ subjects taken from the electrical world or indulge gay fancies in speculation over some electrical achievement?

What word in the language is so popular as "electric"? It is applied to every advertised specialty and to a variety of quack nostrums. It is evidently commendable as descriptive of soap, stove polish, hair brushes and real estate. It is indeed a potent word to conjure with. "Magnetic" is not quite so bad, though it serves as a qualifying adjective for a host of substantives ranging from mineral water to political candidates.

There was once a danger that a slang expression arising from electrical experience might find its way to popularity. In places where electric cars were in operation people once on a time were beginning to find that it was much more forcible and picturesque to remark "Oh! your trolley is off," than to say "You are mistaken." For some reason, perhaps because it was not absolutely senseless, the expression did not commend itself to popular favor, for which let us be truly thankful. But the increasing familiarity of the public with matters electrical is too well recognized to require emphasis here, and when the public is familiar to any extent with the expressions of any technical field it is bound to use them in common speech. This familiarity and this use of electrical expressions is bound to increase, too, for the reason that electricity appeals to the imagination, as so many of our engineers have testified. An inventor whose name is stamped on all the apparatus of a well-known electric light system once told the writer that he experienced no longer any difficulty in seeing the whirls of the current around the wire. Perhaps others have attained that same ecstatic height.

It is a pleasure to realize that electrical nomenclature does not lend itself readily to puns. Some few have been perpetrated which can be recalled with a shudder, but only a few. It is to be hoped, therefore, that the international congress of electricians which will assemble at the time of the World's Fair will take care to follow the good precedent in naming new units. If the unit of self-induction is to be known as the henry, let it be distinctly understood that the first syllable is not to be used as the abbreviation. We will all hear from it in due season should such be the case. The writer once occupied an humble position on an electrical journal, and as he looks back on that experience the pleasantest recollection is that of consigning to oblivion a poem designed to be electrical, humorous, and full of puns.

Among the writers for the daily press electrical expressions are extremely popular. The first one that comes to light in a paper that lies before me is one in which a certain statesman is alleged to be trying to "palm off an electric light as the only original star of destiny."

Dr. Oliver Wendell Holmes is particularly addicted to the use of expressions suggested by electrical phenomena. This is true in the case of his novels as well as in his poems and sketches. In "Elsie Venner" a dozen or more apt similes and metaphors, can be found, all of this character. We all are familiar with the Autocrat's poem descriptive of the electric car as the "broom-stick train." Within the last fortnight Dr. Holmes has again drawn upon his fund

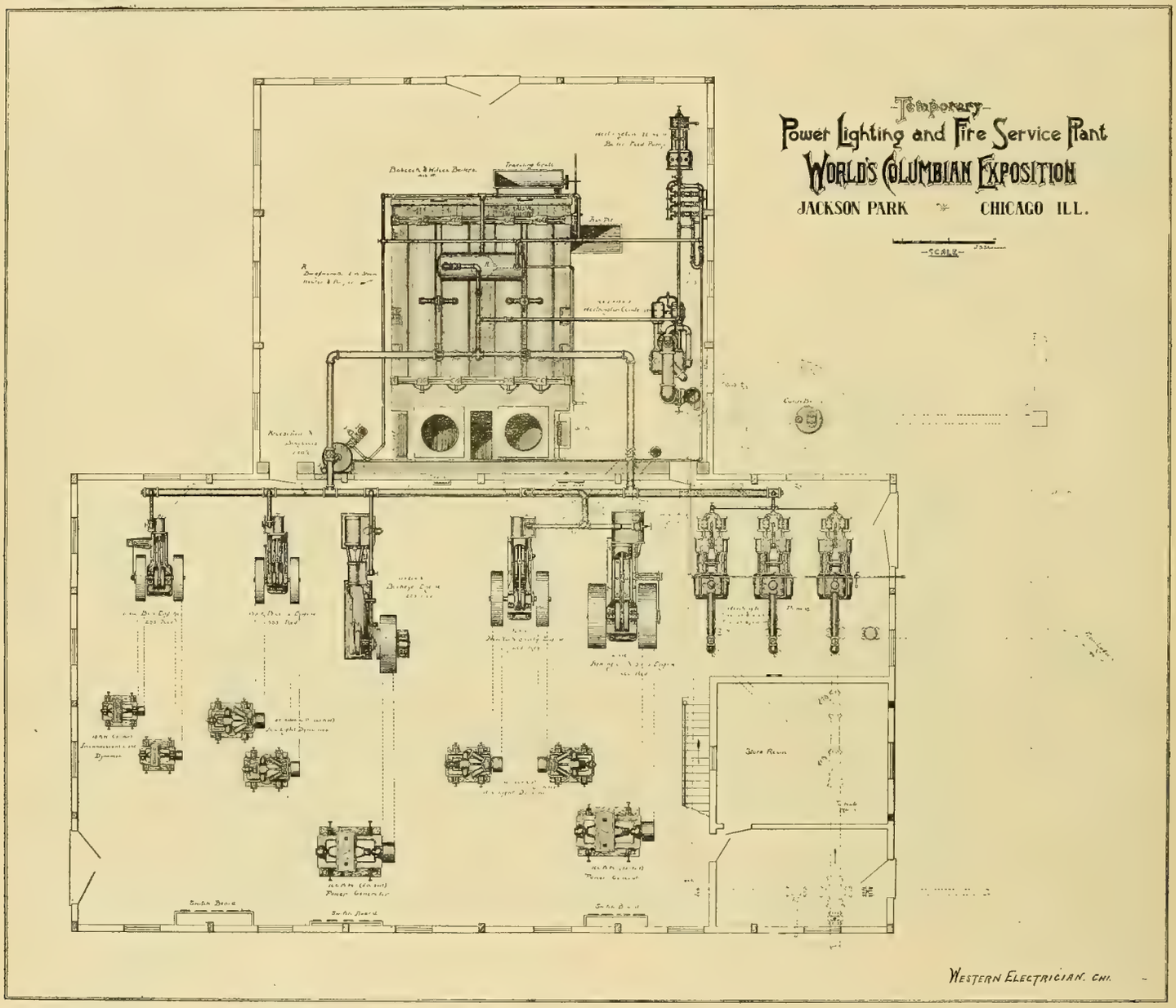


FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

of electrical expressions. At the reception given to Rev. Dr. Edward Everett Hale on April 18th the following poem by Dr. Holmes was read.

THE LIVING DYNAMO.

Night after night the incandescent arc
Has fought its dazzling battle with the dark,
Our doubtful paths with purest ray illumed,
Untired, undimmed, unswerving, unconsumed.

A slender wire the living light conveys
That startles midnight with its noonday blaze,
Through that same channel streams the giant force
That whirls the wheels along their clanking course
When, like a mail clad monster, o'er the plain,
With clash and clamor sweeps the broom-stick train.

Whence gains the wondrous wire its two fold dower,
Its double heritage of light and power?
Ask of the motor man, he ought to know—
And he will tell you "from the dynamo."
And what, again, the dynamo inspires?
'A mighty engine, urged by quickening fires,"

When I behold that large, untiring brain
Which seventy winters have assailed in vain,
Toiling, still toiling, at its endless task,
With patience such as Sisyphus might ask,
To flood the paths of ignorance with light,
To speed the progress of the struggling right,

Its burning pulses borrowed from a heart
That claims in every grief a brother's part,
My lips repeat with reverence, "Even so
This is in truth a living Dynamo!"

Be ours to heed its lessons while we may,
Look up for light to guide our devious way –
Look forward bravely, look not weakly back,
The past is done with, mind the coming track;
Look in with searching eye and courage stout,
But when temptation comes, look out! look out:

Heaven grant all blessings time and earth can give
To him who has taught us how to live,
Till on the golden dial of the spheres
The twentieth century counts its gathering years,
While many a birthday tells its cheerful tale,
And the round hundredth shouts All hail! All hail!

It is unnecessary to multiply examples; those who desire others can probably find them in the first clever book that they read. The poem quoted is only presented because it is novel.

The same tendency is to be found in stage literature. We are all familiar with the valuable service which the telegraph, telephone and phonograph have performed in the development of dramatic situations (called such at any rate) in comedies and farces. But the fact to which attention is specially drawn here is that in plays nowadays ideas suggested by familiarity with electricity are worked into the very fabric of the drama. In the "Lost Paradise," for example, the plot hinges on the theft of an invention of an improved form of dynamo. The wrongful owner of the invention made more money out of it than any manufacturer of dynamo electric machinery ever did in real life; but that is legitimate dramatic exaggeration. In this case the theft of any other invention would have served the purpose, but the writer or the adapter of the play naturally made a choice from this field as something best calculated to appeal to the popular mind.

"Niobe" is electrical throughout. The statue which comes to life and amuses the audience by the application of Greek sentiments to modern circumstances is quickened into being by current leaking from wires wrapped around the feet of the statue by a careless wireman. Of course the latter should be deprived of his certificate. Had a competent inspector been about, *Niobe* would have remained in the stone. *Peter Dunn*, the much-abused and much-confused wretch in the play, is constantly making remarks of an electrical turn, referring for example to the Thomson-Houston-Edison consolidation, saying that sculpture is not in it with the telephone, etc., etc.

Other dramas in which electricity plays its part could be enumerated; in fact, those who have perused this article to this point can doubtless amplify the list very satisfactorily.

McLeod's Junction Box for Underground Telephone Cables.

In a recent issue of the WESTERN ELECTRICIAN there was presented an illustrated description of the new and elegant quarters now occupied by the Wisconsin Telephone company in Milwaukee. This company has been busy perfecting a long-distance service and burying its wires in Milwaukee, and by next fall it is expected that the conductors will be underground. In prosecuting the work of underground extension the Wisconsin company has had to overcome many difficulties and its present system is the result of much study and hard experience on the part of its officers.

In laying out the underground service the question of insulation was, of course, of prime importance, but no less so was the necessity of flexibility and extensibility. Telephone systems expand sometimes, in a very erratic manner and these future extensions in the system must, to a certain degree, be predicted and provided for at the start. It was with a knowledge, then, of the intricacies of the problem to be dealt with that General Manager John D. McLeod set about his work of amplification.

The cuts show one of the most important features that has been introduced into the Milwaukee system. This junction box is, is to quote Mr. Leod, "the result not only of our own experience but the experience of many other telephone companies with whom I have consulted." From the following description, telephone men will have no difficulty in appreciating the advantages of the McLeod box.

Figs. 1 and 2 show, bolted to the concrete walls of the manhole, a cast-iron box, 17 inches long, 11 inches high, including its cover, and 5½ inches through. This box is a mere protection and support to an inclosed lead box. On the top of the lead box rests a diaphragm containing 100, more or less, projecting lead tubes. Each tube contains its pair of wires extending below the diaphragm sufficiently for connection with the cable wires. To illustrate the manner of connecting the box there may be, say, four rows of these tubes, of 25 each, hence wires Nos. 1 and 2 at the cable head, after identification in the "central" end of the cable, would be attached to the pair of wires in the left rear tube. This numerical order would be maintained to wires Nos. 99 and 100, which would be contained in the front tube, to the extreme right. The outgoing cable would, of course, be connected differently. In the process of connecting with the cable, the diaphragm, with its wires, is raised slightly above the box, and after splicing, the wires are stowed away and the diaphragm set on the top of the lead box. The edges are soldered, leaving one corner open so that the box can be filled with the insulating compound. After filling the final soldering is done. With this box there is available any pair of the 100 pair cable at this manhole. Each pair possesses the same integrity, so far as the insulation is concerned, as if it were within the sheath of the cable. The process of splicing offers no more difficulty than in splicing a straightaway cable, except that double the number of splices are necessary. Given a hundred pair cable, it is the purpose to make any pair contained available at any point in the district it is designed to serve. To illustrate this service, reference may be made to a locality where this method of distribution is in practical operation. This district is covered by 10 manholes, containing wires for 78 subscribers, and the supply is by service wires from the junction boxes to adjacent pole tops. The diagram represents the number of manholes, and the subscribers to be served at each point, Fig 3.

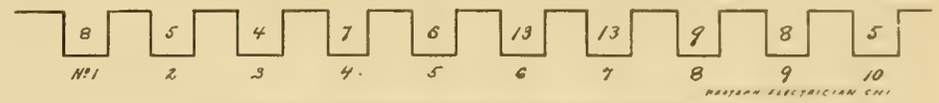


FIG. 3 M'LEOD'S JUNCTION BOX FOR UNDERGROUND TELEPHONE CABLES.

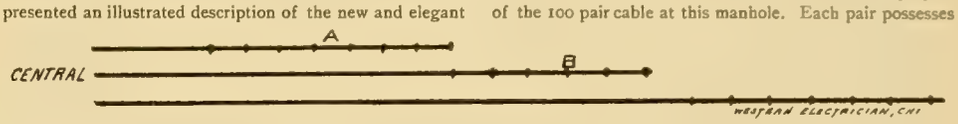


FIG. 4. M'LEOD'S JUNCTION BOX FOR UNDERGROUND TELEPHONE CABLES.

As in this box there is presented and made available every wire at every point, it is obvious that the growth of the business at any point within the mile this cable is designed to serve, can be met until the last wire in the cable is occupied.

To illustrate the applicability of the box, let it be supposed that there is a demand for the sixth subscriber at the second manhole. To connect this subscriber the lead tube containing the wires designated at the cable head is first identified and cut, and then that pair is connected with the wires trained through the tube to the top of the pole.

If, on the other hand, a subscriber at No. 2 is lost, the service tube may be restored to the normal condition, and the wire removed may be utilized for, possibly, the fourteenth man, at manhole No. 7, and so on. The installation between the junction boxes and tops of the poles will never exceed the number of working subscribers.

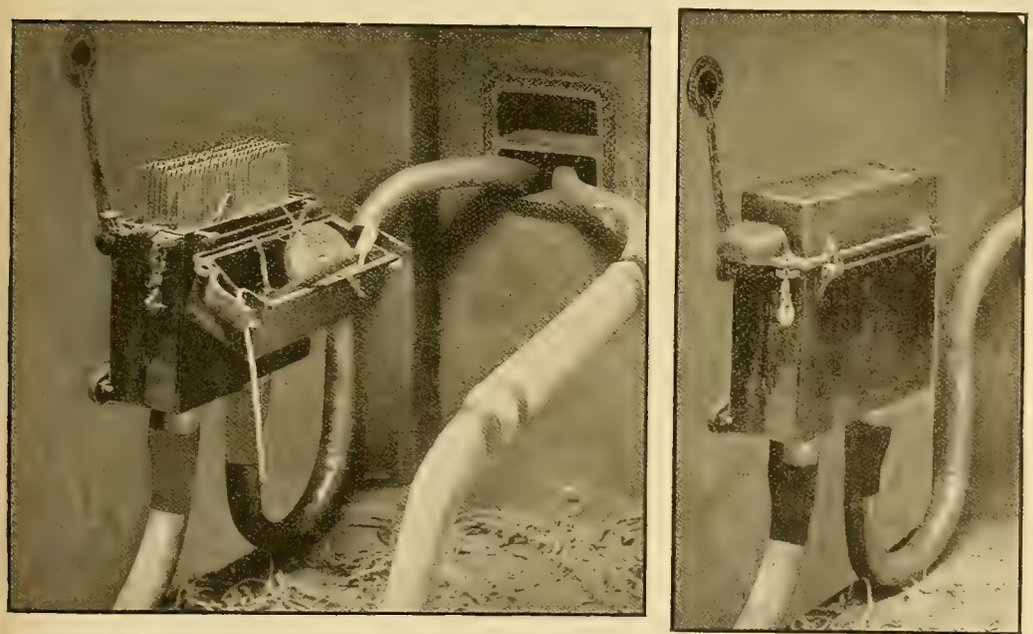
Having met the needs of one district, as indicated above, points beyond on the second and third systems in the same direction, will be supplied by other cables from "central," on the same plan. In this manner an abnormal growth of business filling the cable in one system, may, by the use of its dead-ends and paying from one to the other, be relieved by either of the adjoining systems as shown in Fig. 4 at *A*, *B*, *C*, *D*, etc.

These expedients, in a way, hedge against the cost of a new cable until the last wire of all the adjacent systems is engaged.

Experience only of course, can show the flexibility of this method of distribution, but it is thought that the dead ends in the several cables may be ultimately employed by merely carrying a relief cable from the exchange to the nearest manhole, and connecting the dead ends at the terminus of system *A* with those of system *B* and so on.

The arrangement seems to be flexible enough to meet the growth of business equally well at all points, although according to Mr. McLeod, the investment in service wires at distributing poles equals precisely the number of active lines.

In writing of his new system Mr. McLeod states that the box has been in practical operation for some time, and has undergone the severest possible test. Through the breaking of a water main, three of these junction boxes, with their local service wires, were entirely submerged for a period of five weeks, and the measurements taken upon the lines in this condition showed no signs of the insulation failing.



FIGS. 1 AND 2. M'LEOD'S JUNCTION BOX FOR UNDERGROUND TELEPHONE CABLES.

Hazards of Artificial Illumination.[1]

By George P. Low.

The careful student of statistics cannot but feel that cold facts and figures are sometimes viewed from a standpoint that makes them appear entirely different from the reality. Such a condition is often found during an investigation of statistics concerning fires, their causes and the fire loss, which will be mixed up into a jumble, impossible of rational comprehension. If a red-hot meteor should fall into and ignite a warehouse, and if the fire so started should get beyond control and consume property worth a hundred millions, while the fire loss in America from all other causes for the year was fifty millions, would it be rational to contend that the most potent cause of fire was falling meteors? Unreasonable as this would be, it is but an exaggeration of a prevalent idea that the fire loss on fires due to a particular cause for a given period forms a reasonably adequate basis for the determination of the rank of the cause as a fire producer. In every instance a cause is an incipient fire, and whether that fire is extinguished in its incipiency or whether it develops into a conflagration depends upon conditions foreign to the cause itself; and hence these conditions exert no influence upon the cause, and are not to be confounded with it.

The methods of artificial lighting in use resolve themselves into four classes—lamps and lanterns, gas, candles and the electric light. With the exception of the incandescent lamp all the methods of lighting named consist of a flame of interesting structure, from whence issues light; but inasmuch as the arc light is virtually surrounded by a glass globe, and particularly as it is now being used most generally for outside street lighting, and for other reasons that will be apparent, it would be well to exclude it from the general class of flame illuminants. In the candle and gas jet are found the open flame, while in the incandescent electric lamp is realized a light without flame, which is entirely sealed in glass, and which has no exposed part that is susceptible to excessive heat.

Statistics show that as fire producers the sources of illumination rank in the order given, the first named, or lamps and lanterns, being generally more prolific of fires than all other methods combined. The reason therefor is easily perceived. Lamps, lanterns and other kindred evils must be small and compact, which necessitates the bringing of the flame close to a reservoir containing a highly inflammable oil. This in itself is a formidable danger, even when the best oil is used; and for proof it is but necessary to refer to the number of lamp accidents and upsettings daily reported. It is not the oil that explodes, but the invisible vapor which is always generated when the lamp heats materially, when the lamp is but partially filled or nearly empty, or when the wick is so closely woven or fits so tightly as to prevent a sufficient supply of oil to the flame.

These details, though of great importance, are all secondary to the quality of oil used; and to show what a wretched lot of illuminating kerosene is to be found, it is only necessary to state that, of 106 samples tested by the Fire Underwriters' Inspection Bureau of San Francisco, but forty samples, or a trifle over 37 per cent., were found to be up to the legal test. One of these was such a curiosity as to deserve special mention. Its flashing point was found to be ten degrees Fahrenheit, and in order to test it it was necessary to make extraordinary exertions to bring it down to a temperature at which it could be used with safety.

The open-flame types of illuminants are confined to candles and gas, and it is remarkable how nearly identical are the two methods of lighting; for each candle is but a diminutive gas plant that generates gas and burns it on the spot. So far as the open flame is concerned, the fire-producing qualifications of each are about equal; yet the candle possesses unfortunate characteristics that would make it a greater firebug than gas were it used as extensively. To offset these inherent hazards attending the use of candles, gas presents a danger distinctly its own, namely, defective or leaking pipes, meters and fixtures, with the explosions or fires frequently consequent thereto. Moreover, where gasoline gas machines are used, the attending hazard is materially increased by the use of gasoline, unless every possible precaution is taken in installing the plant. Another hazard associated with the use of gas presents itself, and that is the necessity for the storage in gas holders of immense quantities of inflammable gas, a practice which always causes no little uneasiness whenever a fire occurs near a gasometer.

In brief, then, in all the methods of artificial illumination thus far considered, light is the result of combustion; and in order to produce it there must be present: First, some highly inflammable substance, either a liquid, a gas or a solid; and second, a flame which is the actual burning of one of the three substances defined. A trifling accident occurring to either of these forms of illumination may cause direful results; and it will require but a glance at the statistics which will be presented to show that these accidents are not only liable to occur, but that they do occur with alarming frequency.

Turning now to the most modern methods of illumination, we have in the electric light a commodity that is at once the acme of ingenuity, utility and safety; and a discussion of the topic of this paper cannot but narrow down to a comparison between lighting by means of lamps, candles and gas, and electric light. On the one hand is found a method of illumination in which light is the direct result of actual combustion, necessitating the bringing together of flame and some highly inflammable substance which entails inherent hazards that cannot be eliminated. On the other hand, in the incandescent system, no combustion of any nature takes place, no explosive or inflammable substance is required to produce the light, and no open flame exists. In fact, it is impossible for a fire to originate through the use of a properly constructed and properly cared for incandescent plant.

With arc lighting, however, a slight hazard exists, which is due to the fact that the arc lamp is to a certain extent a flame illuminant. To be more explicit, the light given from an arc lamp is the result of an arcing attending the leaping of the electric current across the separation between the carbon points. This arcing is virtually an electric flame, and the heat attending its existence is extremely great; but it is imprisoned within walls of noncombustible material, and the carbon points are rigidly secured. The current feeding it is not inflammable, neither will it explode like gas or kerosene, for the conclusive reason that in the arc lamp the flame or arc is not brought into contact with an explosive or inflammable liquid, solid, gas or any other ignitible substance whatever. As to interior wires they are absolutely as free from a fire hazard as a metallic picture cord, when properly placed and cared for. No little emphasis must be placed on this remark, as the safety or hazard of any electric light plant depends entirely upon the manner of its installation and upon the care it receives.

This and other kindred points have, however, been so fully discussed in the papers previously read before your association that it is unnecessary to do more than allude to the hazards attending the use of improperly constructed electric circuits. But let me place unusual emphasis on a statement which I know many will question, namely, that incandescent electric lighting circuits, when properly installed and properly cared for, do not present a fire hazard. Lest it be judged that my ardor as an electrician leads me to err in making a statement so strong, let us see just how far statistics bear out my estimation of the relative hazards of methods of lighting.

It is unfortunate that reliable statistics concerning many details that would be of inestimable value in the preparation of a paper of this kind are not at hand, and if they have ever been compiled I am not aware of it. Particularly would it be of interest if we could form a reasonably correct approximation of the number of kerosene lamps, lanterns, candles or gas jets in use at given periods. If such statistics were available, comparative tables could be formed, from which it would be easy to deduce some very conclusive ratios; but in their absence we must make the best of the sources of information at hand. All statistics concerning the number of fires caused in the United States by the use of illuminants have been taken from the "*Chronicle* Fire Tables" for the six years from 1885 to 1890, inclusive, while the statistics for San Francisco are from the Reports of the Underwriters' Fire Patrol, from 1885 to 1891, inclusive, as compiled by Capt. Russell White, to whom, as well as to F. H. Porter and G. W. Harrison of the Fire Underwriters' Inspection Bureau, I am indebted for much interesting information. No figures previous to 1885 are available, but if they were presented it is doubtful if the general result would be materially changed.

Tables A and B show the number of fires caused by artificial illuminants, together with the percentage of each cause to the whole number of fires from all causes, illustrated in Fig. 1, and to the whole number of fires caused by artificial illuminants, illustrated in Fig. 2.

In studying statistics it occurs to me that another hazard connected with the use of flame illuminants rests in the fact that some means for lighting them must always be at hand. Gas is lighted by electricity without entailing an iota of danger from the use of electricity as a lighting medium, but not one gas jet in a thousand is so ignited. It may be said then that the flame illuminants are lighted with matches exclusively; and of all causes of fire the use of matches is one of the most prolific. It is extremely difficult if not impossible to estimate even in an approximate degree the percentage of match fires that are due to the use of matches for lighting the older of illuminants but when it is remembered how few are the number of heating appliances in any building compared with the number of lamps, gas jets or candles, the extent to which matches are used for igniting flame illuminants will be appreciated. Many fires caused by matches are due to children or rats, but if it were not necessary to have matches convenient to almost every lamp, gas jet or candle, the incendiary lucifer would not be as accessible to these little mischief makers. Of course other use of matches cause fires, but at a very low estimate fifty per cent. of all fires caused by matches are due to the necessity of using them for igniting the flame illuminants. This hazard of course does not attend the use of the electric light. In Table A is shown the number of fires caused by matches in the United States, and of which it would be eminently proper to charge fifty per cent. to the flame illuminants pro rata; but, in order that no question may be raised, no further mention will be made of this matter.

Turning to Fig. 1 we find a pictorial comparison between the different methods of artificial illumination as

Table A.—United States for 1885-1890, Inclusive.

Year.	Whole No fires from all causes	Whole No. caused by illuminants	Lamps, etc.			Candles.			Gas			Electricity.			Matches.
			No.	Percentage of all causes.	Percentage of illuminants.	No.	Percentage of all causes.	Percentage of illuminants.	No.	Percentage of all causes	Percentage of illuminants.	No.	Percentage of all causes.	Percentage of illuminants.	
1885	15,196	774	509	3,34	65.76	53	.034	6.84	197	.130	25.45	15	.009	1.92	374
1886	17,541	729	476	2,71	65.27	57	.032	7.81	180	.102	24 69	16	.009	2.19	498
1887	16,394	1,024	668	4,01	65.23	86	.052	8.39	232	.141	22.65	38	.023	3 71	636
1888	16,019	1,093	718	4,41	64.86	84	.052	7.68	242	.151	22.14	49	.030	4.48	592
1889	17,598	1,223	756	4,29	61.81	105	.059	8 58	288	.157	23 54	74	.042	6.05	574
1890	22,412	1,502	940	4,14	62.51	112	.049	7.45	329	.149	21.23	121	.053	8 05	691
Total,	105,160	6,345	4,067	....	....	497	....	....	1,468	....	....	313	....	....	3,365
Average,	17,527	1057.5	677	3.81	64.24	83	.046	7 79	245	138	23 28	52	027	4.40	560

Table B.—San Francisco for 1885-1891, Inclusive.

Year	Whole number of fires from all causes	Whole No caused by illuminants.	Lamps, etc			Candles.			Gas			Electricity.		
			No	Percentage of all causes	Percentage of illuminants	No.	Percentage of all causes	Percentage of illuminants.	No	Percentage of all causes.	Percentage of illuminants	No	Percentage of all causes	Percentage of illuminants.
1885	247	34	24	9.71	70 58	5	.202	14.70	4*	.160	11 76	1	040	2.94
1886	310	42	27	8.70	64 82	8	.258	19.03	7	.226	16 65	0	.000	0 00
1887	406	50	30	7.36	60.00	11	.270	22.00	9	.226	18.00	0	.000	0.00
1888	364	54	33	9.07	61.11	10	276	18.51	9	247	16.66	2	.054	3.70
1889	369	40	23	8.92	57.50	12	.446	30.00	2	.074	5.00	3	.111	7.50
1890	338	50	30	8.87	60.00	9	.266	18.00	7	.207	14.00	4	.118	8.00
1891	292	68	46	1.72	67.64	13	.331	19.11	5	.127	9.35	4	.102	5.88
Total,	2,326	338	213	. .	....	68	....	....	43	....	....	14	....	....
Average,	332	48.3	30.4	9.19	63.09	9.7	.292	20.19	6.1	.181	13.06	2	.057	4.00

1. Abstract of paper read at the sixteenth annual meeting of the Fire Underwriters' association of the Pacific.

fire producers expressed in percentages of the whole number of fires occurring each year. Statistics for the United States are represented by the broken lines, and not being materially affected by local conditions the characteristics there presented may be accepted as final and conclusive. It will be seen that the number of fires caused by lamp accidents and explosions lead those caused by the other illuminants by a marked degree, while gas comes in a fairly good second, followed by candles and lastly by electricity, which thus captures the "booby" prize as a fire producer. In these characteristics a general upward trend will be noticed, which can only be explained as a natural result of the hazard in the increased use of illuminants

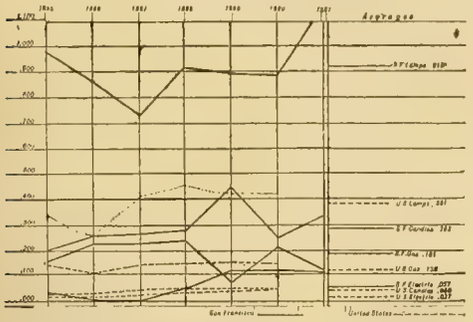


FIG. 1. HAZARDS OF ARTIFICIAL ILLUMINATION.

attending the increase of population. More especially is this true with the flame illuminants; but while the population of the United States, and presumably the use of flame illuminants, increased only a comparatively few per cent. during the six years under consideration, the electric lighting industry has increased by perhaps a thousand per cent. In this point rests what might be called a "personal error" of these diagrams. If it were possible to place the number of fires caused by each illuminant upon a basis of unity, then the result would be more fair to electricity, and certainly more satisfactory in every way.

What else is to be learned from these angles? First, that the percentage of fires due to artificial lighting in the United States is but a trifle more than 6 per cent. Again, though gas is the most extensively used illuminant, yet lamps are far more hazardous; and that such a comparatively small percentage of fires is caused by candles is due to the fact that they are now but little used. With electricity a steady and continuous rise brought the fire underwriter to a realization that steps must be taken to check this strong upward tendency; and as a result the insurance inspection of electric circuits was instituted. That it has been productive of beneficial results cannot be gainsaid.

The continuous lines in the same diagram representing the behavior of artificial illuminants in San Francisco are more interesting in that they portray local conditions. Here again lamps come in ahead of all others, causing an annual average of over nine-tenths of one per cent. of all the fires that occurred during the seven years noted. In 1891 the kerosene lamp fairly outdid itself by causing a percentage of 1.117 of all fires. In the next two lines it is found that candles and gas have changed places from those in which they existed in the United States statistics. Here candles caused more fires than gas, and the angles presented by these two forms of illuminants are a study. For the first four years they keep fairly apace, but in 1889 a remarkable divergence occurs that I have tried in vain to account for. At first one would suppose that a general war had been waged on the gas company, or that the already high gas rates had been increased, either of which would result in a decreased gas consumption and an increased consumption of other illuminants, with proportionate variations in the fire ratio; but no such conditions prevailed, as might be partially proven by the lamp characteristics, which shows a lesser proportion of fires for 1889 than for 1888. Again, the remarkable jump made by candles during 1889 is peculiar, and I have tried without success to convince myself that it was due to a society fad for burning candles. In 1890 these two lines approach,

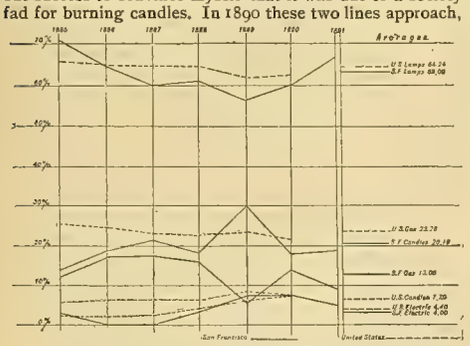


FIG. 2. HAZARDS OF ARTIFICIAL ILLUMINATION.

and in 1891 they again recede in a most unaccountable manner. The trend of the gas line, however, shows a gradual falling off, while those of the other illuminants gradually increase. Doubtless this indicates the inroads made in the business of the gas company by electricity.

A study of the curve of fires caused by electric lights and wires becomes in a measure a gratification to me, as to my hands has fallen the task of reducing the electric light hazard in this city. From 1887 to 1889 the line shows a rapid increase in the percentage of electric fires. This condition tended to alarm the local fire underwriters, which resulted in the enforcement of the electrical requirements of the Pacific Insurance Union. In 1890 this upward tendency was checked, and statistics for the year just closed show that the ratio of increase is broken, and that, in the face of the wonderful development of the electric lighting industry, the tide has turned, and is now ebbing. Captain White of the Underwriters' Fire patrol is authority for the statement that the four fires charged to electricity in 1891 were needless alarms, and my own knowledge of the fires referred to bears out his assertion. Three of them were ordinary converter burn outs; the other was simply a short circuit on a fixture caused by bronzing the fixture cord. Had not these needless alarms been turned in, the record of San Francisco for 1891, so far as electric light fires is concerned, would have been most gratifiying.

In this connection it may be well to refer to the natural increase in the fire hazard attending the use of artificial illuminants; and, as stated, about the only method of estimating this ratio for the older methods of lighting is found in the assumption that their use increases directly with the population. This, if correct, would indicate that their fire hazard would also increase with the population. In 1880 the population of San Francisco was 223,959; in 1890 it reached 298,997, an increase of 27.85 per cent. or an average annual increase of 2.78 per cent. This would therefore, indicate about the theoretical ratio of increase in the hazard attending the use of the older illuminants. I have taken the trouble to ascertain the actual yearly increase in the amount of the electric lighting business done in San Francisco during the past seven years, and find it to have increased in the ratio of 126, 184, 166, 131, 117, 131, and 136 per cent. respectively, or an average annual increase of 141 per cent. It must be evident then that the hazard attending electric light installations has not kept pace with the growth of the industry; and, if the statistics presented were reduced to the basis of unity referred to, it would be found that the line for the fires caused by electricity would show a constant downward trend, while those of the older illuminants would rise in about the ratio of the increase of population, Unfortunately, however, statistics from which these data may be deduced are not to be obtained.

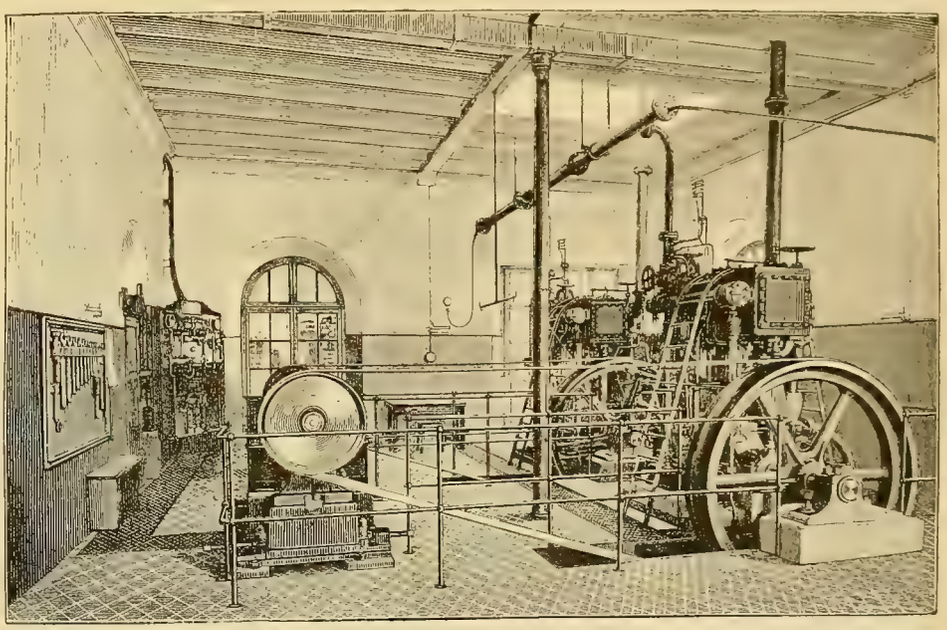
Fig. 2 is designed to show the proportion which the number of fires caused by any artificial illuminant bears to the whole number of fires caused by illuminants. At the first glance one is struck by the remarkable closeness which exists between the average percentage of fires caused by lamps and also by electricity in the United States and San Francisco respectively. In the United States, for instance, lamps caused 64 24 per cent. and electricity 4.4 per cent. of all the fires caused by artificial illuminants, while in San Francisco these figures stand 63 09 per cent. and 4.0 per cent. respectively. We see that in the United States gas causes an annual average of over 23 per cent. of the fires due to artificial lighting, and that candles cause less than 8 per cent. which proves that gas ranks next to lamps as a fire producer. For some local reason yet to be explained the conditions are changed in San Francisco, where candles lead gas in having 20 per cent. to 13 per cent. for the last named illuminant. In other respects the characteristics are very similar to those described in Fig. 1.

Here is given abundant and irrefutable proof that all electric lighting installations taken as they actually exist cause less fires by far than any other general illuminant. Can we not hope then that when we have eradicated all the bad and indifferent work, the percentage of electric fires will be brought down to zero, and eventually the property owner will be assured that he may light his premises without entailing a fire hazard thereby. Careful investigation will carry the conviction that in the properly constructed and properly cared for incandescent system, is realized a light without hazard: and, inasmuch as it is the constant aim of the fire underwriter to reduce the fire hazard whenever possible, it would appear to be imperative that the placing of such installations, when used to the exclusion of all other methods of artificial lighting, should be encouraged in every manner possible. That such a course would tend to reduce the fire waste can hardly be doubted.

Electric Light Plant at Monte Carlo.

The principality of Monaco, with its population of 8,000 persons, supports two electric light stations. The principal customer of the Societe des Bains de Mer et du Cercle des Etrangers is the Casino, with its hundreds of brilliant lights. The station is located on the east shore of the little harbor of Monaco, about a quarter of a mile from the noted gaming resort. The plant is rather small, and is arranged in three units. The boilers are of the tubular type, and coke is burned under them. The engines are vertical, compound, condensing, and each is capable of developing 90 horse power at a speed of 150 revolutions per minute. The three dynamos are Ganz direct current machines each of a capacity of 45,000 watts. Two of the engines and generators are shown in the accompanying illustration. Current is carried from the station to the Casino by a 60 wire lead covered cable buried under the pavement in a wooden trench.

Proceedings would of necessity come to a sudden stop at the Casino should darkness fall upon the game. If it should continue for many minutes the experience would be very trying on the nerves of the players. The palatial structure has therefore been connected with the second station in Monaco, where Ganz alternators are operated. A bank of transformers is located at the Casino, and if the continuous current should fail the alternating current is available to light 1,000 lamps. The illustration is reproduced from *L'Electricien*.



ELECTRIC LIGHT PLANT AT MONTE CARLO.

The Advisory Council of the World's Electrical Congress.

Upon the invitation of Prof. Elisha Gray, chairman of the committee on the World's Electrical Congress, an informal meeting of the eastern members of the advisory council was held at the rooms of the American Institute of Electrical Engineers, New York city, on Tuesday, April 26th. The following named members were present: Prof. Gray, chairman; Prof. F. B. Crocker, Prof. A. E. Dolbear, Dr. William E. Geyer, G. A. Hamilton, A. E. Kennelly, Thomas D. Lockwood, T. C. Martin, George M. Phelps, Franklin L. Pope, Dr. M. I. Pupin, R. W. Pope. Letters of regret were read from Profs. Alexander Graham Bell, George F. Barker and John Trowbridge. It being simply a gathering of a portion of the council, no formal action could be taken, but it was unanimously agreed that the last week in August, 1893, would be the most suitable time for the meeting of the congress, and this date will doubtless be recommended. Dr. Gray sailed for Europe on the Majestic, April 27th, accompanied by Prof. H. S. Carhart, secretary of the committee.

The electrical reciprocating principle has been applied to a stone-carving tool invented by W. P. Carstarphen of Colorado. With this tool, the carver or sculptor, instead of giving a portion of his attention to striking his chisel, can devote his entire time to the lines which he is following, thus producing more accurate and rapid work. It is estimated that the machine will produce work in one-fourth the time of hand work, and that therefore a material reduction in the cost will be secured.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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IN his annual message to the Milwaukee city council Mayor Shannon recommended that the bridges be operated by electric motors. This official approval of the new system which has been on trial in Milwaukee during the last year is highly satisfactory, and meets the approval of the residents of the Cream City. The Board of Public Works, acting on the mayor's suggestion, has decided to equip three of the bridges at once. It has been decided, to duplicate the equipment of the Grand avenue bridge, Milwaukee, illustrated in the WESTERN ELECTRICIAN of Aug. 15, 1891.

AT this writing there appears to be but little doubt that a fresh start will be taken in the matter of the incandescent lighting for the World's Fair, and that new bids will be solicited. This result can be viewed in no other light than as a triumph for Mr. Westinghouse, who has made extraordinary efforts to induce the officials of the World's Fair to give him a chance to put in a lower bid than that made by the Edison-Thomson-Houston company, and accepted by the committee on grounds and buildings. It by no means follows, however, that the Westinghouse company will get the contract, for the cutting of bids is a game that two can play at, and it is not unlikely that the two great companies will engage in a desperate cut-throat competition over this contract, by which the exposition will be greatly benefited. The spectacle is not a pleasant one, and it will excite general regret among all true friends of electrical development.

PROPERTY owners in cities in which opposition to electric railways has been developed should learn a profitable lesson from conservative Milwaukee, where a bonus of $30,000 has been raised by owners of real estate along a proposed line, in order to insure its extension. In this week's Milwaukee letter the details of this arrangement are presented. It is stated that there is considerable activity among owners of property along the line, that they have contributed to the fund according to the amount of the property they possessed, and that it is believed the building of the road will result in the establishment of one or more residence suburbs. Such action as this in a city where the overhead trolley system has had a fair trial is the best testimonial to its availability.

ATTENTION has been repeatedly directed to the fact that the present prosperous condition of the electrical business is due in a large measure to the bold and confident policy of manufacturers in championing their systems, and now comes the news from Baltimore, Md., of what to the general public will seem to be one of the boldest propositions yet advanced. A prominent electric railway company has offered to equip the tunnel of the Belt Railroad company for the running of trains by electricity without the expenditure of a dollar on the part of the Belt company. The proposition has been accepted, and the electric company agrees to give the railroad the free use of the plant for six months, provided, of course, that if the enterprise proves successful it will be accepted and paid for.

While there is not the least doubt but that the electric company will surprise the railway people and show them what electricity can do, one cannot fail to admire this example of that enterprise which has been characteristic of the more successful of our electrical exploiters. In this instance, as has been the case before with a number of other concerns, we find the electrical people shouldering absolutely the entire responsibility of the project, while the railroad company very generously and magnanimously agrees to witness what it doubtless believes in heart to be an experiment. Now that so many rapid transit underground schemes are projected, a demonstration like that which will be made in the Baltimore tunnel will have a most salutary effect in convincing the doubting minds that the one motor for tunnel service is the electric.

COMPLIMENTS for that much-abused servant, the Western Union, are seldom found in the columns of the daily papers, and when one does appear it is worthy of more than passing mention. The New York *Times* graciously acknowledges the superior service which the newspapers of the country have received during the last year from the Western Union and presents some interesting figures from which an idea of the magnitude of the work of the telegraph company may be gained. It may be mentioned in this connection, that there is no institution in this country upon which the daily papers are so dependent as the telegraph, and yet notwithstanding the excellence of the service, there is no other point from which so much adverse criticism and opposition come as from the daily press. It may be said that the telegraph company is consulting its own interests in thus serving the newspapers, but it is equally true that the advantages are reciprocal. Despite the adverse criticism of the press, the telegraph company is ever alert in meeting the requirements of special occasions, no matter what the expense may be. An illustration of this is afforded in the action of the Western Union in preparing for the national Republican convention to be held at Minneapolis. As has already been pointed out in this journal, a poorer selection than Minneapolis could scarcely be made, for such an event so far as facilities for transmitting press reports is concerned, yet there is every indication that when the time comes the telegraph company will be found ready to accommodate all. The Western Union has already begun its arrangements and in addition to securing several railroad wires for this special service, it will have thirty wires devoted exclusively to transmitting press dispatches. In view of these facts, is it too much to ask the daily press, usually so generous in its acknowledgment, to give this public servant credit for its faithful service?

ONE of the most gratifying features of the electrical work already accomplished on the World's Fair grounds is the conspicuous success of the plan of electric power transmission adopted for the work of construction. An idea of the extent to which motors have been introduced for the purpose of driving the machinery employed in the work of erecting the great buildings and preparing the grounds, can be gained by a glance at the table presented on the first page of this week's paper. There is no novelty, of course, in the idea of centralizing and distributing by electricity the power needed for a large plant. But the great advantage lies in the fact that the contractors were compelled to use motors and were thus brought to see the economy and convenience of this method. Now, after several months' trial all are enthusiastic in praise of electrical transmission. The visitor has but to put a few casual questions to workmen or employes to be convinced of this fact. The danger of fire is reduced to a minimum; there is a great economy of labor in attending to the engines and boilers, but one set of men being employed in place of a dozen; the motors are less bulky than engines, require practically no attention, and are easily transferred from one point to another; there is no "getting steam up" in the morning, and at night the turning of a switch is all that is necessary: in a word, the difference is comparable to that of having water from a city pumping conveniently on tap in one's house in preference to each household establishing a pump and maintaining miniature water service of its own. All these points of superiority have been impressed on a number of large power users by actual experience, and it will be strange if the temporary power plant at the World's Fair shall not, in its capacity as a practical school of instruction for contractors, prove to have been of material advantage to many central station companies and manufacturers of electrical machinery. The electrical fraternity is already indebted to the World's Columbian Exposition for this demonstration, and particularly to Messrs. Burnham and Sargent of the construction department, who have so resolutely adhered to the plan of electrical transmission.

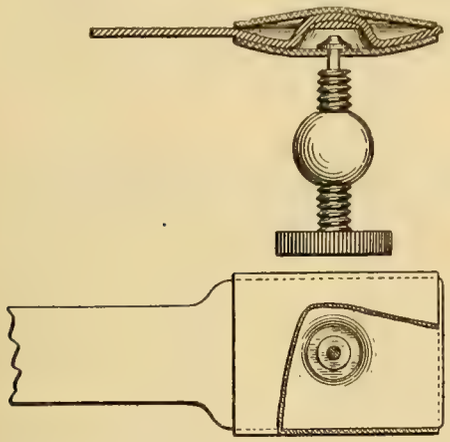
INSURANCE men have devoted much time and attention to the subject of electric lighting, and while many of them have, at times, opposed the introduction of electric lighting, they may now, as a class, be considered friendly to the electric interests. From violent opponents of the electric light many of them have changed to earnest advocates of the modern illuminant. The opposition of the insurance interests, no doubt, proved of great benefit to the electric interests, inasmuch as it made it necessary for the construction companies to improve their methods and raise the standard of work. That this has been done is evident from the fact that the danger to life and property has been appreciably lessened, and to-day the electric light is considered by fire underwriters the most desirable form of artificial illumination. This conclusion has not been reached without considerable difficulty, due almost entirely to the mistakes and failures of pioneers in this field. Even at this late day, after all the improvements that have been made in the art, and the general introduction of electricity, the cry is still raised that it is unreliable. This is, of course, the result of the failures of some of the pioneer plants.

As evidence of the fact that this prejudice is fast losing ground, an interesting article is presented elsewhere in this issue on "Hazards of Artificial Illumination." This article is an abstract of a paper read by George P. Low of San Francisco before the Fire Underwriters' association of the Pacific. Statistics show that as fire producers the sources of illumination rank as lamps and lanterns, gas, candles and the electric light. With the exception of the incandescent lamp, says Mr. Low, all the methods of lighting named consist of a flame from which issues light, but inasmuch as the arc light is virtually surrounded by a glass globe, and particularly as it is now being used most generally for outside street lighting, and for other reasons that will be apparent, it would be well to exclude it from the general class of flame illuminants. He describes the electric light as the "acme of ingenuity, utility and safety," and furthermore, he says: "Incandescent electric lighting circuits, when properly installed and properly cared for, do not present a fire hazard." Again he adds, "As to interior wires, they are absolutely as free from a fire hazard as a metallic picture cord when properly placed and cared for."

These complimentary allusions, coming as they do from an insurance man, and one who has special knowledge on the subject, are very gratifying. Mr. Low supports his statements by carefully prepared statistics, which will form interesting reading for electrical engineers.

Contact Protector.

The accompanying cuts show an improvement recently made by Richard Varley, Jr., of Englewood, N. J., on his elastic shield for electric contacts. This device is placed over the contacts in such a manner as to exclude air and dust from them, and thereby lessen the risk of their becoming inoperative by the presence of oxide or of foreign substances. With the old type of shield difficulty



CONTACT PROTECTOR.

has been experienced in putting the parts together with sufficient facility and rapidity.

The cut shows the modified shield. The spring over which the shield is to be placed is recessed for the reception of the electrode, which is preferably in the form of a small platina plate introduced into the recess, and soldered in place. The shield is made in the form of a thin flat rubber band of sufficient width, so that it may pass around the end of the spring, the elastic material being stretched sufficiently as it is applied to to the spring to cause it to contract firmly against the face of the spring. Hence in putting the parts together it is only necessary to draw back the screw contact, and the rubber can be forced over the button end of the adjusting screw, and then it will contract and become substantially air-tight against the face of the spring.

Lemp's Induction Discharge Protector for Electric Welders.

The apparatus illustrated in the cuts was designed by Hermann Lemp of Lynn, Mass., for the purpose of protecting coils from injury by extra current or induction discharge. The apparatus was devised especially for use with electric welding machine transformers.

In this class of apparatus it is particularly necessary to provide a means for preventing injury to the primary coil

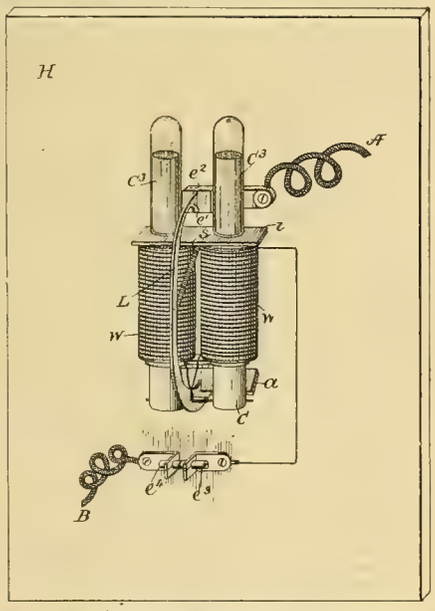


FIG. 1. LEMP'S INDUCTION DISCHARGE PROTECTOR FOR ELECTRIC WELDERS.

on the sudden interruption of the current in the secondary, since, owing to the low potential of the current in the secondary and its inability to maintain an arc, the interruption of the secondary current produced by rupture of its conducting path is exceedingly sudden, and an extra current of enormous potential is developed in the primary coil.

Mr. Lemp's device consists of apparatus which is designed to provide a path for the extra or induction discharge current, and which is also organized to interrupt or put out any electric arc which may tend to follow across the contacts of the protective devices.

The apparatus involves the employment of two electrodes like those of an ordinary lightning arrester connected respectively to the terminals of the primary coil and separated by a very narrow space.

Fig. 1 is a perspective view of the apparatus, and Fig. 2 is a diagram of circuits, illustrating the manner of connecting the apparatus to the circuits of a transformer and generator.

The object of the invention is, generally speaking, to provide an organization in which there shall be entire freedom from the continuance of any electric arcs in the protector, and which shall be capable of resetting itself after operation.

For the purpose of putting out the arc which may form between the electrodes of the protective device there is employed a circuit breaker carried by the armature lever of an electro-magnet, and the contact of the circuit breaker is placed in the field of the magnet.

Referring to Fig. 1, C indicates two magnet cores, mounted on a base H, of slate, and having projecting poles C^3 C^3, covered with glass tubes to insulate them against the passage of an electric current over the poles. L is the lever of a circuit breaker, the contacts of which are indicated at e^1 e^2. The contact e^2 is in the form of a block and is fastened to plate H, while the contact e^1 is carried by the lever and is normally held in connection with the first by means of a spring S, applied to the lever. The lever L is mounted on a pivot carried by the cores of

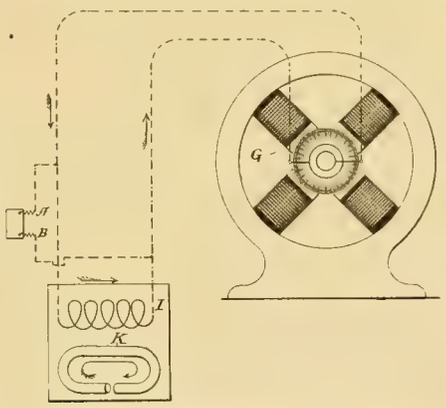


FIG. 2. LEMP'S INDUCTION DISCHARGE PROTECTOR FOR ELECTRIC WELDERS.

the magnets and is provided with an armature a, which is attracted to the poles of the magnet on the passage of the current through the coils W, and thereby operates the circuit breaker by moving the contact e^1 away from the contact e^2. A plate of slate or soapstone z is applied, as shown, to protect the coils W against any arc formed at the contacts e^1 e^2. At e^4 e^3 are indicated two electrodes of the protector, consisting of two pieces of copper held a short distance apart at their ends, and separated by a narrow air space. These electrodes are mounted in pieces of metal secured to the base H. One of them has a wire B connected to it and forms one terminal of the apparatus. The other terminal A of the apparatus connects to the contact e^2, as shown. The coils W are in the circuit between the circuit breaker and the electrode e^3, as indicated.

The apparatus is applied to the circuit of a welding coil, as indicated in Fig. 2, where G indicates an alternating-current generator, I the primary of the transformer, and K the low resistance and low potential secondary connected with the work. The terminals A B connect to the circuit, so as to place the electrodes e^3 e^4 and the other apparatus into a circuit across the terminals of the coil I.

The apparatus is normally in the position indicated in Fig. 1. On the occurrence of any high pottential induction discharge current produced in the primary I by the interruption of the secondary S or from other cause, such discharge current, instead of flowing across and through the insulation of the coils, will flow through the protector by way of contacts e^2 e^1, coils W, through electrodes e^3 e^4, and across the space between them and out by terminal B. The high potential of such current permits it to jump the narrow space between e^3 e^4. The establishment of a circuit of however slight duration across the space between e^3 e^4 establishes a path for the generator current, and an arc would form and continue to burn were it not for the fact that such current energizes the magnet which attracts the armature a and operates the circuit breaker so as to stop the flow of current, and thereby cause the arc to cease.

Commutator Connection.

The cut illustrates a method of fastening armature wires to commutator segments which has been devised by Charles G. Curtis of New York. The segment is formed with a lug, through which holes are bored of the same size as the wire. The end of each wire is passed through the hole so that it projects a short distance beyond the edge of the lug, and this projecting end of the wire is enlarged as shown. This can be done very satisfactorily by simply flattening the ends of the wires by a few blows of a light hammer sidewise against an anvil, or by pinching the wire

COMMUTATOR CONNECTION.

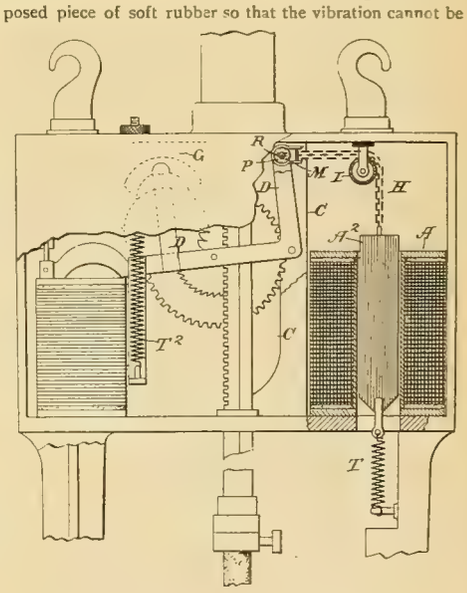
with a pair of pliers, so that its width becomes somewhat greater than the diameter or width of the hole. The enlarged end of the wire may now be driven back into the hole, so that it will wedge itself tightly.

Ward's Alternating Current Arc Lamp.

In devising an alternating current arc lamp a difficulty is encountered in that the vibration of the core or other movable portion of the lamp magnet, produced by the rapid alternations of the electric current, are communicated to the lever or other support which sustains the upper carbon, and the result is a flickering and unsteadiness of action. It is likewise found that the lamp will not "pick up" properly—that is to say, the arc will not be formed properly when the current is turned on, and the parts will simply vibrate without causing separation of the carbons. Another difficulty arises from the fact that the vibrations are apt to loosen the parts of the mechanism.

The manner in which these difficulties have been overcome by Barton B. Ward, the designer of the lamp shown in the cut, will be understood after a study of the illustration.

To overcome vibration there is employed in the combination, with the carbon supporting lever, an actuating magnet connected with the lever through a cord or chain, the links of which have lost motion with respect to one another so as to constitute a flexible connection. There is also provided a damper between the magnet core and the supporting lever for the carbon. This damper bears against the core laterally, so as not to interfere with the lifting movement of the lever, but it prevents the free communication of the vibrations from the core to the lever. Another feature consists in mechanically connecting the core with the carbon supporting lever through an interposed piece of soft rubber so that the vibration cannot be



WARD'S ALTERNATING CURRENT ARC LAMP.

readily communicated to the lever. Fig. 1 is a side elevation of the lamp, the parts being broken away to better illustrate the construction. C is the standard on which the carbon supporting lever D is pivoted. The lever D carries a feed regulating train of wheels, having an escapement, the action of which is controlled through the engagement and disengagement of the anchor with a suitable stop, indicated at G. A indicates the lamp magnet, which operates upon the lever D to lift the carbon and hold it

in arc forming position. In the present case this magnet is provided with the usual movable core. The core A^2 is laminated. The core is rectangular in outline, and it works up and down in the center of a spool. The body of the spool is also square in section. The loose connection between the lever and the magnet, consists of a series of links constituting a chain H, which is attached to the lever at one end and at the other to the upper end of the core A^2. This device of itself tends to avoid the difficulties before mentioned, inasmuch as it allows free vibratory movement of the core in a longitudinal direction to a certain extent without a necessarily accompanying movement of the lever D. This link connection also avoids communication, to a certain extent, of any other vibrations from the core.

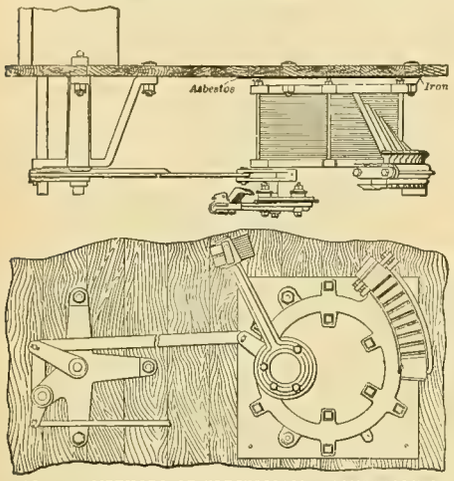


FIG. 3. METHODS OF ELECTRICALLY CONTROLLING STREET CAR MOTORS.

To still further shut off the vibrations, there is a damper, I, which bears laterally against the connection between the core and lever and deadens the vibrations, nevertheless permitting a slow and steady movement of the core which is required in order to lift the carbon. This damper is a pulley or a wheel sustained on a hanger connected to the lamp case.

As a further precaution against the communication of the quick vibrations from the magnet to the lever, connection with the lever is made through an interposed piece of soft rubber. For convenience, this rubber is applied at the point of connection of the chain with the lever. In the cut the last link of the chain is shown as connected to a strap M, which encircles a block or washer P, of soft rubber, through which passes a pin R, fastened to the lever D.

At T is shown a spring connected with the movable core of the magnet, at its lower end. This spring is independent of the usual assisting spring (indicated at T^2). Its office is to check the vibration of the core.

It will be obvious that all of the devices described need not be employed; but it is desirable to use them, as they all contribute in eliminating the objectionable vibrations in the carbon and its supporting lever.

Methods of Electrically Controlling Street Car Motors.[1]

By H. F. Parshall.

Part II.

A method that is receiving a great deal of attention now is that known as the "series parallel method." While it has not yet been introduced very largely in practice, numerous experiments have indicated the desirability of doing this as soon as some of the troublesome features of the switch have been overcome. The method of operating is as follows:

In starting, a rheostat of from 8 to 20 ohms is used, according to circumstances, in series with the motors, which are in series with each other. After this resistance is thrown out of circuit the magnet coils of one of the motors are short-circuited, a section at a time. To make the start smooth, three or four coils at least are required. The magnet coils being short-circuited, the armature is then short-circuited, and the magnet coils thrown in circuit simultaneously with the armatures being thrown in parallel. It is just at this point where the difficulty with the switch has been encountered, since either the switch has to be operated with great rapidity or the contacts act in perfect unison; otherwise unpleasant results as to short-circuiting occur.

The advantages of the method are that a very wide range of speeds is obtainable at a comparatively high efficiency, and that the energy required to be dissipated by the rheostat is small for the low speeds frequently required in city practice. This lessening the duty of the rheostat is a very important point, since as yet it has been found exceedingly difficult to construct a cheap rheostat that could be placed under the car in the small space available, and dissipate so large an amount of energy as is required when the car is to be run for a considerable time at a speed as low as two or three miles an hour. Any method of control that has lessened the energy to be dissipated in the rheostat has in general been considered with favor, since there has been a corresponding diminution of trouble in each case that the energy to be dissipated has been lessened.

Having now given a general discussion of the problem, a brief description of some of the apparatus recently devised may prove of interest.

Fig. 1 shows the general design and arrangement of an improved form of platform switch, which combines both the "field commutation" and the "series resistance" methods of starting cars. To start the car, the switch handle is turned from the position marked "off" with a counter-clockwise movement; this movement carries the arm of the rheostat, which is placed under the switch, around and over the contact segments, so that the resistance is gradually cut out of circuit. After the contact arm has been carried around to 135 degrees and all resistance has been cut out, it is released from the cylinder shaft and left locked in this position. A further movement of the switch handle then affects only the cylinder, and commutates the sectional windings of the field magnets of the motor from series to parallel in the usual way. In stopping the car, the field coils are turned from parallel to series, the resistance coil is then again put into circuit, and the circuit broken when the contact lever leaves the last segment of the resistance coil, and not, as hitherto, upon the cylinder contacts. The only caution to be observed in stopping is to see that the switch handle shall be turned to the position marked "off," for the motors are reversed by means of a separate reversing switch placed under the car and operated by a lever connecting with a separate shaft in the controlling switch case. The shaft of the platform switch interlocks with this reversing shaft in such a manner that it is impossible to reverse the motors until the cylinder is in the "off" position. The use of this separate controlling switch has been objected to, but to combine both the advantages of the rheostat and commutated fields the switch mechanism becomes too complicated, and the switch too large to have the reversing performed by a reverse movement of the controlling switch handle.

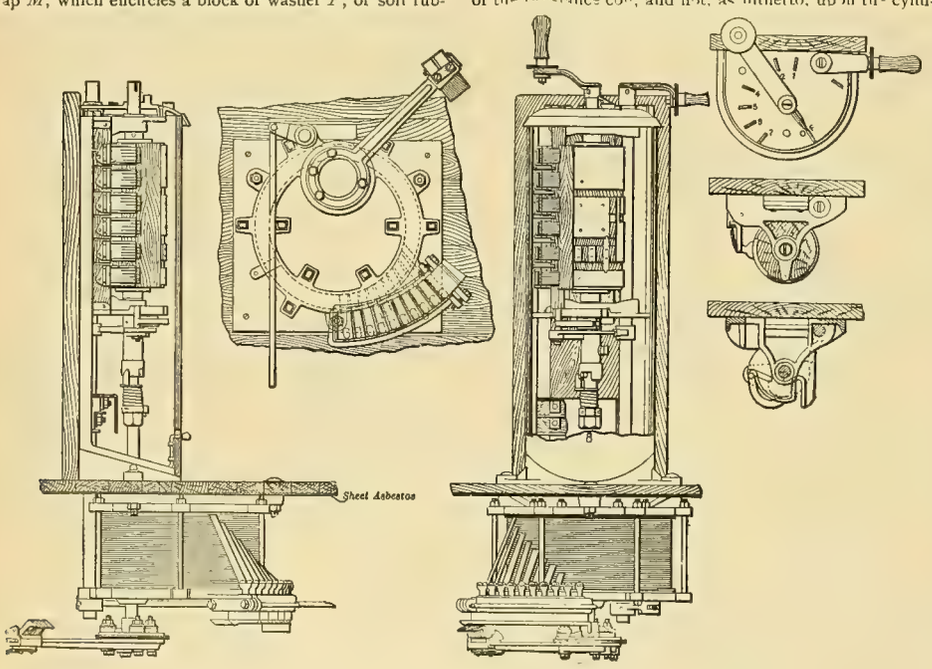


FIG. 1. METHODS OF ELECTRICALLY CONTROLLING STREET CAR MOTORS.

The cylinder plates and contacts are made of thick iron stampings, as experience has shown that iron is more durable than brass for this purpose. The burning, due to the formation of arcs, does not have so much effect upon iron as it does upon brass, and there is more certainty of good contact. The contacts on the cylinder consist of a number of stampings arranged in a brass frame, each stamping making an independent spring contact with the switch cylinder. The rheostat employed is built up in a circular form from a large number of flat rings, stamped from thin iron sheets. The rings are built up in the form of a cylinder, each ring of iron being separated from the adjacent rings by a ring of mica, except at the point where it makes contact with the ring on the other side of it. Instead, however, of being arranged in a continuous spiral circuit, the coil is divided into a number of parts, so arranged that the direction of rotation of the adjacent spirals is reversed. this being done to make the inductance of the coil as small as possible. A coil wound up in a continuous spiral, having a mean diameter of 12″ and a radial depth of 1″, 6″ long, and composed of 400 plates, was found to have an inductance of 40 millihenrys. The coil was then wound up in 12 sections, the direction of each section being reversed, and the inductance in this case was found to be 8.5 millihenrys. These sections are stamped from different thicknesses of metal, so that those coils which are in circuit the shortest time and have the least current to carry, are of highest resistance and least ampere capacity, and those that are liable to be in circuit for some time are thicker and have less resistance and greater ampere capacity. Copper connections are made at different points in the coil, all these connections being brought to a number of small iron contact pieces fitted in a spiral form, and arranged so that the switch contact lever can slide over them. The contact pieces are insulated from the frame with sheet mica and from one another with small slate slabs. The rheostat is entirely fireproof and can expel with safety the heat evolved within it under all ordinary conditions. As a point of practical importance it is, however, advisable to place a sheet of metal and a layer of asbestos paper between the rheostat frame and the car floor. This will prevent any danger from fire, either from heating or sparking, should such occur. It is to be noted that the general design of this rheostat is such that those parts having mechanical functions and energy-dissipating functions have been separated as much as possible. Of course the mechanical functions of a rheostat are more or less limited; it is evident, however, this effort is in the right direction. It is with respect to this particular point that the rheostat has a decided advantage over any form of mechanical clutch in starting a car. The clutch, of course, has its advantage in starting quickly bodies that have a great amount of inertia. In ordinary practice, however, the amount of energy dissipated in a clutch is approximately equal to that necessary to dissipate in a rheostat, but the clutch has, in addition to its energy-dissipating function, a very exact mechanical function, and these two functions are interdependent on the same wearing parts. For this reason, if no other, clutches have not been made to compete favorably with rheostats.

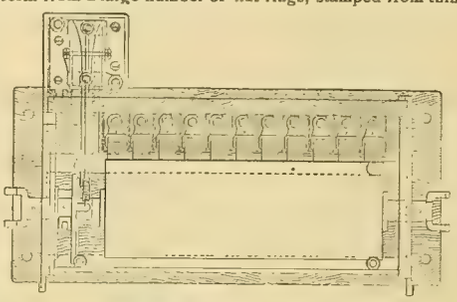


FIG. 4. METHODS OF ELECTRICALLY CONTROLLING STREET CAR MOTORS.

Fig. 2 gives a diagram of the car connections for this switch. It will be seen that the current from the trolley wire first goes through the field coils and switch cylinder for commutation, then through the armature and reversing switch, and thence through the switch contact lever and resistance coil (in starting) to ground. It will be noticed that by use of the separate reversing switch the armature wires and field wires are each kept separate and distinct from one another. Formerly there was considerable trouble from the breaking of these wires, especially where the wire entered the brass terminals at the various terminal boards. This has been almost entirely obviated by using 49 strand cable wherever wire was subjected to bending.

In some cases the construction at the platform ends is such as to make it inconvenient to place the rheostat used with this form of switch immediately underneath the cylinder. This is the case when certain kinds of draw-bar or step constructions are used. In these cases a modification of the switch arrangements is made, so that instead of the rheostat a light frame is placed directly under the cylinder. This frame serves to support the switch shaft, upon which is placed a crank connecting with a bar, which is carried off to the rheostat contact lever. With this arrangement the rheostat can be placed under any convenient part of the car flooring and operated as well as when directly under the platform.

Figs. 3 and 4 show general plans of a car switch designed to be placed under the car and about half way between the motors, when the car construction permits. This design, while open to the criticism that the switch is somewhat inaccessible for inspection, meets the demand

1. Read before the American Institute of Electrical Engineers, April 19, 1892.

that has sometimes been made when it has been thought the space ordinarily occupied by the platform switch could not be sacrificed. The principle is the same as the platform switch already described, but it is modified in form and shape to suit the particular condition under which it is to work, and it is to be noted that the mechanical adjustments required are much more exact, otherwise there would be considerable burning of the contacts, since the motorman would be unable to tell whether or not the switch contacts were on proper positions. The rheostat is arranged in sections, and connections brought from them directly to cylinder contacts. A cylinder is used to commutate both resistance and field magnet coils.

An important point that has been attended to in this switch is the breaking of the circuit on a separate switch instead of on the cylinder. A snap switch, of the knife blade pattern,

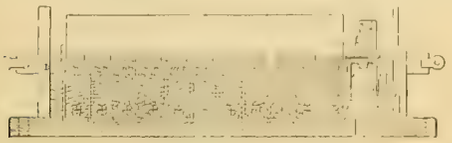


FIG. 4a. METHODS OF ELECTRICALLY CONTROLLING STREET CAR MOTORS.

is employed to break the circuit at four points. It operates in connection with the cylinder shaft, to which it is connected by a special locking and releasing gear of similar design to that shown in Fig. 1. The first movement of the cylinder shaft closes the snap switch and completes the circuit through the coil. Further movement then disengages the snap switch from the shaft (leaving it closed), and the different commutations are effected. When breaking the circuit the snap switch is again brought into action.

When this form of car controlling switch is used the platform lever is fitted at its lower end with a bevel gear wheel meshing into another gear wheel placed on the cylinder shaft. When necessary an extension shaft, fitted with one or more universal joints, makes connection between the platform lever and the cylinder shaft. When this switch is placed in the middle of the car the amount of car wiring is materially lessened, and the car inspection made more easy.

With reference to controlling switches in general, it is evident that a great number of designs may be prepared that will give approximately the same electrical results in point of efficiency. In deciding, then, upon the merits of a new design of switch, the commercial factor relating to repairs has therefore to be very largely considered, and had designers been able to guide their work more closely from the balance sheet of railroad companies, when such had been properly kept, instead of conforming to popular notions, very much more progress would have been made in this line during the last few years.

In closing this paper it might be well that I should remark that my experience has been largely confined to what is known as the commutated field method of control, and that I have naturally expressed many of the qualities of other methods in terms of this method. If these expressions are not judged satisfactory, I leave it for those

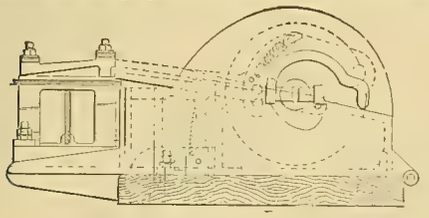


FIG. 4b. METHODS OF ELECTRICALLY CONTROLLING STREET CAR MOTORS.

who have had a similar experience with other systems to express in their criticisms the qualities of the commutated field system in their own terms.

W. F. Osborne's Affliction.

W. F. Osborne of New York suffered a terrible affliction in the death of his wife at Jamaica, L. I., on Sunday, May 1st. The body was brought to Chicago on Wednesday for burial. Mrs. Osborne was well-known in Chicago, having lived in this city the greater portion of her life, and the news of her death was a great shock to her many friends. Mr. Osborne, who has been eastern manager of the WESTERN ELECTRICIAN during the last year, has a host of friends in the electrical fraternity who will sincerely sympathize with him in his great affliction.

Electric Railways in the South.

President John N. Beckley of the Rochester, N. Y., Railway company, on returning, from a trip through the South, said: "I think it is a benighted region. Charleston is a dead town. Savannah is a progressive, enterprising city. There is considerable industrial activity in Georgia, but the rest of the South is way behind the times. Savannah has electric street railway lines. Charleston's street cars are drawn by mules. There has been some progress, of course, in the South since the war, but there is need of great improvement."

An enterprising electric light company has lately been established in an Ohio town. It advertises that if the residents guarantee it a sufficient amount of business to insure success it will light the churches free.

Brooklyn's Electric Railways.

The Atlantic Avenue Railroad company of Brooklyn is rapidly pushing forward the preliminary work of electrical construction. The power station will be located on the Gowanus canal, between First and Second streets, and will cover an entire block. There will be a frontage on the canal of 200 feet and 630 feet on a lateral basin. The boiler equipment will consist of three batteries of Babcock & Wilcox boilers, each battery comprising two 250 horse power boilers. Each boiler will be twenty-three feet long, with tubes one half inch thick, and will rest on extra heavy shelves. Four Corliss tandem compound condensing engines have been ordered, one of 350 horse power, and three of 500 horse power each; and the latter will be adopted as the unit for future work, the station having been designed for an ultimate capacity of 5,000 horse power. The fly wheel of the largest engine will weigh 60,000 pounds. One condenser and two air pumps have also been ordered, and will be run by a smaller engine. Three different kinds of rail are to be laid, manufactured respectively by the Lewis & Fowler Girder Rail company, the Duplex Street Railway Track company and the Pennsylvania Steel company. Samson bridge joints, made by the Tramway Rail company of Pittsburg, will be used with the last named rail. Ties of 5x9 Florida yellow pine and Connecticut white oak will be laid 30 inches between centers. The tubular style of poles, twenty-eight feet long, with

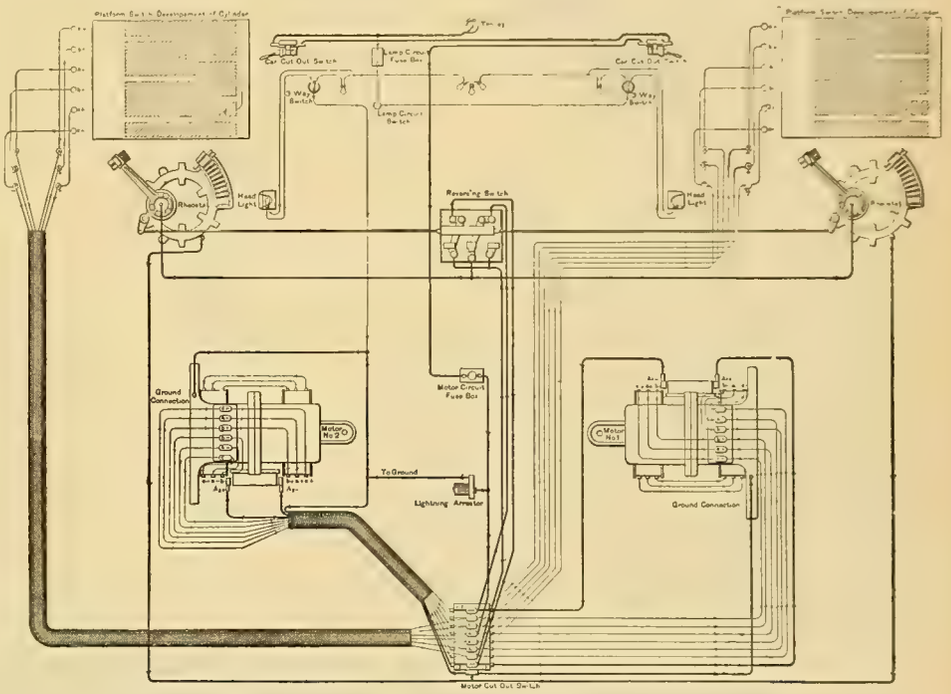


FIG. 2. METHODS OF ELECTRICALLY CONTROLLING STREET CAR MOTORS.

shrunk rings at each joint, will be used. They will be furnished by Wallace & Co. of New York. Most of the overhead construction will be of span wires, an exception being made on a part of Ninth avenue, where the poles will be placed on one side of the street, with a fifteen foot bracket extending over both tracks. This construction is practicable at this point, as the tracks are not in the center of the street, but more to one side. An order has been given for fifty cars, to be furnished by the St. Louis Car company. They will be twenty-seven feet in length, the body being eighteen feet six inches. They will be finished inside with mahogany and three-ply birdseye maple and have beveled edge mirrors and bronze trimmings. Peckham's flexible non oscillating motor trucks "No. 4 B" will be used. It is expected that a portion of the road will be in operation early in July.

Telephones in Army Maneuvers.

During the monster military maneuvers which took place last autumn in the east of France the telephone was used extensively. Batteries being inadmissible, magnetic telephones were alone employed, the receiver being fastened to the kepi, while the transmitter was held in the hand. A combined receiver and transmitter (50 mm. diameter, 400 grammes weight) was also tried. A naked .6 mm. bimetallic wire was used with an earth return. A good earth was made by sticking a bayonet well into the ground. Mounted soldiers connected the earth wire to their horses' bridles, the current going to earth through the horses' hoofs. Two men formed a telephone detachment. One carried the telephones and a rolling drum weighing 2½ kilogrammes and wound with 1000 meters of conductor; the other had a light bamboo stick, with a hook at the end and another drum of wire. The two men could thus lay two kilometers of line. The man with the telephones walked rapidly along unrolling his wire and his comrade followed and placed it as far as possible out of harm's way on branches, hedges, walls and along trenches. In one experiment a 2½ kilometer line, with 10 intermediate posts, was laid down in five hours, speech was perfect, and the whole was taken up again in an hour. Earth contacts seemed to have but little influence. During the sham fight of September 7th a 12 kilometer line worked without a moment's interruption, although an entire cavalry division passed over it. The cost of the system need not be an obstacle, 10 kilometers of line, 10 drums, three telephones and five bamboo rods, only costing 185 francs.

Electric Light Investigators in Trouble.

An amusing story of mistaken identity, in which the electric light plays a prominent part, comes from Boston. The *Traveller* tells it as follows:

Mayor Matthews has been doubtful for a long time that the city was getting the contract candle power from the electric lights in the streets. He was led to this belief by numerous complaints that had been made to him to this effect. The lights are supplied by the Boston Electric Light company, and, to test the merits of the case, his honor instructed City Engineer Jackson to employ a force of men to test the lights at night and see if the city was receiving a sine qua non. The engineer was instructed to do the work with great secrecy, so that the company or any of its agents might not discover the object of the city officers.

Now it happened that just at the time that the mayor ordered his lieutenants to test the lights, a complaint came to the office of the Boston Electric Light company to the effect that large quantities of wire owned by the company were being stolen. Night after night it was reported to the general office that vandals were cutting and hauling away the wire. Said Manager Gilbert: "Put on an inspector and notify all our trimmers to be on the lookout for these robbers." So an inspector went on at night, and all night trimmers were notified to keep a sharp watch.

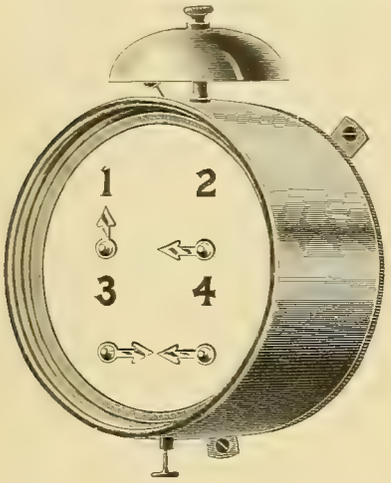
And all this time the city hall investigators continued their inquiry. One night, a week or two ago, while the city people were applying a meter to one of the lamps in the common they were espied by an Argus-eyed trimmer. "The robbers at last," he thought to himself as he dodged behind a mammoth elm tree. Visions of a reward and coveted glory floated through his mind. Out of the common came the testers and jumping into a carriage they were driven swiftly toward the Back Bay. The watchful employe followed on foot. Horse and man were unevenly matched, and the man was terribly winded when he caught up with them where the next test was to be made. Ensconced behind a tree he watched operations. What the men were doing he could not tell from his distance, but surely they were guilty of some act of vandalism.

To a station house he hastened and informed the officer in charge that robbers were cutting the wires of the Boston Electric Light company and he could lead them so as to catch the fellows in the very act. In an instant the "hurry-up" wagon was at the door and three officers and the "pilot" were aboard and hastening toward the scene of the alleged depredations. In a short time the minions of the law swooped down upon the unsuspecting city men, and laid hands upon them. A special officer who accompanied the city employes and who had been given a special badge by Commissioner Whiting showed his insignia of office and explained why the men were there and what they were doing. Thereupon the man who had given the alarm became greatly excited, and, gesticulating wildly, shouted: "Never mind what he or they say, pull them in, pull them in. They have been cutting wires. Pull them in," and he showed his badge which proclaimed him to be a regularly employed servant of the Electric Light company. Then

the "yes, you dids," and the "no, we didn't's," flew thick and fast. The officers were nonplussed. What were they to do? It was nearly 2 o'clock in the morning, and every officer was mindful of the policeman's motto, "Let no guilty man escape." That sentiment finally prevailed, and the city men and the special officer were bundled in the patrol wagon and hurried off to the station house. Arriving there the men who had been "pulled in," after a great deal of expostulating and furnishing of evidence, succeeded in convincing the officers in charge that they were what they represented themselves to be, and after much parleying they were allowed to depart.

A New Annunciator.

The Union Electric Works, Springer building, Chicago, are manufacturing an annunciator for department houses



NEW ANNUNCIATOR.

as shown in the accompanying illustration. It is unique in appearance and apparently cheap and efficient, both essential requirements in apparatus of this character. The annunciator resembles a small metal clock occupying but a small space, and is operated on the gravity needle system recently patented by this company.

The Eickemeyer-Field 20 Horse Power Swivel Truck.

In the Eickemeyer-Field apparatus all the weight of both motor and car is supported on springs, the motor forming part of the car body and moving with it, also being absolutely rigid in the direction of travel and cushioned on springs vertically. By this arrangement it is claimed that the wear of the motor on the track is no greater than that caused by a loaded horse car, while the motor in turn is so cushioned on springs that the passage over irregularities of track or ordinary street obstructions results in no particular jar to the motive, in that in the latter there is on each side one rod having a reciprocating as well as rotary motion. The impossibility of balancing the reciprocating motion is a feature which materially decreases the speed at which a steam locomotive can be driven. Not so, however, with the parallel rods of the Eickemeyer-Field mechanism, every point on which, when in motion, describes a true circle, with the rods perfectly balanced, so that no matter what the speed of rotation, the company claims, no jarring action is experienced.

The mechanical construction of this apparatus is exceedingly simple, and all parts are readily accessible and interchangeable. The frame supporting the armature shaft is a single, nearly square casting, within which the armature is mounted. Its bearings, being bored at a single operation, are necessarily in exact alignment with the pole faces. This frame is entirely closed underneath, so that no mud or moisture from the street can penetrate. At either end of the motor frame are bolted the pedestals carrying the springs and axle bearings, upon which the whole motor and car body are supported. The motor is governed by a detachable crank arm or wheel, located preferably on the dashboard at either end of the car. The speed and direction are governed by a single lever, and as the diameter of commutation in this machine is at an exact right angle with the pole faces, it follows that movement of the armature in either direction is accomplished without change in the brush position.

These trucks are now being manufactured by the Eickemeyer-Field company, Yonkers, N. Y.

New Era Burner.

This electric gas lighter is a departure from former productions in electric gas lighting apparatus, and the

NEW ERA BURNER.

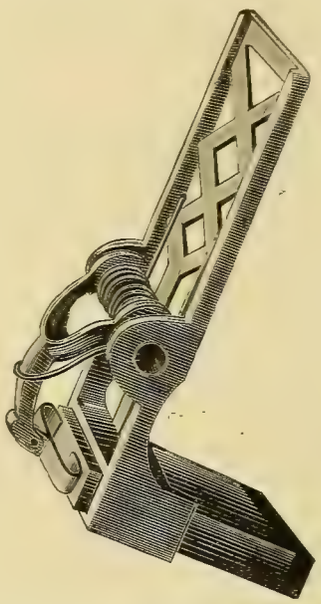
manufacturers claim not only that it never fails to light, but that it is absolutely safe from danger of leaking gas. It is operated only by the key, which always indicates whether the gas if turned on or off. Turn on the key for full head of gas, and this operation lights the gas. Turn back the key as far as it will go, and the gas is securely shut off. The flame can be reduced or increased at will, from the key.

This little fixture is handled by the Fletcher & Fletcher Electric company, Cleveland, Ohio.

New Brush Holder.

Recognizing the advantages of carbon brushes, the Utica Electrical Manufacturing & Supply company of Utica, N. Y., has just placed on the market the new style of holder shown in the cut. The device is six inches long, 1⅜ inches wide at the shank, and will hold a carbon brush 1½x2½ inches.

The manner in which the carbon block is advanced against the commutator as it wears, will be readily understood after a glance at the illustration.



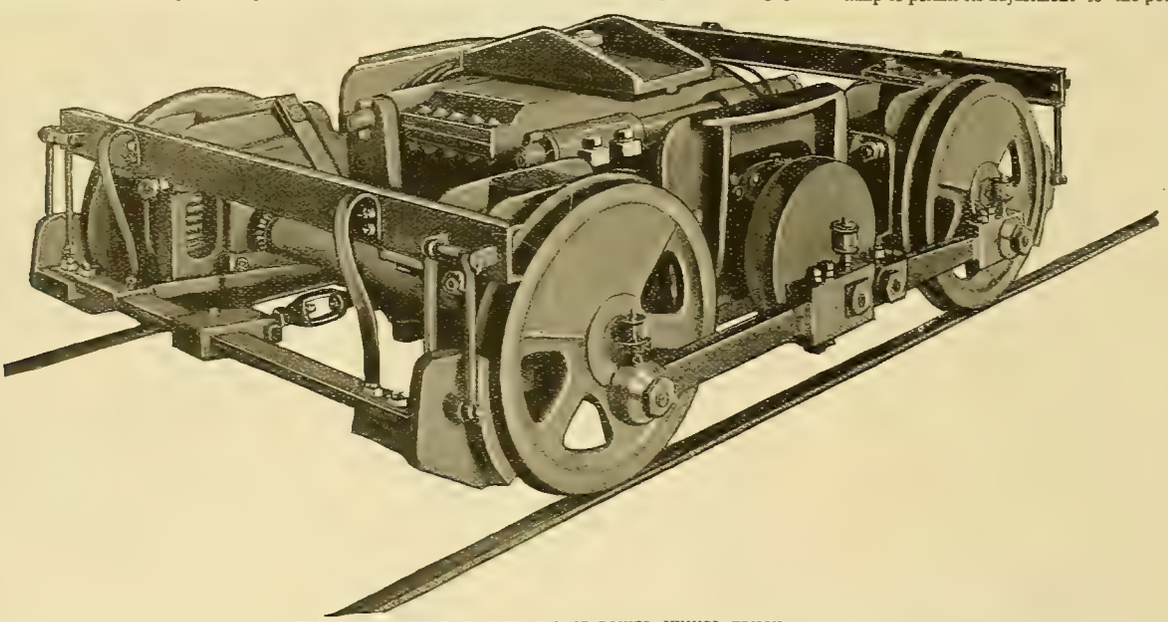
NEW BRUSH HOLDER.

The Utica Electric Light company is using thirty-four of these carbon brush holders, and the company states that they are giving eminent satisfaction on Fort Wayne-Jenney arc machines. This company's experience is that a commutator will last three times as long as when run with copper brushes.

Edison Projector.

The accompanying cuts show a new search-light projector, recently designed by the Edison General Electric company. Fig. 1 shows the side and front view, and Fig. 2 illustrates the lamp mechanism.

The lamp is designed to run on an incandescent circuit with a potential of 50 to 55 volts, at which it requires about 15 amperes of current and gives a light of 3,000 candle power. A suitable resistance is placed in series with the lamp to permit its adjustment to the potential of different circuits upon which it may be used. The lamp is both self-regulating and self-focusing. The lower carbon is pressed upward against fixed stops by a spiral spring, thus maintaining the arc in the focus of the reflector. A hand adjustment is provided for raising and lowering these stops, by which the vertical position of the arc can be altered. The upper carbon falls by gravity, its descent being perfectly regulated by the lamp mechanism, so that great

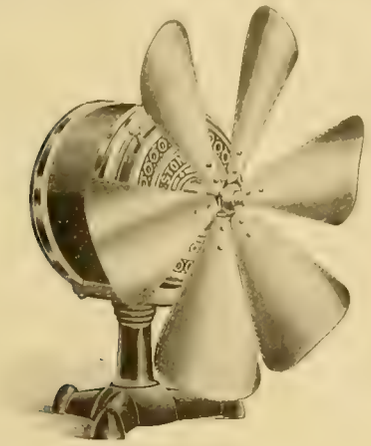


EICKEMEYER-FIELD TWENTY HORSE POWER SWIVEL TRUCK.

mechanism or to the rails. As a result of this combination this mechanism can be operated on rails of medium weight, such as are found on existing horse car tracks, thus avoiding an expensive re-equipment of heavy rails.

Attention should be called to the feature of parallel rods in the Eickemeyer-Field equipment. This method of connection is different from that employed in the steam loco-

steadiness of light is obtained. The negative carbon being placed a little back of the line of the positive carbon, a crater is thus formed on the side of the latter and nearly all the light is thrown toward the reflector. A ventilating



MESTON FAN MOTOR.

hood on the top of the drum provides an escape for the heat.

The drum is of iron, and 18 inches in diameter. A highly polished silver plated parabolic reflector 17 inches in diameter, with 5 inch focus, is mounted at one end of the drum on a finely threaded screw piece, by which it can be moved to or from the arc. By this means the light can be concentrated in a narrow beam or be widely diverged. The usual focus in projectors of this class is from 2 inches to 3 inches, and considerable advantage is derived by the increase in focus obtained in this projector. A fine hole is drilled through the screw piece on which the reflector is mounted, through which the exact position of the arc is shown on a small piece of ground glass.

The drum is provided with vertical and horizontal adjustments. The vertical adjustment is effected by means of a hand wheel operating a double threaded screw. It has a vertical movement of 30 degrees, 15 degrees above and 15 degrees below the horizontal line, which is sufficient for ordinary purposes.

The horizontal adjustment permits a complete revolution of the drum upon its base, so that the light can be readily thrown toward any point of the compass. By means of a clamp screw the drum can be quickly fastened in any position.

Provision is made for a cord attachment in order that the projector may be operated from a distance if preferred, as for instance from the pilot house, when the projector is set at the bow or any other part of a vessel.

The connecting terminals for the lamp are placed on opposite sides of the drum, and the conductors can therefore be brought up in the form of spirals without risk of their "crossing."

The height of the projector is 48½ inches and the center of the reflector is 36 inches above the bottom of the base. The floor space required for the base is 22 inches in diameter.

This projector is simple, strong and substantial, and all the parts have been arranged with a view to secure efficient and easy operation. It is estimated that in clear weather the beam of light will have an effective range of 2,000 yards.

New Terminal Block.

The cut shows a new style of terminal block for station switches, manufactured by the Electric Engineering & Supply company of Syracuse, N. Y., in which the wires are all brought in from the back, none whatever showing in front of the slate base, thus adding greatly to the neat appearance of the switch, and to the ease with which the wires can be inserted or withdrawn from the terminal blocks.

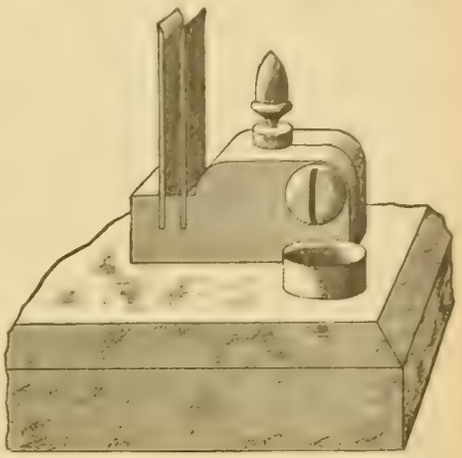
To insert the wire into the terminal one has only to loosen the set screw, draw out the hollow terminal plug and solder the wire into it when it can be readily pushed into the terminal block again, the set screw tightened, and the operation is complete.

This style of terminal is now used by this company for all sizes of station switches from 35 to 1,000 amperes.

The Meston Fan Motor.

The cut illustrates the Meston fan motor, which is handled by the Emerson Electric Manufacturing company, St. Louis The Meston fan was put on the market last season, and recent reports from the maker indicate not only an increase in the demand for a fan for ventilating purposes, but particularly for a fan that will work satisfactorily with alternating current.

The "1892 Model Meston" will have, among other improvements, a regulating and reversing attachment that will make it possible to run the fan at any speed desired, the amount of current used being in direct proportion to the speed. The arrangement employed is a simple form of commutator the position of which is changed by means of a short lever. Brushes are provided that will run an entire season, the brush holders being arranged to carry two carbons of special composition 2½ inches long, and of large cross section for contact and wear. The fan is provided with self-oiling bearings. The Emerson company is also perfecting an alternating motor of three horse power.

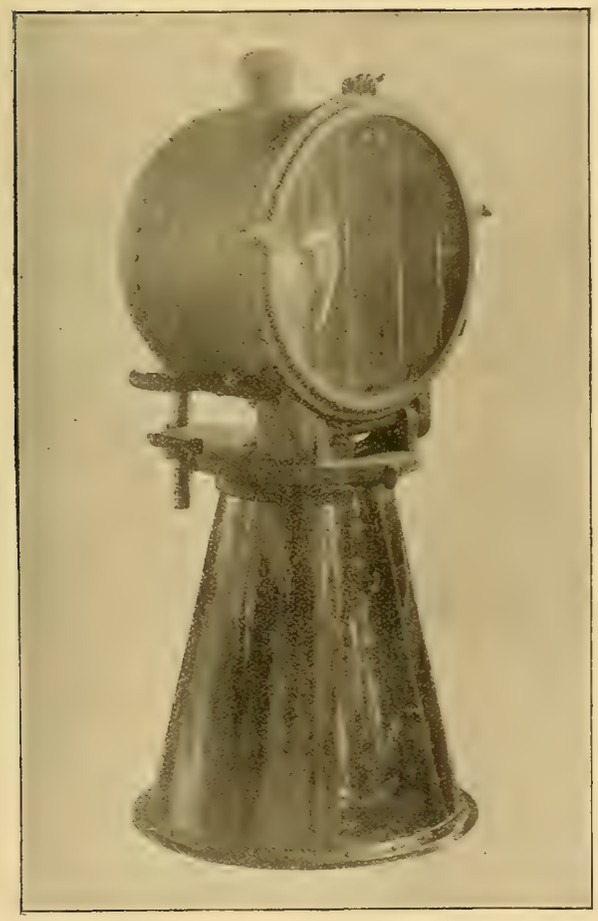


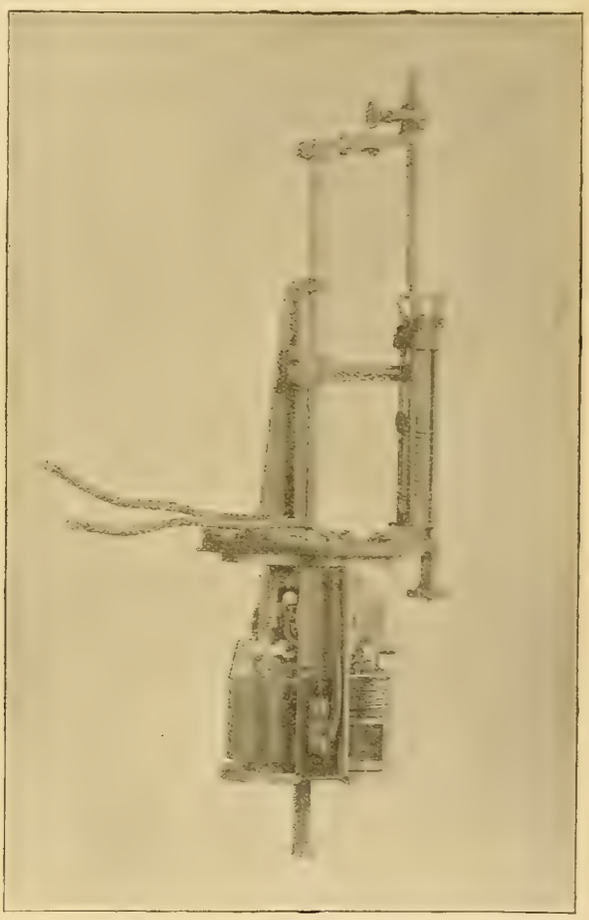
NEW TERMINAL BLOCK.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 30.—The Edison Electric Light company, and the United States Electric Light company are in the courts and some day, perhaps, after two or three lawyers have made independent fortunes, we will know which company owns certain valuable patents. The case, which is a test one, was begun on Wednesday in the United States Circuit Court of Appeals, and was continued on Thursday by Gen. S. A. Duncan, counsel for the appellant. The point of litigation, it will be remembered, is whether the United States Electric Light company has, by the manufacture of a certain form of incandescent light, infringed the patent filed by Thomas A. Edison in 1880. Points of considerable importance are to be brought out in





FIGS. 1 AND 2 EDISON PROJECTOR.

this re-trial of the case, which was decided last year by Judge William J. Wallace of the Circuit Court in favor of the complainants.

The chief point of defense in Gen. Duncan's argument and the one on which he dwelt with repeated emphasis was in regard to the statement in the third claim which requires the carbon filament to be coiled. He took up the second and third claims in the patent, as filed in detail. The second claim reads: "The combination of a carbon filament with a receiver made of glass, and conductors passing through the glass, and from which receiver the air has been exhausted for purposes set forth." And the third claim reads: "A carbon filament or strip coiled and connected to electrical conductors so that only a portion of the surface of such conductors shall be exposed for radiating light as set forth."

Gen. Duncan in analyzing these two claims, the most important ones, brought out the ambiguity in the use of the word "filament" and the fact that the method of arranging the filament, as set forth in the third claim, is so vague as to defy exact definition or imitation.

Word comes from Troy to the effect that the electric chair to be used at the execution of Charles A. Wright, the Essex county murderer, has been ordered by Warden Thayer of Dannemora prison. The one at the institution was destroyed by fire some time ago. The new chair will be made by convicts of Auburn prison. May 16th has been fixed as the day of execution, but the victim's attorney expects to secure a stay of proceedings.

Few people have a good word for the "grasping monopoly," but the *New York Times*, in a dispatch from Albany on Friday, compliments the Western Union Telegraph company for the satisfactory manner in which it has handled newspaper matter this winter. The *Times* says that its service has been exceptionally good. Since the first day of January not more than half a dozen errors—and those of the most unimportant character—have occurred in the 200,000 and more words, covering more than 100 columns of type, transmitted between Albany and New York. Under the management of Manager M. L. Morgan and Night Manager Henry V. Shelley, the reputation of the Albany office, which has always been of the first class, has been well sustained.

The Board of Electrical Control has ordered subways built in fifty streets at present unsupplied. It also ordered that in streets recently repaved the subways must be placed under the sidewalks. Fifth avenue was exempted from this list.

Manager A. E. Davis, of the advertising department of *Electric Power*, New York, has severed his connection with that journal to take charge of the advertising of the Dr. Bury Medical company, and the Covert Manufacturing company of West Troy, New York. Mr. Davis is well-known to the electrical trade, and has many friends, who wish him success in his new position. W. F. O.

Cincinnati, O.

CINCINNATI, April 30.—The question of lighting the streets by electricity is advancing step by step, and the probability now is that the contract will be awarded to the Cincinnati Edison Electric Light company at $84.90 per lamp per year.

In the meantime the committee on light has reported to the Board of Legislation "without recommendation," and at a spirited meeting Friday night an ordinance passed the first reading, awarding the contract to the Edison company.

The bids for the electric light and power plant for the new city buildings were opened on the 22d, at the office of the Board of Trustees, and were announced as follows: Creaghead Engineering company (U. S. system) electric plant, $7,242.00; steam and electric plant, $12,612.00; Electric Supply & Contracting company (Eddy system), $7 550.00; Thomson-Houston company, $7,500.00; Edison General Electric company, $8,450.00; G. P. Altenburg (National system), $5,600.00, with engines, $9,900.00; Mather Electric company, $6,750.00; Jones Bros. Electric company, $6,130.00; Card Electric company (with engines) $11,679.00; Brush Electric company, $9,300.00; Detroit Electrical works $6,830.00; Western Electric company (with engines), $10,385.00; Jenney Electric company, $5,576.00; Finney Electric company (with engines), $10,676.00. The engine bids were Thos. G. Smith, Jr. (Ball engines), $7,513.00; Boughen Engineering company (Beck engines), $5,179.82; Lane & Bodley, $5,900.00; Buckeye Engine company, $5,100.00; Barnes & Co. (Russell engine), $4,500.00.

The Cleveland syndicate is still purchasing stock of the South Covington and Cincinnati Street Railway company, the last block bought being that of Vice-President Abbott, at $125. Major Abbott will, however, remain as vice-president of the road, as he has been connected with it since its organization.

The new syndicate will push its work on the extension of its road to Letonia race track, which adds greatly to its traffic during racing season. It will also extend its road to St. Thomas and Highlands.

The Mount Auburn electric road is adding a number of new cars. These are of a new design for our city, and are attracting much attention. The seats are arranged as in the ordinary steam railway car on either side of the aisle, and in an ordinary car can seat twenty-eight instead of only twenty-two. The traffic on this road is greatly increased since the stoppage of the Mt. Auburn & Avondale cable road, two months ago, when the power house was burned down and patrons have been complaining of lack of cars. All should now be happy on the electric road. C. E. C.

Milwaukee, Wis.

MILWAUKEE, April 30.—Secretary J. D. McLeod, of the Wisconsin Telephone company, is an enthusiast on the subject of long-distance telephoning. Inside of a year, he predicts, Milwaukee will be able to talk to New York. It appears that the long-distance telephone lines of the American Telephone & Telegraph company are now finished between New York and Cuyahoga Falls, near Akron, O., and that material for the line between that point and Chicago is being laid down, the intention being to have the line in operation for the opening of the World's Fair. There is now an excellent metallic circuit between Milwaukee and Chicago, and this city will, therefore, have the use of the long-distance line to New York as soon as it is completed to Chicago. The line between Milwaukee and New York will be about 975 miles long. Many people here find it very hard to believe that such a wonderful feat as telephoning nearly 1,000 miles is soon to be accomplished.

To the Thomson-Houston Electric company the Board of Public Works has awarded a contract for furnishing electric motors for three bridges—those on State, East Water and West Water streets. The motors for West Water street bridge will cost $1,490 and the other two $1,475 each. The Villard company will furnish the power free of charge. In his annual message to the Common Council Mayor Somers recommended electric motors for bridges quite strongly and their use will undoubtedly be extended.

The Chicago, Milwaukee & St. Paul Railway company will allow eight of its wires between Milwaukee and Minneapolis to be used for press dispatches during the Republican National Convention. The company's telegraphic headquarters are here, and hence it has more telegraph wires between Milwaukee and Minneapolis than it has between Chicago and Minneapolis. Its action will help out Minneapolis and the press materially. The Western Union, which is not very well equipped so far as Minneapolis is concerned, at least in comparison with the railway company, is extending its wires and will have thirty wires in use transmitting press dispatches during the convention.

After a strong fight the Villard syndicate won a decisive victory before the death of the old Common Council Early in the fight, owing to opposition, Henry C. Payne, Villard's representative, brought in a substitute ordinance which differed from the "blanket" measure in that it admitted the Howell avenue, the Lake Shore Park and the Galena street extensions. In committee the ordinance received favorable consideration. It was no sooner before the council, however, than it was referred back to the committee. In the council Alderman Lorenz proposed that a fare of only 3 cents be charged at certain hours and that the tracks revert to the city on the expiration of the franchise. Alderman Ziegler wanted to compel the company to pave the entire street where it was permitted to lay tracks. That was on Saturday last. The committee held another meeting on Monday afternoon. It decided to kill the amendments just mentioned, and to include the Howell avenue and Lake Shore Park franchises in its report. The council met the same afternoon and wrestled with the report. Alderman Lorenz charged that the ordinance was loosely drawn and Alderman Ziegler maintained that the city ought to have a share of street railway earnings. Once more the "blanket" ordinance was sent back to the committee. The committee met on Tuesday forenoon and decided to recommend the passage of the ordinance in substantially its original form. Alderman Lorenz offered an amendment, which was lost by a vote of 6 to 27, requiring the company to build at least a mile and a quarter of track each month and to have the lines completed by Jan. 1, 1893. The rules were then suspended and the ordinance was passed, only Aldermen Lorenz and Ziegler voting against it.

At the same time the council passed the ordinance giving the Villard people a franchise on Fond du Lac avenue. That ordinance, like the "blanket" ordinance, had been knocked back and forth between the board and the committee for a number of weeks, and at one time it looked as though it would never pass, owing to the objections of business men on that street. It was adopted on Tuesday by a vote of 29 to 2, only Aldermen Lorenz and Dietrich voting against it. Side poles will be used. The result is very satisfactory.

The council has empowered the Milwaukee Street Railway company to remove its track on Fourth avenue, between Greenfield and Windlake avenues, and build on Sixth avenue from National avenue to the city limits. It is explained that inasmuch as the company is building a line on First avenue, a road on Sixth avenue would be of more use to the public than one on Fourth avenue. The change was made without opposition.

To secure the extension of the Villard system on Howell avenue, interested property-owners have raised a bonus of $30,000. The line is to be built to a point one and a half miles north of the city limits, and the bonus, it is estimated, will pay half the cost of construction. The road will branch off from the Russell avenue line at the intersection of Howell and Kinnickinnic avenues. I will pass the city park at Howell avenue and Oklahoma avenue and go a short distance south of the town hall. The farmers who contributed to the bonus assessed themselves at so much per acre, according to the benefits that each would derive from the road. Some subscribed more than $5,000. There is a great deal of activity among owners of property along the line, and its construction will probably result in the addition of one or more residence suburbs to the city.

Early Monday morning a large force of laborers was put to work on the uncompleted portion of the Bay View electric line. East Water street bridge was closed for repairs, and the Russell avenue and Forest Home cars were run around by way of Reed and West Water streets. Another large force is at work on the Greenfield avenue section of track. C.

PERSONAL.

P. H. Alexander, electrical engineer, Baltimore, was in New York last week.

Manager Sam G. Booker of the Fidelity Carbon company of St. Louis was in New York last week.

Superintendent of Construction S. B. Fowler of the Standard Underground Cable company, Pittsburg, Pa., is in Chicago.

H. W. MacLachlan, manager of the electrical department of the McIntosh Battery company, Chicago, is now located at Harrison, Neb.

Manager M. M. Hayden of the Law Telephone company, New York, returned home last week after an extended trip west as far as Denver.

Jas. A. Wright, formerly general manager of the Federal Telephone company of Montreal, has left this company to fill a similar position with the Maxwell General Supply company of Toronto.

NEW INCORPORATIONS.

Buffalo & East Aurora Electric Railroad company, East Aurora, N. Y.; capital stock, $150,000; to operate a street surface railroad.

Oxford Electric Light company, Oxford, N. Y.; capital stock, $10,000; to manufacture and use electricity for light, heat and power.

Walden Electric Light & Power company, Montgomery, N. Y.; capital stock, $10,000; manufacture and use of electricity for light, heat, etc.

Cumberland Development & Improvement company, Castle, Mont.; capital stock, $60,000; to generate and use electricity for light, heat and power.

King Exploration company, Roanoke, Va.; capital stock, $600,000; mining, mills, furnaces, coal and personal estate, gas, electrical and water works, street, railways, etc.

Phoenix Consolidated Gas & Electric Light Company, Denver, Colo.; capital stock, $300,000; to manufacture and supply to any city or town in the United States, gas, electric light, power, etc.

Jefferson Electrical company, Steubenville, Ohio; capital stock, $50,000; generating and distributing electricity and building and operating street railways; Geo. A. Maxwell, Steubenville, Ohio.

Arnold Novelty company, Tacoma, Wash.; capital stock, $12,500; to buy and sell novelty goods, merchandise and electrical appliances, and especially Arnold electric flexible brackets; A. F. Esperson, Tacoma, Wash.

Seth B. Smith Electric company, Butte, Mont.; capital stock, $50,000; general electric business, installing plants, furnishing supplies, and doing repairs; John O'Rourke, Geo. T. Schmetzel, Seth B. Smith, Butte, Mont.

Columbus Street Railway company, Columbus, O.; capital stock; $3,000,000; constructing and operating street railroad in Columbus, electric, steam, horse or other motive power to be used; Columbus Street Railway company, Columbus, O.

Kankakee Electric Light company, New York, N. Y. (incorporated in West Virginia); capital stock, $10,000;

constructing and operating an electric light system at Kankakee, Ill.; Moffett, Hodgkins & Clarke company, Syracuse, N. Y.

American Battery company, Chicago, Ill.; capital stock, $1,000,000; to manufacture and sell electric batteries, dynamos, motors, electric carriages, and other electric apparatus or appliances; Banning, Banning & Payson, 225 Dearborn street, Chicago, Ill.

Standard Electric company, Castle, Mont.; capital stock, $100,000; to generate electricity for power, lighting, manufacturing, domestic and other useful purposes, in the towns of Castle, White Sulphur Springs, Neihart and at all producing mines in said county.

Pennsylvania Mining & Improvement company, Everett, Wash.; capital stock, $80,000; to deal in and operate mines, mills, smelters, build, operate and dispose of railroads, eletcric light plants, telephone and telegraph lines, water and gas works; B. W. Brintnall, 402 West Twelfth street, Olympia, Wash.

ELECTRIC LIGHTING.

The municipal plant at Ashtabula, O., is practically completed.

Sharpsburg, Pa., will probably hold a special election to vote on the question of erecting an electric light plant.

The city council of Schuyler, Neb., is advertising for bids for a 100 horse power engine for its electric light station. The city clerk will receive bids until noon of May 12th.

The Detroit Electric Light company has sold its Pontiac plant to Pontiac citizens for $40,000, and a stock company has been formed under the name of the Citizens' Electric Light company of Pontiac.

The Consumers' Electric Light & Power company of De Soto, Mo., has purchased the plant and business of the De Soto Electric company, and hereafter both companies will be managed under the title of the Consumers' company.

The contracts between the city of Rochester, N. Y., and the electric light companies will expire on July 1st, and negotiations for renewals have already been begun. An effort will be made to have the wires buried in the principal streets.

This year's appropriation for Chicago street lighting is causing the city officers some close figuring. It costs $56,000 to operate the South Side electric light plants. Comptroller May says that he has only $50,000 available for that purpose.

Minnesota rejoices in a town bearing the name of Sleepy Eye. The village is not so lethargic, however, but that it owns an electric light plant, and it is said that the record of receipts and running expenses for January and February show a return at the rate of 15 per cent. a year on the investment.

The electric light plant recently shipped to the Eagle Bird mine, Washington district, California, is now running and the mill is lighted by electricity. Wires are being run to the boarding house, store, compressor room, and other buildings, and in a few days they will be supplied with the electric light.

The new Orient line steamship, Ophir, is equipped with 850 16 candle power lamps, to which must be added a mast-head arc lamp and a projector for use in the Suez canal. There are twenty circuits, the electromotive force being sixty-five volts throughout. Four compound wound drum armature dynamos are driven direct by compound engines, having cylinders 8 inch and 13½x7 inch stroke. One large switch-board and one distributing board in the dynamo room enable all the necessary combinations to be effected, any three dynamos being capable of doing all the work, thus leaving a machine in reserve.

On April 21st the city council of Burlington, Ia., canceled the contract with the Electric Light & Power company, on the ground that the company has lately "failed wholly to furnish light as specified and provided for in its contract with the city for electric lighting, and which contract bears date May 18, 1891." The mayor was directed to issue a proclamation calling for a special election "for the purpose of submitting to the qualified electors of the city of Burlington, the question whether the establishment and maintenance of an electric light plant, with all necessary poles, wires, burners and other requisites, shall be authorized."

Trouble has been caused in the pleasant village of Warsaw, N. Y., by the application of the Citizens' Gas Light company to put up poles and wires in and through the streets for electric lighting, etc. The directors of the Warsaw Electric Light & Power company oppose the granting of the franchise, claiming that their contract with the village, granted some two years since, gave them exclusive right over the territory for five years. After a personal controversy between the two companies at the trustees' meeting at which the matter was considered, the matter was ordered to be laid on the table and just at this juncture the electric light company served an injunction upon the president of the board restraining it from taking any action upon the matter and the application was tabled until some future time.

The question of establishing a municipal electric light plant at Richmond, Va., is again being agitated. A few weeks ago a resolution was offered in the council asking for an appropriation of $125,000 to be used for the erection of a plant. This resolution was adopted unanimously by the council, but when it reached the board of aldermen a week later it was referred to the finance and electric light committees, and those committees were requested to report back to the board. The chances of getting it through seem to be favorable, yet there is said to be very strong opposition to it on the part of certain of the taxpayers backed by the influence of the electric light company that is now lighting the streets. The contract for lighting the streets was awarded on February 8th for two years; therefore the city cannot embark in the electric light business until this contract expires.

ELECTRIC RAILWAYS.

The electric system of Grand Rapids, Mich., is to be extended to John Ball Park.

The first electric car in South America appeared upon the streets of Panama on April 27th.

The Princeton, Ill., city council has granted a franchise for a line of electric street cars in that city.

The United Electric Railway company of Nashville, Tenn., will probably extend its road to Noelton.

An electric road is to be built in Hammond, Ind., a southern suburb of Chicago. The Short system is to be used.

Three generators of 260 horse power each will be used in the station of the new Carrollton electric road of New Orleans.

The Waco, Tex., Electric Railway & Light company is reported as purchasing the Waco dummy line, and as about to change it to the electric system.

The surveying has been done and the right of way secured for the new electric railway to be built from Farmington, Mo., to Doe Run Junction.

The mayor of Baltimore has signed the ordinance authorizing the Baltimore, Canton & Point Breeze Railway company to build an electric railroad, using the overhead system.

The Peoria, Ill., council has passed an ordinance granting to the Peoria Rapid Transit company the right to construct and operate an electric street railway over certain streets and avenues.

At the last session of the Maryland legislature the South Baltimore & Curtis Bay Railroad company was granted authority to extend its electric railroad thirty miles south toward the Chesapeake Bay.

The Robertson Southern Electric Railway company of Knoxville, Tenn., will, it is said, soon commence the survey for an electric railroad from Knoxville to Dandridge, a distance of from 30 to 35 miles.

A company has been formed to build an electric road from the north line of Dundee township to the south line of Aurora township, in Kane county, Ill. The principal office is to be maintained at St. Charles, Kane county. The capital stock is $400,000.

The East Middlesex Horse Railroad company has obtained permission from all the towns and cities within whose limits it extends, from Chelsea to Woburn, Mass., to equip its road with electric power. This system will be probably in operation by the middle of June.

It is reported that the North Woburn, Mass., Street Railroad company will equip its line with electric power when its petition for that privilege shall have been granted by the municipalities through which it operates. The company has about seven miles of track, with terminals at North Woburn and Medford.

It is reported from Santa Cruz, Cal., that the Electric Light & Power company of that city has contracted with the Risdon Iron Works of San Francisco for a compound, high speed Ball engine of 200 horse power. This engine will supply power for the new electric railway running from Pacific avenue to the ocean.

It is reported that the capitalists whom Manager Jones of the Burlington, Ia., street railway represents, have offered the old Electric Light & Power company $12 000 for that company's plant and franchise. In the event of a consummation of such a deal no special election would be necessary, as the franchise of the old company is assignable.

The Rochester, N. Y., Railway company will extend its lines so as to furnish rapid transit to the public park south of the city. It has also a proposition before the Park Commission providing for the establishment of an overhead trolley line through the park for the convenience of visitors. The proposed route will enable the company to furnish transportation to all parts of the park.

The Bozeman electric plant at Bozeman, Mont., with its franchise and property, has been sold out to a company composed of St. Paul, Minneapolis and Helena capitalists. The company is incorporated for $150,000; $100,000 fully paid up. It is the intention to proceed at once to lay a street railway from the depot to Church and Main streets to the courthouse, running several lateral branches over different streets. Work will be commenced immediately.

J. H. Rhomberg of the Dubuque Electric Railway company has sworn out warrants against Manager Hoopes, Superintendent Wise and two other employes of the telephone company in Dubuque charging them with malicious mischief in cutting the street railway company's wires on Couler avenue. It is understood that the telephone company claims exclusive right of way on Couler avenue by virtue of sole and undisputed possession for ten years. Another system of electric wires there, the company alleges, would destroy the usefulness of the telephone wires, and thus practically deprive the company of its franchise on that street.

The application of the Thomson-Houston Electric company for the appointment of a receiver for the Dubuque, Ia., Electric Railway, Light & Power company came up before Judge Shiras in the United [illegible] on April 27th. The petition alleges that the [illegible] company is insolvent, specifying many [illegible]. The defendant enters a general denial. It is charged that the Thomson-Houston company is seeking to have a receiver appointed in order to compel the street car company to substitute its machinery for that now in use. Judge Shiras took the case under advisement, and will render a decision soon.

According to the News of Baltimore the Belt Railroad company of that city has received an offer from the Thomson-Houston Electric company, to thoroughly equip its tunnel for the running of trains through it by electricity without the expenditure of a dollar on the part of the railroad company, and to give the latter the free use of the plant for six months, provided that if the experiment shall prove to be what the Thomson-Houston people claim, the railroad company shall take the plant at an agreed price. The Belt Railroad company's officials have accepted the proposition.

MISCELLANEOUS.

The Gamewell fire alarm system has been introduced in Houston, Tex.

It is claimed that $100,000 is due the city of Philadelphia, as license charges from companies maintaining overhead wires in the streets.

The "electrical workers" of Minneapolis held a meeting recently, and it is probable that a local union of the Electrical Workers' association will be formed. It is reported that this organization is gaining in numbers throughout the country.

Prof. S. W. Stratton, professor of electrical engineering and physics of the University of Illinois, visited Chicago last week with his senior class in electrical engineering. They visited the principal electrical works and many of the large buildings containing electrical plants

A jury in Judge Adams' court, Chicago, returned a verdict in the suit of Alpheus H. Pike against the Lyceum Theater company for $10,000 damages, assessing the amount of damages at $600. Pike claimed to have received an electric shock while at the theater on June 10, 1887, and that since that time he has been in poor health

The electric welding of street railway rails as a substitute for fish plates has been the subject of experiment for some time at the works of the Johnson Rail company of Johnstown, Pa. The experiments are now said to be entirely successful, and it is possible to weld by electricity two pieces of steel 25 of square inches section, and a solid steel rail three or four miles long, can be had if required. The tests also are said to prove that the necessity of joints to provide for contraction and expansion is not as apparent as supposed.

It is estimated that the proposed reduction in fees for patents will involve a diminution of $250,000 per year in the receipts of the British patent office. The primary fee of $20 for the first four years will be continued, but after that the following large reductions will take place: The fees for the fifth, sixth, seventh and eighth year will be $25, $30, $35 and $40 respectively, in lieu of $50, as hitheto. In the ninth and tenth years the fees will be $45 and $50, in lieu of $75, as hitherto. During the last four years the fees will be $55, $60, $65 and $70, as against $100. These reductions will come into force on September 20th.

The electrical section of the British Chamber of Commerce is about to petition Sir Michael Hicks-Beach and the Board of Trade against their decision that all conductors of electricity for lighting purposes must be placed underground. The contention of the petitioners is that, while the use of overhead conductors should be regulated as stringently as the public interests require, it should not be absolutely forbidden in all cases, for example, in country villages, where the expense of underground conductors would be prohibitive. They ask that in such cases the use of overhead wires should be permitted subject to certain regulations.

Thursday evening of last week was the date of the third grand reception of the Independent Athletic and Pleasure Club, and the entertainment proved to be a most enjoyable affair. The Auditorium Hall, Chicago, in which the reception was held, was brilliantly illuminated by electricity, the light from the myriads of incandescent lamps greatly enhancing the many beautiful toilets of the ladies. The guests assembled in the large hall with the musicians on the stage at the further end, and dancing was indulged in until a late hour It is said that some lingered long enough to make a comparison between "Edison" and "Sunbeam," but this is not authentic.

A proposition has been submitted by the Oerlikon company to transmit 5,000 horse power from Niagara Falls to Buffalo, a distance of 22 miles. The proposed plant will cost, it is claimed, about $180,000. The proposition provides that the dynamos, which will be of the multipolar drum armature type, are to be coupled directly to the shafts of the turbines, making 250 revolutions. The proposed pressure is between 600 and 700 volts, and it is to be converted into 25,000 volts before passing to line. The Oerlikon company proposes to use two lines, one for lighting and the other for power; the cost of these is to be about $20,000. The guaranteed efficiency of the generators is 96 per cent., and that of the whole line up to the second set of transformers is to be 84 per cent.

TRADE NEWS.

Mechanical Engineer E. E. Johnson, 87 Washington street, Chicago, is handling the Gould trip'ex power pump.

The Republican House at Milwaukee is to be fitted throughout with incandescent lamps, and Geo. Cutter, Chicago, will furnish Simplex braided rubber wire for all the circuits.

The Engineering Equipment company of New York, is sending out printed postal cards asking an opportunity to bid upon iron or wood poles, wire and other electrical construction material.

L. F. Rondinella has opened an office as mechanical, electrical and civil engineer at 705 Chestnut street, Philadelphia. Prof. Rondinella will continue to devote part of his time to educational work and will retain his position at the Central Manual Training high school of Philadelphia.

The Electric Construction & Supply company of New York has sold Chas. B. Rouss seventy Ward arc lamps for use in his large drygoods store in New York. These lamps were selected after several tests, and are to be used where the best light is required for the selection of dry goods.

R. A. Schoenberg, New York, inventor of the pneumatic annunciator reset, has just returned home after a three weeks' trip through the West as far as St. Louis. Mr. Schoenberg has secured as agents for his invention the Central Electric company, Chicago; the St. Louis Electrical Supply company, St. Louis; the Standard Electric company, Cincinnati; the Detroit Electric Works, Detroit, and the Cleveland Electric Manufacturing company, Cleveland.

Queen & Co., Philadelphia, have recently made a series of experiments upon the properties of quartz fibers for use in suspending galvanometer systems and in other physical measurements as compared with fibers of glass, metal and cocoon silk. These tests, it is stated, show conclusively that quartz fibers are so greatly superior to all others in every way, that the firm has decided to prepare them for sale. A number of interesting points relating to quartz fibers will be furnished on application to those desirous of detailed information as to this specialty.

The Robisons of the Cleveland Cable company have at last come into line. It will be remembered that before their company installed a cable plant in Cleveland the electric railway companies made a strong effort to induce the management to adopt electricity. In this they failed, owing chiefly to the influence of the New York element in the board of directors. A number of the gentlemen interested in the Cable Railway company have recently secured franchises for an electric railway in Fort Wayne, Ind., to be operated by the Fort Wayne Electric Railway Company. The order for the complete equipment of this road has been placed by Robison Bros. with the Short Electric Railway company. It consists of the following apparatus: Thirty-two car equipments complete, comprising 64 twenty horse power single reduction Short motors, and ten miles of overhead construction. The shipment of apparatus has already begun, and from the vigorous manner in which the Robisons are pushing the construction work, it is expected that the road will be completed and in operation by the first of June.

BUSINESS.

The Ball Engine company of Erie, Pa., is doing a larger business this spring than ever before. The company is building a very large addition to its present quarters to meet the increasing demand for the Ball engines.

Those installing small electric light plants and undecided as to what power should be employed, will find the catalogue describing the Acme automatic oil or gas engine of interest. This engine is manufactured by the Rochester Machine Tool Works, Rochester, N. Y.

General Manager Mason, of the Railway Equipment company, announces that he has purchased, in behalf of the Railway Equipment company, the capital stock, merchandise and, in fact, the entire business of the Electric Merchandise company. The business will hereafter be conducted under the name of the Railway Equipment company.

"In regard to your request to express my opinion of the Tobin bronze, will say that it is far superior in point of strength to any bronze or metal of that kind I have ever tested." Such an indorsement as the above from Engineer N. O. Olson, of the Fairbanks Department of Tests and Experiments, speaks volumes for this product of the Ansonia Brass and Copper company, New York.

The Interior Conduit & Insulation company of New York is sending to its patrons a copy of its new illustrated general catalogue "No. 7." This catalogue contains 46 pages of descriptive matter referring to interior conduits and special light, heat and power appliances The company forwards along with the catalogue a neat form of wiring specification for electric lights, a few indorsements of the Interior conduit system, and a cautionary notice to architects, builders, etc. Those interested in such work would do well to send for one of these very handsome catalogues, which are a credit alike to the Interior company and Engraver Bartlett.

"To obtain the highest efficiency in power pumps, both in power consumed and general working, it is of primary importance that the discharge be isochronous." In explanation of this statement of the Goulds Manufacturing company, New York, in regard to the Gould Triplex power pump, the company says that when once a column of water is given a certain velocity of discharge it is evident that any deviation from this constant velocity will result in loss of power in overcoming friction and inertia of the moving column. If the column of water when once started be maintained at a certain uniform velocity, the power required to overcome inertia of moving water is reduced to a minimum.

The American Electric Supply company of Buffalo is hard at work on its contract for the Erie County Savings Bank of that city. General Manager W. A. Fenn claims that this will be one of the most perfect isolated plants in the country. The contract calls for 1500 lights and the dynamos are to be of the C. & C. Electric Motor company's make. Three of these machines are each of 40,000 and one is of 20,000 watts capacity. Three straight line engines made by the Straight Line Engine company of Syracuse are to be used. Two of these engines will be of 60 and one of 30 horse power. Okonite wire is being used throughout the building, and all wires are laid in the Interior Conduit & Insulation company's tubes. The work is being done under the personal supervision of Mr. Fenn, whose long experience as an electric engineer and contractor eminently fits him for the position he holds with the American Electric Supply company as its general manager.

The electric railway between East Liverpool and Wellsville, O., consists of eight miles of overhead construction, and operates eight cars. The road was furnished throughout by the Johnson rail company, and it is said to ride as easily as a well constructed steam line. The company, consisting of Al. Johnson, S. H. Short and C. E. Grover, all of Cleveland, have been obliged to double the equipment in order to accommodate the summer travel. The J. G. Brill company are just completing eight fine open cars, and the Short Electric Railway company of Cleveland, O., will furnish 16 20 horse power single reduction motors and two additional 133 horse power generators. E. H. Jones & Co. of Cleveland which put in the first steam plant, are also doubling that part of the equipment. It is a curious fact, to be explained only by the character of the manufactories in Wellsville and East Liverpool, that these towns, the total population of which is 16,000 people, can support a street railway system larger than that to be found in some cities of 40,000 and 50,000 inhabitants.

The Utica Electrical Manufacturing and Supply company, Utica, N. Y., aims to manufacture and sell only the very best appliances, knowing from practical experience that every article used in the electrical business cannot be made too good. By using good material combined with skilled labor, improved machinery and tools, this company confidently expects to receive its share of patronage in the electrical business. The Utica company manufactures and sells the following articles: Simplex, duplex and quadruplex lightning arresters for arc, incandescent, alternating and direct, motor and electric street railway circuits; double pole and double contact switches for arc and motor circuits; double pole, quick-acting, knife switches, from 50 to 1000 amperes, for lighting and power circuits of from 50 to 500 volts; automatic magazine fuse boxes; porcelain fuse blocks, from 50 to 200 amperes, main, single and double branch; carbon brush holders for dynamos; circuit jumpers, carbon holders for all systems of arc lamps, pole stands for Wood, or American lamps; mast arms for street lighting, etc.

The Chicago, Burlington & Quincy railroad has just completed the arrangements for its special through train service between Chicago and Denver during the triennial conclave of Knights Templar, which will be held in Denver August 9th, 10th, 11th and 12th. This effort of the C. B. & Q. promises to surpass anything that has previously been attempted by the road. Thirty solid special trains loaded with delegates and their families from Chicago, New York, Brooklyn, Boston, Philadelphia and other Eastern cities will leave the Union depot, Chicago, in addition to the regular Denver trains, between noon of August 6th and the noon of the following day. The entire traffic of the Omaha and Kansas city divisions will be subordinated to the special flyers, and during August 6th and 7th, when the grand exodus for Denver is being made, all eastbound fast merchandise, together with the grain and live stock traffic, will be side-tracked at division points. The trains will be run in platoons. The entire journey of 1,026 miles will be made in from twenty-nine to thirty-four hours, according to the divisions over which the special will run. The railroad has arranged to make Chicago the pivotal point of the journey, both going out and returning, and all the bodies from the East will be given an opportunity to visit the World's Fair grounds and other places of interest. The great feature of the undertaking will be that there will be no mixed trains. Each delegation of Knights will travel in its own special, and will return by it after the conclave is at an end. The C. B & Q. has issued a circular giving full particulars, schedules, etc. for the conclave.

ELECTRICAL PATENTS.

Issued April 26, 1892.

473,463. Plunge Battery. James H. Howard, Medford, Mass.

473,499. Circuit Closer. Charles H Delano, Woburn, Mass.

473,504 Electric Switch. Halbert K. Hitchcock, Louisville, Ky.

473,514. Induction Discharge Protector for Welding Apparatus. Herman Lemp, Lynn, Mass.

473 532. Two Wire Telephone System. Giles Taintor, Keene, N. H.

The second claim reads:

"In a two wire telephone system, the combination, with a generator located in a loop, a talking circuit and a ringing circuit adapted to be normally connected with the generator, of two movable terminals, a hook switch and an operating receiver to establish electric connection between the generator and the talking or ringing circuits."

473,536. Alternating Current Arc Lamp. Barton B. Ward, New York, N. Y.

473 538. Electrical Measuring Instrument. Edward Weston, Newark, N. J.

473.539 Electric Measuring Instrument. Edward Weston, Newark, N. J.

473,547. Dynamo Electric Machine. Ward Decker, Owego, N. Y.

Claim two is:

"In a multipolar dynamo electric machine the combination, with a series of armature coils, all electrically connected together at one end, of a cross-connected commutator, the adjacent sections of which overlap each other, the sections being connected, respectively, with the opposite or free ends of the coils."

473.567. Commutator Connection for Electric Motors or Generators. Charles G. Curtis, New York, N. Y.

473.568. Armature for Dynamo Electric Machines or Motors. Charles G. Curtis, New York N. Y.

Claim three is quoted:

"An armature provided with a compressible non-conducting water-proof covering and end caps compressing the covering against the armature winding and sealing the comutator connections, thereby rendering the armature water-proof at all points."

473 570. Apparatus for Sinking Shafts. Fulton Gardner, Chicago, Ill.

473 593. Feed Water Heater for Fire Engines. Peter Smith, Detroit, Mich.

473.594. Electric Circuit Controlling Device. Mandeville Thum, Louisville, Ky.

473,595. Circuit Controlling Device. Mandeville Thum, Louisville, Ky.

473 614. Electric Railway Signal. Charles E. Corporan, Colorado City, Colo.

Claim four is given:

"In an electric signaling device, the combination of a railway, the rails of which form an electric conductor, a second conductor along the track, one of said conductors being formed in sections, a vehicle adapted to travel on said track, a pole-changer within said vehicle, one side of which is connected with the track rails and the other side connected with the second conductor, a battery connected with the said pole-changer, a supplemental cylinder and piston, a lever connected with the piston of said cylinder and with said pole-changer so as to connect the poles of the battery with the rails and the second conductor and to change the polarity of the said rails and conductors, and signaling devices included in the circuit to sound an alarm when the circuit is closed from the rails to the second conductor."

473,618 Dynamo Electric Machine Rudolph Eickemeyer, Yonkers, N. Y.

The first claim is:

"The combination of an armature drum or core having at its ends projecting studs or pins, and a set of counterpart detachable coils, each having a long side and a short side which is a little longer than the face of the drum or core and having ends which are located between said studs and diverge from the short side to the long side, said ends near the long sides overlying the ends of the other coils near their short sides."

473,619. Dynamo Electric Machine. Rudolph Eikemeyer, Yonkers, N. Y. Filed Dec. 23, 1889.

An armature composed of independent coils, so connected as to form a set of multiple coils, the multiple coils being readily applicable to and detachable from an armature drum or core.

473,637. Coupling for Electric Wires. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car-Heating Company, Wheeling, W. Va.

Two corresponding heads carrying projecting tongues which are pressed in contact by means of springs.

473,661. Combined Gas and Electric Light Bracket. John Fitzgerald, Montreal, Canada.

473,674 Electric Locomotive. Sidney H. Short, Cleveland, Ohio.

The armature is supported upon a sleeve encircling the axle and mounted on independent bearings. The armature supporting sleeve is connected with the driving wheel by means of a spiral spring.

473 693. Electric Locomotive. Joseph I. Conklin, Brooklyn, N. Y.

A number of vertical armatures are provided with gear wheels to engage a gear wheel on a vertical shaft, the motion of which is transmitted to the car axles by bevel gears.

478,699. Automatic Heat Regulating Apparatus. Chas. F. Goodhue, Boston, Mass.

473,713. Covered Electric Wire. Henry A. Rueter, Boston, Mass.

473,717. Electric Contact Protector. Richard Varley, Jr., Englewood, N. J.

473,820. Automatic Transporter and Exploder for Explosives for aiding Rain-fall. Laurice L Brown, Patmos, O.

473,832. Electric Signal for Railway Trains. Lawrence Dunn, Fort Smith, Ark.

473,841. Manufacture of Carbon Blocks. Leon Hulin, Froges, France, assignor to Grosvenor P. Lowrey, New York, N. Y.

473,848. Electric Switch-board. John P. Mayer, Newark, N. J., assignor of one-half to Joseph Meier, same place.

The dynamo machine leads are parallel and equidistant from each other. Perpendicular to these the lamp circuit leads are also run parallel and equidistant. Terminals upon the leads are so placed that any circuit may be connected to any dynamo by means of a plug having arms at right angles, which arms engage with the terminals upon the leads.

473,866. Process for Obtaining Metals from Their Ores or Compounds. Charles S. Bradley, Yonkers, N. Y.

473,871. Electrically Propelled Vehicle. Fulton Gardner, Chicago, Ill.

The storage battery is carried on one of the wheels. The cells of the battery are arranged at suitable points around the wheel, thus obtaining a more uniform distribution of the load.

11,238. Secondary Battery. Isaiah L. Roberts, New York, N. Y.

ESTABLISHED 1848.

HEMINGRAY GLASS CO.,

Offices, Covington, Ky. Factories, Muncie, Ind.

STANDARD SCREW GLASS INSULATORS,

Glass Break Knobs, Floor Insulators, Battery Jars.

ARC LIGHT GLOBES FOR ALL SYSTEMS.

WORK ON SPECIAL DESIGNS SOLICITED.

FOR SALE CHEAP.

One 14x20 Russell Automatic Engine with line shaft and friction clutch pulleys. Nearly new.
One 8x8 Westinghouse Engine. Both taken in exchange for Ideal engines.
One 24 in. Steptoe Lathe.
One 18 in. Star Tool Co.'s Lathe.
One 36 in. Back Geared New Haven Drill.

A. L. IDE & SON, Springfield, Ill.

WANTED!

An energetic business man who understands electric devices, to handle an Eastern patent which promises to be introduced into every manufacturing concern in the United States. A profitable business opportunity is open to the right party. Address, stating electric experience age, and parties to whom we could refer as to character and ability,

"E O W,"
Care WESTERN ELECTRICIAN.

WANTED!

An Agent to sell our

Niagara Electric Motors and Dynamos,

In every city in the U. S. where we are not already represented. Liberal inducements and exclusive territory to the right party. Address,

LOVELL MFG. CO., Ltd., Erie, Pa

WANTED!

A GOOD LIVE MAN, with small capital, to take active interest in a growing and well established electrical concern; doing superior manufacturing, general jobbing and construction business. Must be experienced in general business management, also possessed of sound practical knowledge. Address,

"A B,"
Care WESTERN ELECTRICIAN.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

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HERBERT H. EUSTIS, President and Electrician.

A LONG FELT WANT SUPPLIED.

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THE CRESCENT INSULATED WIRE & CABLE CO.,

MANUFACTURERS OF ALL KINDS OF

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FAN MOTORS.

SEND IN YOUR ORDERS FOR
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SOMETHING NEW!

An improved 4 or 6 volt Combined Storage Battery especially for Dentists' use at very low price. Purchasers can exchange discharged for charged cells, without extra cost, beyond expense for charging the batteries. Manufactured by

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Room 301, 205 S. Canal St., Chicago.

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ENGINES STEAM PUMPS
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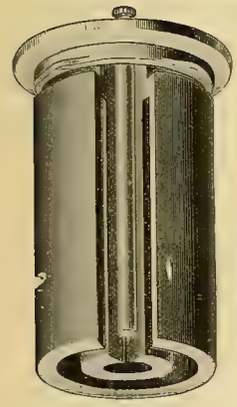
ENGINEERS AND CONTRACTORS.
BOILERS COMPLETE POWER PLANTS

Late of English, Morse & Co. K. C. Mo.



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—WITH—
Double Cylinder Carbon

Element attached with zinc to cover. 147 sq inch carbon surface. The element is everlasting, and is so guaranteed. Why use a battery with a chemical depolarizer that needs frequent renewal of the negative element.

LAW BATTERY COMPANY,

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FOR SALE.

2-35 Light Waterhouse Arc Dynamos, 2,000 C. P., with single and double lamps.

Rose Electric Light Supply Co.,

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ALL SIZES AND QUALITIES

For Electrical Purposes.

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218 Water St., New York.

PORTER-LEAVITT ELECTRIC MOTOR CO.,

124 Mitchell St., Providence, R. I.

Battery Motors a Specialty.

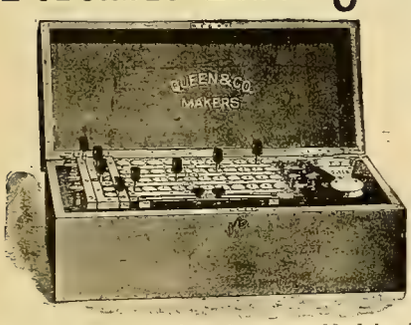
FOUR REGULAR SIZES.

Suitable for running Sewing Machines, Dental Drills, Jewelers' Lathes and all kinds of light machinery

No. 1, 2 Volts, 1-32 h. p., $3.00.
No. 2, 4 Volts, 1-16 h. p., $5.00.
No. 3, 6 Volts, 1-12 h. p., $10.00.
No. 4, 10 Volts, 1-8 h. p., $15.00.

Send for Circular. Every Motor Guaranteed.

Portable Testing Resistance Sets.



We claim that our **"1891" TYPE** Portable Testing Set is the most efficient of its class on the market. The coils are wound with platinoid wire and adjusted to a guaranteed accuracy of one-fifth of one per cent. The galvanometer is deadbeat, sensitive, and is unaffected by mechanical vibrations and proximity to masses of iron or intense magnetic fields. The total range is from .001 to 11,110,000 ohms.

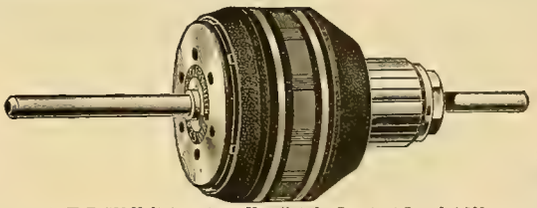
We believe that no other testing set embodies these features, which are essential to satisfactory results.

It is possible to buy sets from ourselves or elsewhere at prices lower than the cost of the above, but we would advise all to examine the merits of our **"1891" TYPE** before purchasing any other.

Send for illustrated descriptive circular No. 285.

QUEEN & CO., PHILADELPHIA.

CROCKER-WHEELER ELECTRIC COMPANY,



SLOW SPEED MOTORS.

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The Motors are made with the best appliances and material obtainable, and embody every improvement of merit, with the intention that they shall be the Standard of their class.

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GAS AND ELECTRIC

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ELECTRIC AND GAS GLOBES,

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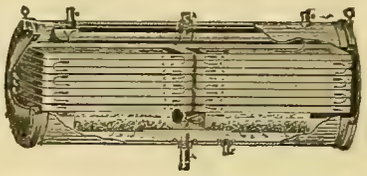

Removes all Impurities.

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Five 240 Ampere compound wound T.H. Incandescent Dynamos, 110 Volt.
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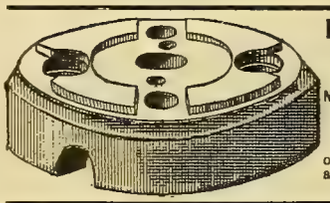

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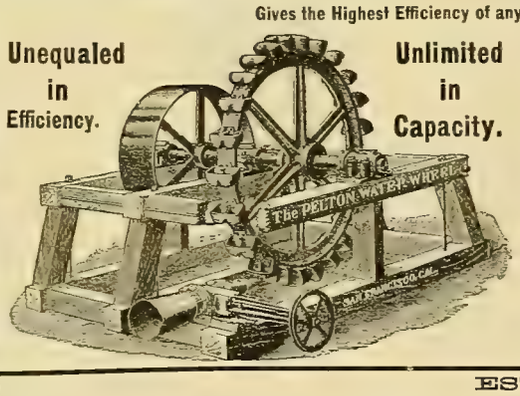

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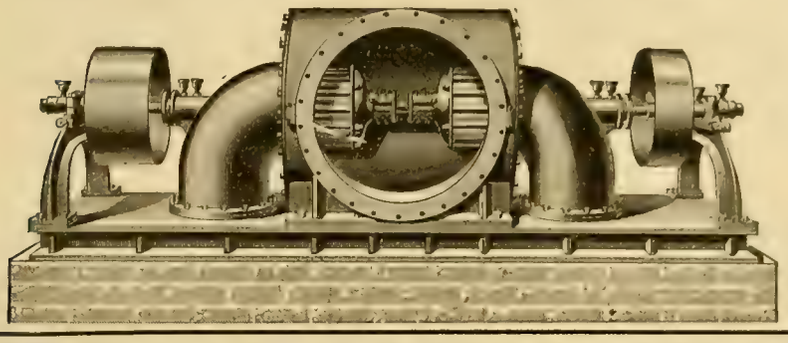

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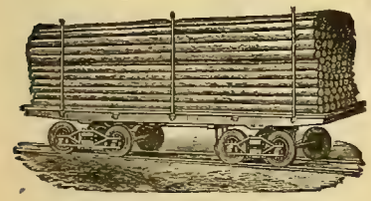

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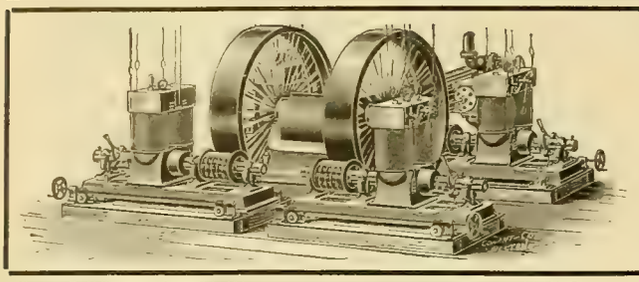

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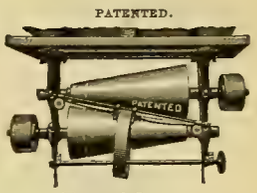

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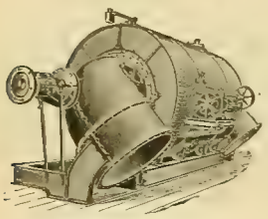

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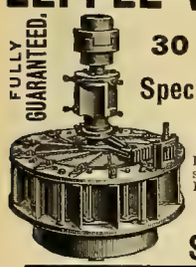

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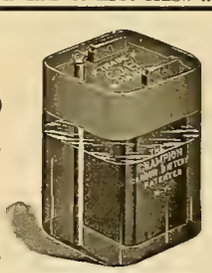

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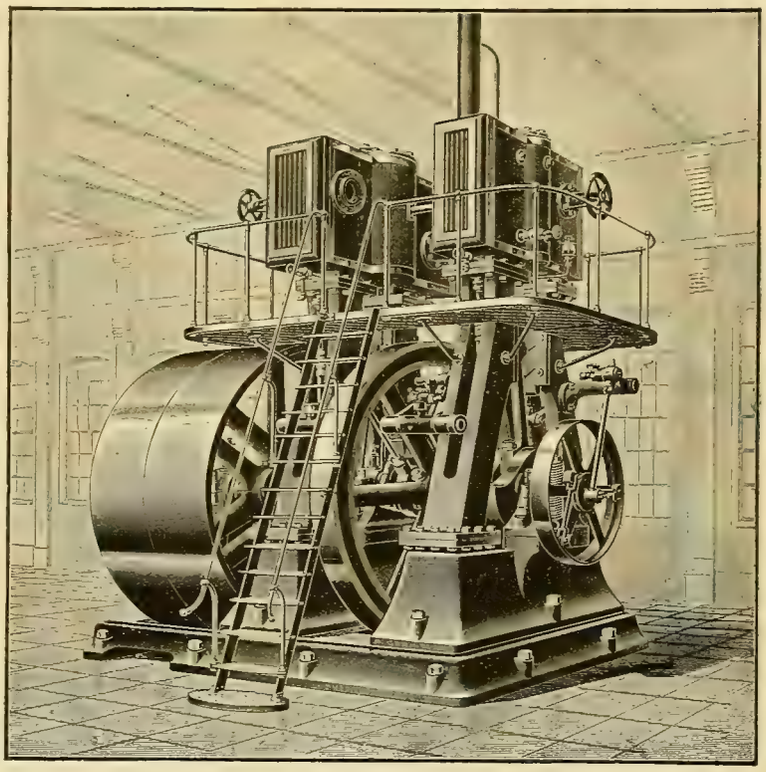

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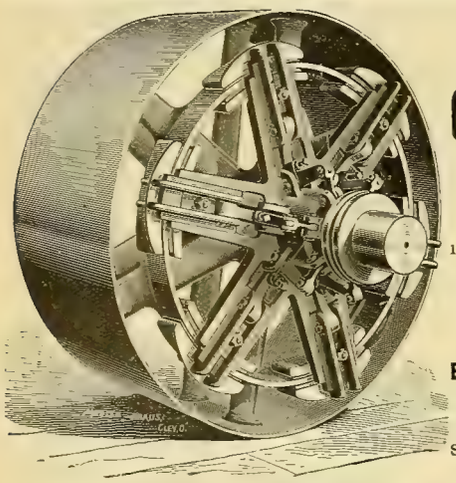

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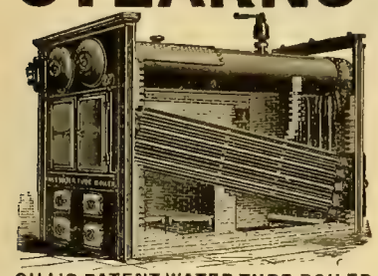

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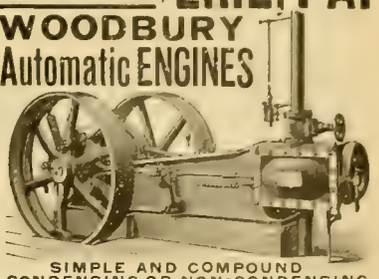

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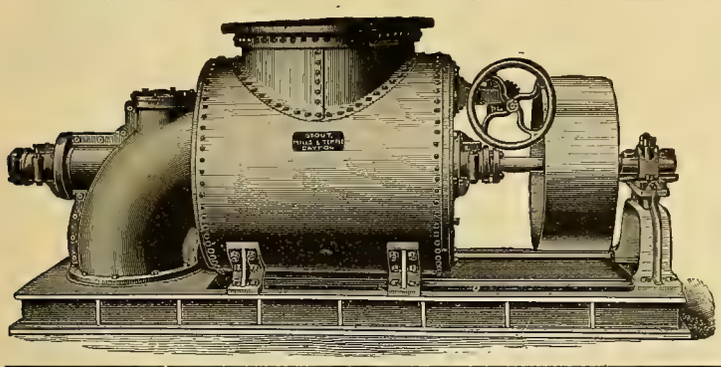

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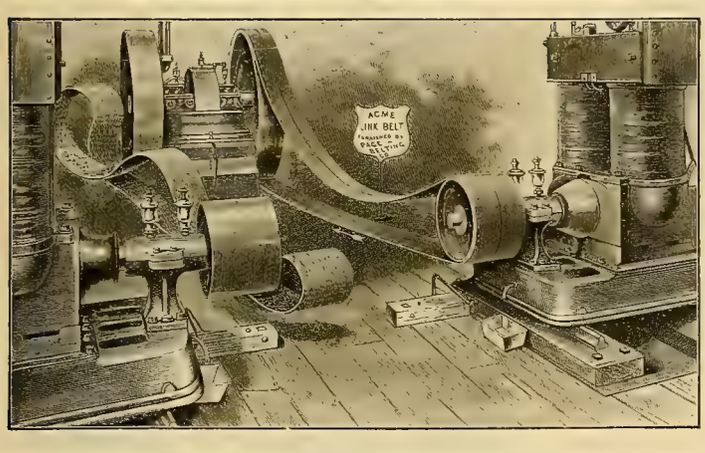

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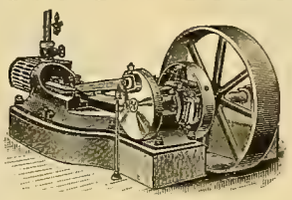

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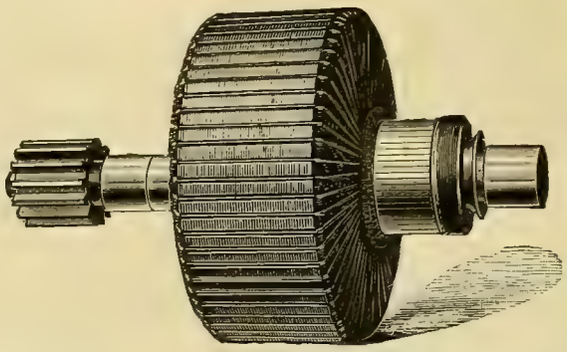

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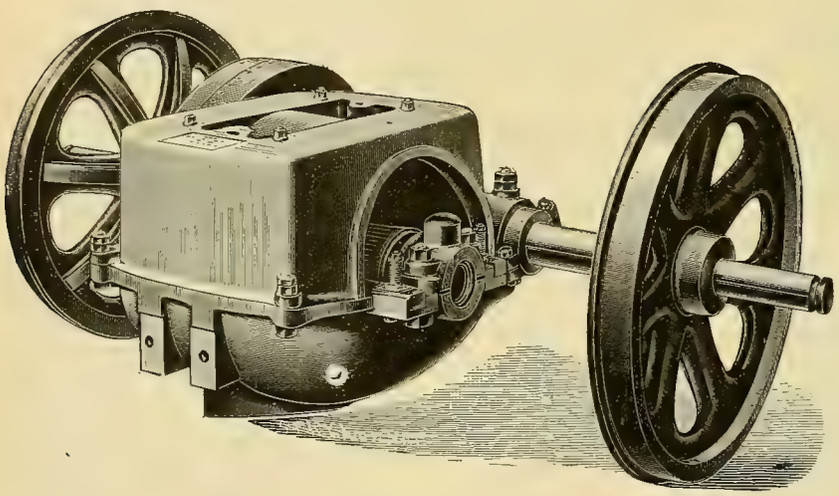

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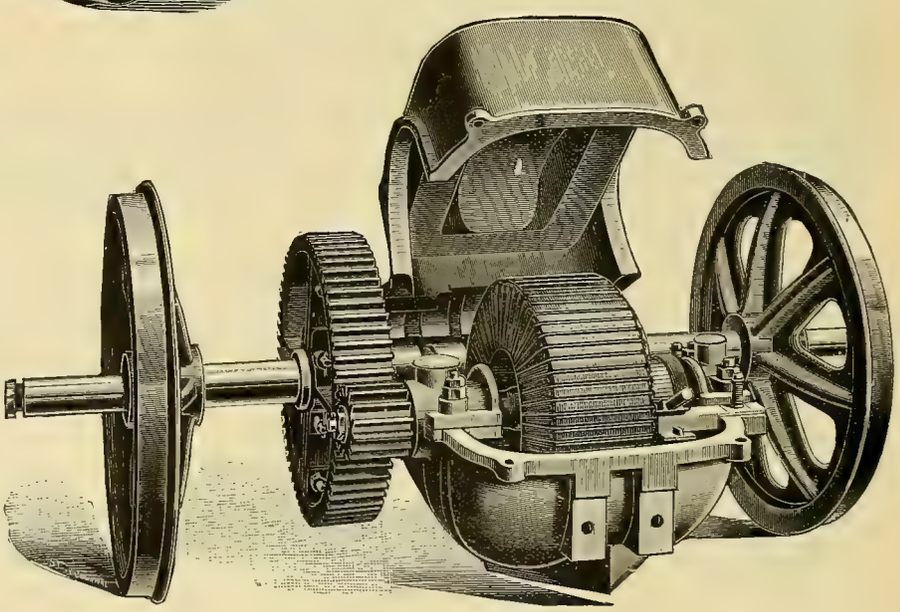

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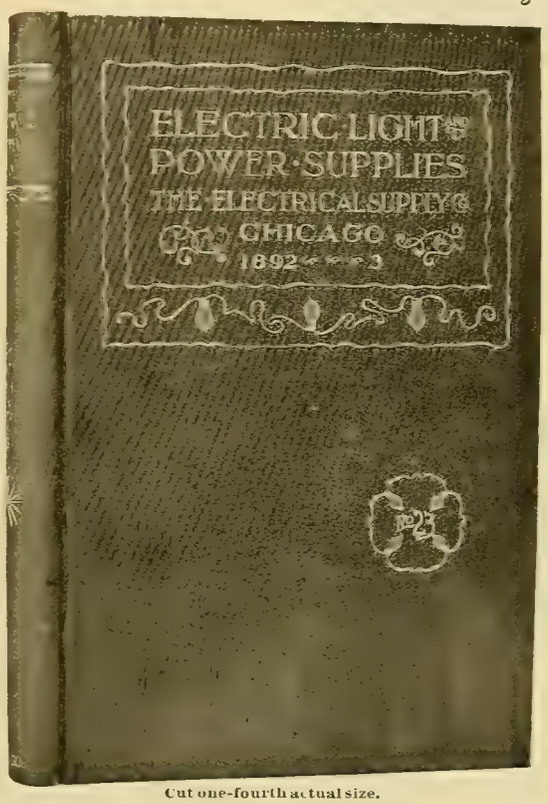

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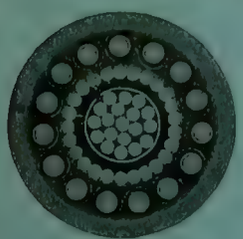
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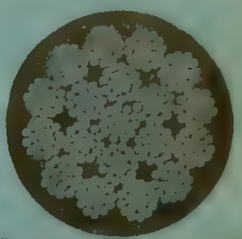
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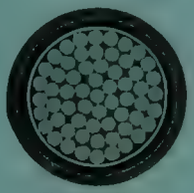
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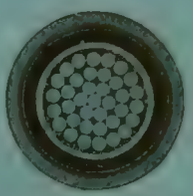
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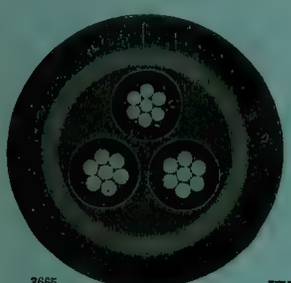
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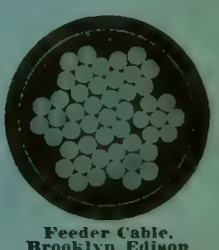
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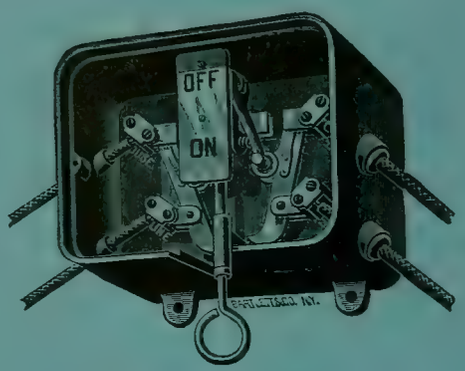

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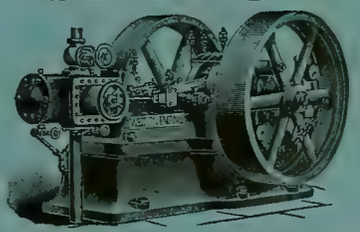

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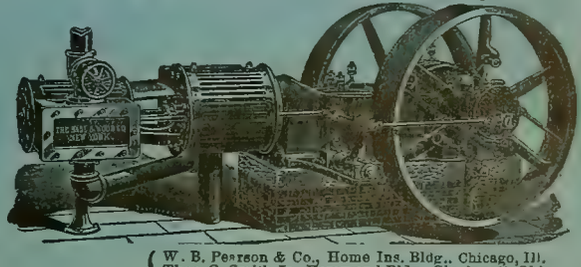

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Westinghouse Electric & Mfg. Co.
Western Electric Co.
Weston Engine Co.
Williams Engine Works.

Copper Wires and Tapes.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cutter, Geo.
Detroit Electrical Works.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Roebling's Son's Co., J. A.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cut-Outs and Switches.
Andrae, Julius.
Bryant Electric Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Electric Engineering & Supply Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Perkins Elec. Switch Mfg. Co.
Star Electrix Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Detroit Electrical Works.
Diamond Electric Mfg. Co.
Duplex Electric Co., Ltd.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
La Roche Electric Works.
Lovell Mfg. Co., Ltd.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Rose Electric Light Supply Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Waddell-Entz Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Lava Gas Tips.
Smith, A. T.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Rae, Frank B.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical and Mechanical Engineers.
Pierce, Josiah Jr.
Rae, Frank B.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
La Roche Electric Works.
Queen & Co.
Union Electric Works.
Western Electric Co.

Electrical Specialties.
Andrae, Julius.
Bryant Electric Co.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Electric Engineering & Supply Co.
Fletcher & Fletcher Electric Co.
Hussey & Co.
Ries Electric Specialty Co.

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Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.

Electrical Intelligence.
Keller & Degenhardt.
Rae, Frank B.

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American Engine Co.
Ball Engine Co.
Ball & Wood Co., The.
Lake Erie Engineering Works.
Lane & Bodley Co.
Morse & Co., A. M.
Pearson & Co., W. B.
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Smith, Thos. G. Jr.
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Stearns Mfg. Co.
Taylor Engine Co.
Weston Engine Co.
Williams Engine Co.

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Chicago Electric Motor Co.
Edison General Electric Co.
Emerson Electric Mfg. Co.
Premier Electric Co., The.
Stanley Electric Mfg. Co.

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Kartavert Mfg. Co.
Vulcanized Fibre Co.

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Electrical Supply Co., The.
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Partrick & Carter Co.
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Detroit Electrical Works.
Fletcher & Fletcher Electric Co.
Knapp Electrical Works.
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General Electrical Supplies.
Andrae, Julius.
Bryant Electric Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Cons. & Supply Co.
Electric Engineering & Supply Co.
Electrical Eng. & Supply Co.
Electrical Supply Co., The.
Fletcher & Fletcher Electric Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Western Electric Co.

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Hemingray Glass Co.
Phœnix Glass Co.

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Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Cushing, F. W.
Edison General Electric Co.
Electric Engineering & Supply Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
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Cutter, Geo.
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Edison General Electric Co.
Electrical Supply Co., The.
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International Okonite Co., The.
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Electrical Eng. & Supply Co.
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Electrician Publishing Co.

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Detroit Electrical Works.
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Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.

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Be suspicious of any Company that is anxious to lose money in order that you may have the best equipped electric railway in the country.

The Short Electric Railway Company

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APPLIANCES FOR OVERHEAD CONSTRUCTION, GEARLESS AND SINGLE REDUCTION MOTORS, IMPROVED RAILWAY GENERATORS,

AT REASONABLE PRICES.

Workmanship, Efficiency and Successful Operation Guaranteed.

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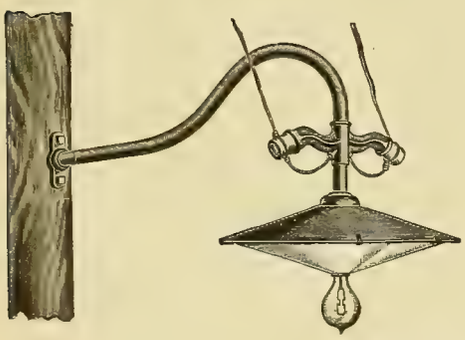

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For ARC and ALTERNATING Circuits.

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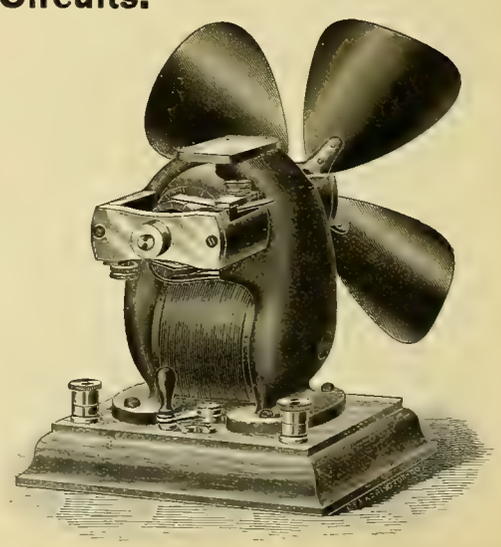
Perfect in Design. Tasteful in Appearance. Simple Throughout.

Reliable Agents wanted in every section of the country. Write for particulars.



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620 ATLANTIC AVENUE, BOSTON, MASS.

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HIGH GRADE STOCK.

EACH ONE LEADS IN ITS CLASS.

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And Products—record unbroken.

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By method of exclusion, the Bryant all porcelain sockets and switches stand alone.

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The Interior Conduit & Insulation Company's tubing, plain and brass, out-classes all others.

SWAN LAMPS.

The Swan Lamp is one of high efficiency, long life and brilliancy.

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The Washington Carbons are noted for long life, low resistance, high efficiency.

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A tower of strength in the electrical arena.

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THE NATIONAL ELECTRIC MANUFACTURING CO.,

EAU CLAIRE, WISCONSIN,

Is doubling the capacity of its factory to meet increased business.

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St. Paul, Minn.—THE ELECTRICAL ENGINEERING AND SUPPLY CO.
Detroit, Mich.—COMMERCIAL ELECTRIC CO.
San Francisco, Cal.—NATIONAL ELECTRIC DEVELOPMENT CO.
Lincoln, Neb.—LINCOLN ELECTRICAL MFG. AND SUPPLY CO.
Seattle, Wash.—CHAS. H. BAKER & CO.
New Orleans, La.—ENTERPRISE CONSTRUCTION AND SUPPLY CO.
St. Louis,—W. E. BAILEY, Special Southern Agent, 7 & 8 Equitable Bldg.
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CARBON TRUST IS A FAILURE!

(You may thank us for it), and indications are it will soon fall apart, each fellow pulling for himself. Then

Your Harvest Will Come,

So don't make Long Time Contracts, ONE YEAR IS LONG ENOUGH. We booked orders in March for

3,000,000 CARBONS

And in April, (up to the 16th.), have sold 1,871,000, and indications are, demand will run
AHEAD OF PREVIOUS MONTH.

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Holmes, Booth & Haydens,
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The Washington Carbon Co.,
641 N. Broad St., Philadelphia.

Electrical Supply & Construction Co.,
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Standard Electrical Works,
161 W. Pearl St., Cincinnati.

Central Electric Co.,
116 Franklin St., Chicago.

OUR CARBONS ARE NOTED FOR THEIR

Long Life, High Efficiency, Low Resistance.

Write us for samples and quotations before you contract for supply.

THE WASHINGTON CARBON COMPANY,

Works at WASHINGTON, PA. PITTSBURGH, PA.

AN OLD FRIEND IN A NEW DRESS.

The more you see of the "Ward" lamp the more you become interested. Mechanical and electrical perfection. It is all that. Are you aware that we are combining these features with a line of ornamental lamps that surpass in beauty of finish and design any arc lamp ever offered to the trade, and equal to the handsomest electrical fixtures manufactured?

You need such lamps for interior lighting and decoration. They increase the output of your station, and delight the consumer. How about prosperity? Of course you're through with experiments. Why need you injure your business and add personal worry by the purchase of any other style of lamps, which are so imperfect that they will have to be changed over every month, and brought out as a "New Lamp"?

The "Ward" lamp, in all cases, is specially designed to meet the varying conditions demanded, and had passed the experimental stage when first offered to the public by this Company. The thousands of "Ward" lamps in use prove it to be the only lamp that works satisfactorily on an incandescent circuit.

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ORGANIZED 1881.
INCORPORATED 1883.

ARC LAMPS

FOR INCANDESCENT AND STREET RAILWAY CIRCUITS.

AN ESTABLISHED FACT: THE ONLY ARC LAMP THAT WORKS SATISFACTORILY ON AN INCANDESCENT CIRCUIT.

SPECIAL APPLICATIONS:
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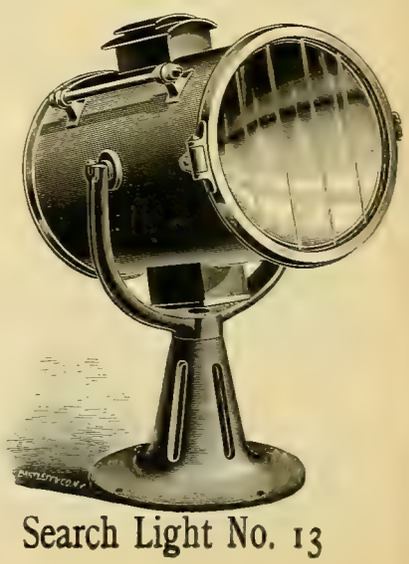

Search Light No. 13

SUPT OFFICE

HEAD QUARTERS

FIRE DEPARTMENT.

* CITY TELEGRAPH. *

Chicago, Mar 21st., 1887. 13

C. B. Hotchkiss. Esq.

Gen'l Agent Days Kerite.

New York.

Dear Sir:-

I send herewith a piece of Kerite Wire cut out of service on account of construction of manhole. The wire, two pieces of about 3000 feet each, was placed in one inch common gas pipe and buried beneath the pavement about thirty inches, on Cass Street from Chicago Avenue to Erie street, thence to Pine street. This work was done in the summer of 1877 and the wire has been in continuous, and is now in service, without interruption of any kind. I see no perceptible change in the material and congratulate you upon the record.

Yours respectfully,

J P Barnett Sup't.

P. S. This piece was removed March 14th, 1887.

April 18, 1892.—This wire is still in service after 15 years' use.

DAYS KERITE

No other rubber covered wire in this country can show such a record as this, as none of them were in existence when this wire was laid.

DAYS KERITE

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Gen'l Agent,
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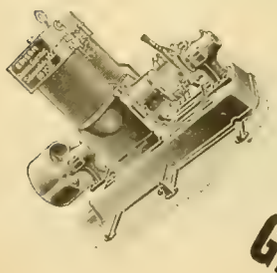
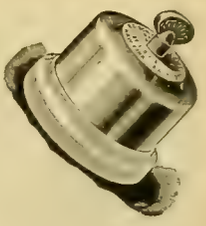
F. W. CUSHING,
Gen'l Western Agent,
225 Dearborn St., CHICAGO.



EDISON SYSTEM.



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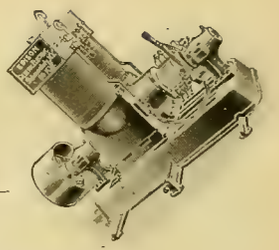
WIRE.



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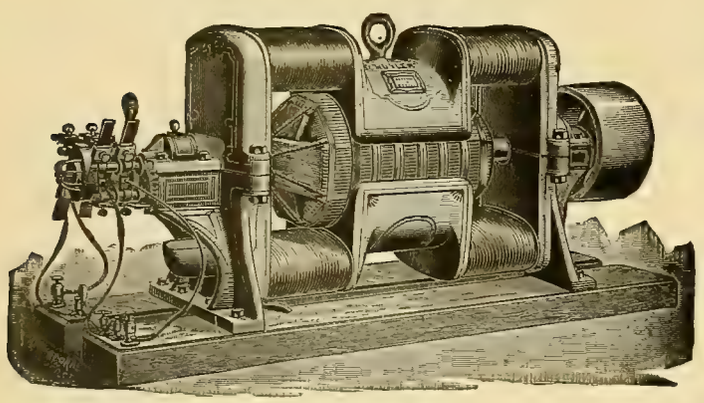
THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

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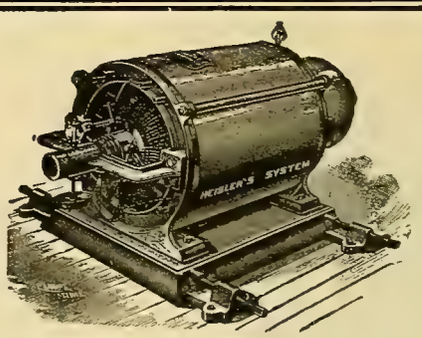
HEISLER ELECTRIC CO.,

DREXEL BUILDING, PHILADELPHIA, PA.,

MANUFACTURERS OF THE ONLY

LONG DISTANCE SERIES

Incandescent Lighting Apparatus



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Noted for Brilliancy of Light and Great Efficiency.

—ALSO—

Series Sockets and Lamps for Arc Light Circuits.

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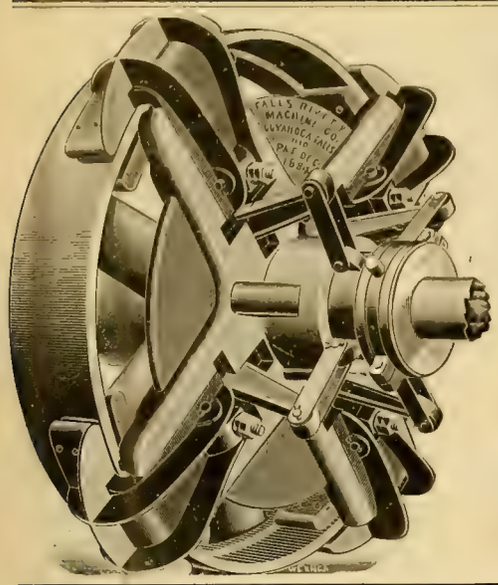

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Special attention given to the Complete Equipment of Electric Plants.

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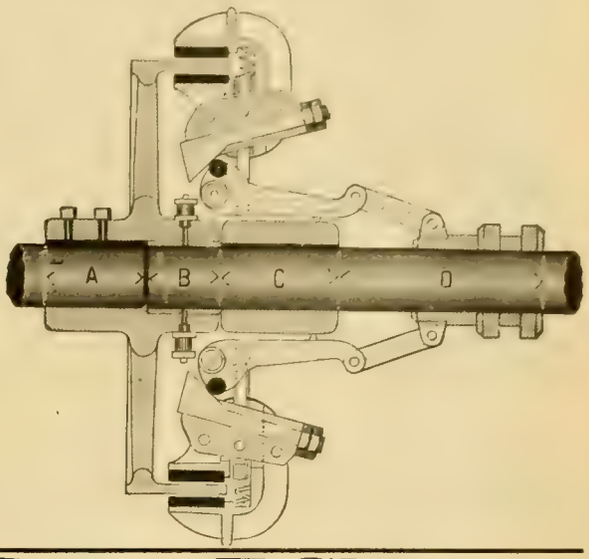

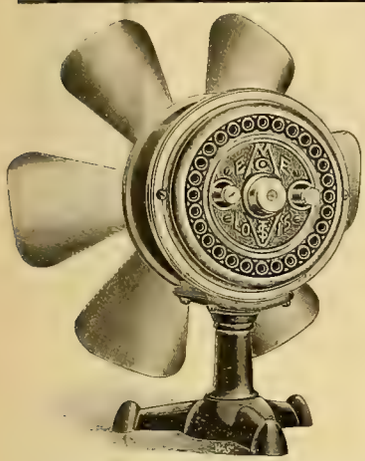

THE MOST PERFECT
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and the only successful one on the market for the Alternating Current.

Send for descriptive circular and price of the

"MESTON ALTERNATING FAN MOTOR."

It is not a toy, but a strong, well built, durable machine. Maximum speed 1,700 revolutions per minute. Can be regulated by moving a lever to as slow speed as desired, and flow of current is regulated accordingly. Commutator brushes feed up automatically and are guaranteed for three months' wear at constant use, ten hours per day. Manufactured only by

The Emerson Electric Mfg. Co., St. Louis, Mo.

FOR SALE CHEAP.

Three 500 Lt. T.-H. Dynamos, Compound Wound, 110 volt, with Base, Rheostat and Ammeter.
Two 1,000 Lt. Fort Wayne Alternators, complete.
Two 25 Lt. American 2,000 C. P. Arc Dynamos.
One 50 Lt. Sperry 2,000 C. P. Arc Dynamo.
One 600 Lt. Edison Dynamo—not the latest style.
Twelve Knowles 12 Lt. Arc Dynames with Lamps.
Nine 30 Lt. Westinghouse Arc Machines, 2,000 C. P.
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Twelve 50 Lt. Schuyler Dynames, 2,000 C. P.
One 20 Lt. U. S. Arc Machine with 20 Single Lamps.
One 300 Lt. U. S. Dynamo, 110 volt, with complete Station Fixtures.
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One 200 Lt. Mather Dynamo, 110 volt, no Fixtures but Base.
Six 30 Lt. Excelsior Dynamos, Arc, 2,000 C. P., with Single Lamps.

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Insulating Compounds, Armature Varnish, Insulating Tape and Insulating Papers.

P. & B. Products are all thoroughly water, acid and alkali proof. Send for our latest Circular.

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NO MORE BURNED TERMINALS.
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A LOCK SWITCH
For all Fine Work—Nickel, Bronzed, Plain, Engraved, or to Match any Finish.

SIMPLE, PRACTICAL, NEAT.
Do not fail to inquire about this.

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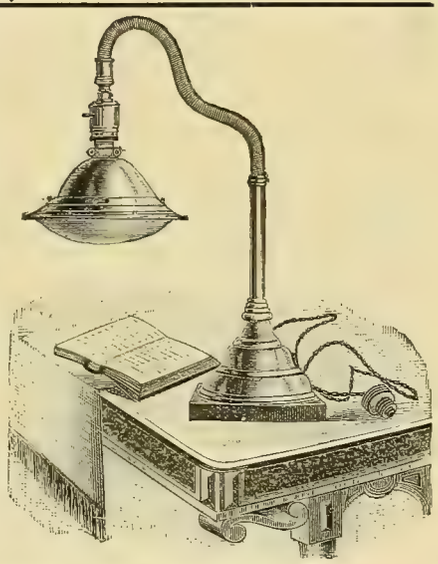

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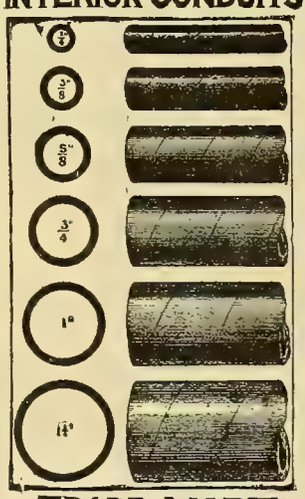

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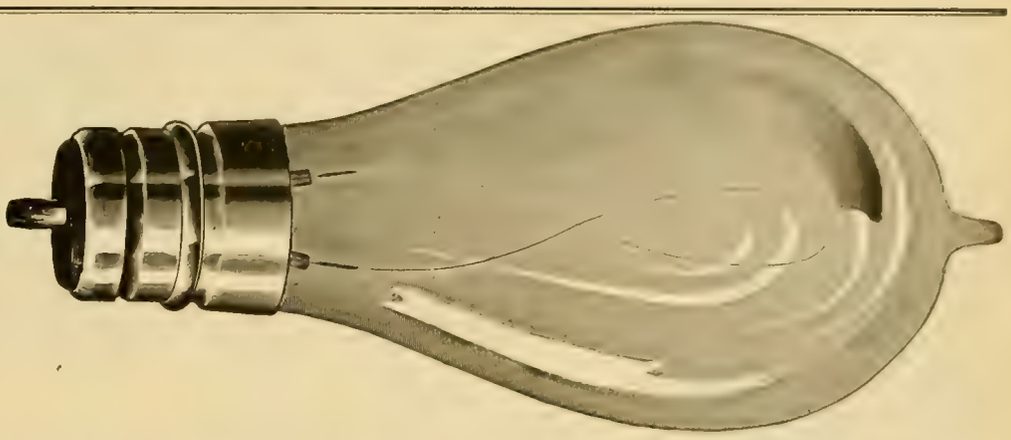

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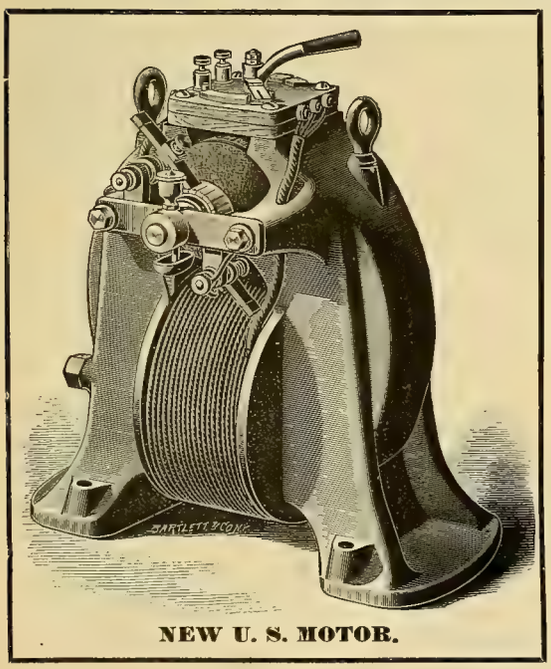

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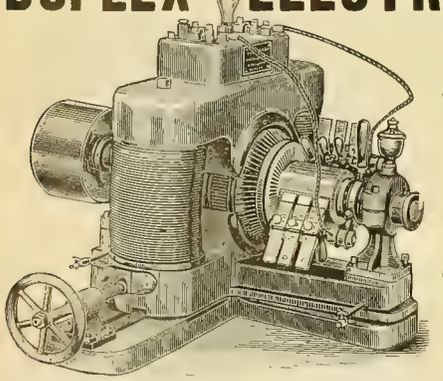

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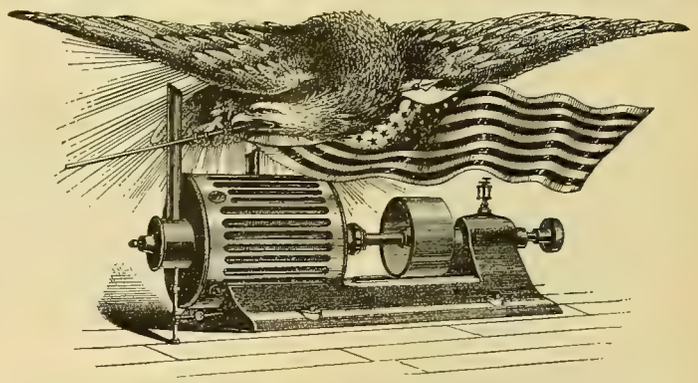

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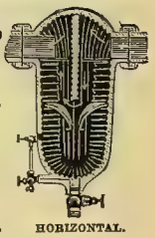

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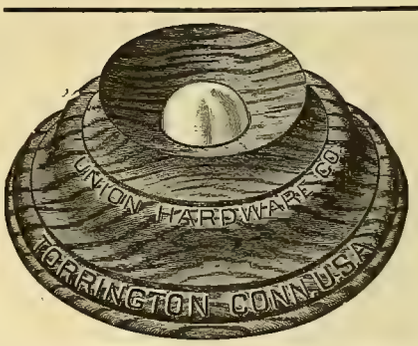

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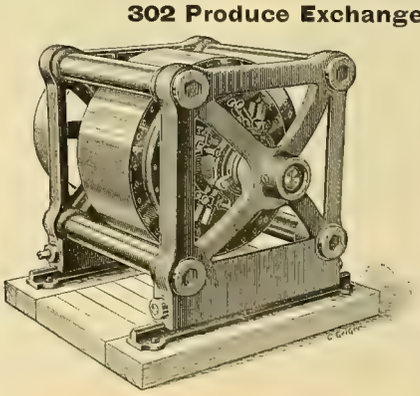

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Western Electrician.

EVERY SATURDAY.

Vol. X. CHICAGO, MAY 14, 1892. No. 20

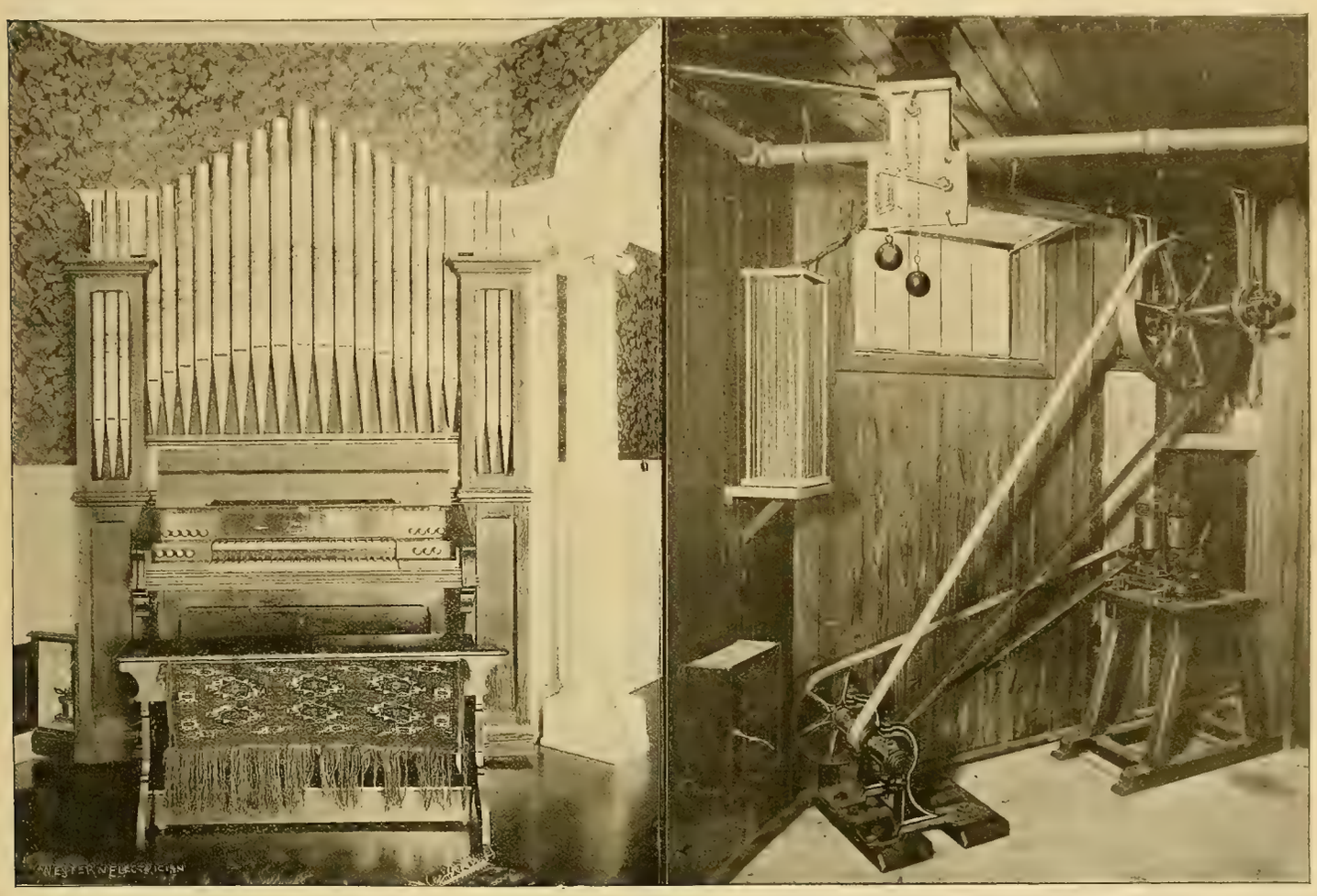
Electric Organ Attachment in a Private Residence.

The neatly arranged attachment for operating the bellows of a pipe organ by an electric motor shown by the illustrations on this page is undoubted y the first installation of the kind set up in a private residence in Chicago. The little plant is now in operation in a Prairie avenue house and gives great satisfaction. It is entirely automatic in its operation, and the turning of a switch is all that is required to insure a steady supply of air.

The greater part of the mechanism—the portion represented in the picture on the right—is located in the basement of the house, directly under the organ. It consists of a one-half horse power Edison motor, mounted on a suitable support and ordinarily covered with a square glass case, not shown in the illustration. The covering, which is supplied with holes for ventilation, is attached to protect the motor from dust and to prevent interference with the brushes by servants or others. The motor runs at a speed of 2,100 revolutions per minute, and is belted to a countershaft, from which the power is conveyed to the pulley and rod operating the bellows above.

The apparatus for automatically stopping the motor when the bellows has been pumped full of air is simple but effective. The motor is in series with a resistance box, shown at the left, which is capable of entirely stopping the machine. When the current is turned on the motor quickly fills the bellows. The latter is attached to a rheostat by a small chain, which is pulled up by the rising of the bellows, and thus enough resistance is cut in to entirely stop the motor when the bellows is full. A ball of iron is attached to the chain, and, as the air is exhausted from the bellows for the operation of the organ, this weight pulls down the contact bar of the rheostat and cuts out enough segments to start up the motor again. This operation is indefinitely repeated as long as the current is switched on.

A view showing a corner of the music room above, with the organ built in the wall, is given on the left. The motor can be started or shut off only from this room, and the box for the switches is at the left of the organist's bench, as shown. Current is supplied from the South Side station of the Chicago Edison company, which installed the electrical plant. J. H. Goehst, the superintendent of installation, planned and supervised the installation.



ELECTRIC ORGAN ATTACHMENT IN A PRIVATE RESIDENCE.

A Singular Fatality.

The strange case of James Grant, a lineman employed by the Chicago Telephone company, has excited much interest in Chicago. During the thunderstorm of the afternoon of Monday of last week Grant had occasion to ring up the central office from the station at West Fortieth and Lake streets. A peal of thunder, following quickly upon a flash of lightning, rang out as he had the receiver at his ear. He fell to the floor. The bystanders ran to help him and found him breathing heavily and unconscious. He was taken to his home near by. Doctors came promptly. Efforts to restore him to consciousness were useless, and he lay insensible until Tuesday. When at last he awakened from the stupor his first words were: "Hello, ring off!" and this he muttered day and night. It was evident that the unfortunate man had become insane, and on Wednesday night he became violent, still laboring under the delusion that he was at the telephone. It was necessary to summon help from the neighborhood to restrain him. All night long he muttered, "Hello, ring off!" at intervals making frenzied attacks upon the men who were holding him in bed. The patrol wagon was called on Thursday morning and he was carried, feebly fighting, in to a ward at the detention hospital. Throughout the day the afflicted man struggled pitifully with his delusion, and at 6 o'clock it was necessary to administer quieting medicines in order to get him to bed. At 9 o'clock he was quiet at last and breathing easy, with a decreased temperature. Twenty minutes later he aroused himself shouting but without attempts at violence. The attending physician was called, and, as Grant's voice seemed to grow fainter, he found his pulse failing with it. At 10:25 o'clock, still persisting in his cry of "Hello, ring off!" sunk to a whisper, James Grant died.

The case is a mysterious one, and it is not known whether the lightning itself or the fall to the floor was the cause of the insanity and subsequent death. There are several instances recorded in medical journals where persons have been rendered delirious by shocks of lighting, but none is known precisely parallel to Mr. Grant's sad fate.

Chicago Edison Company.

On May 4th the stockholders of the Chicago Edison company held a meeting and decided to increase the capital stock of the corporation from $1,000,000 to $3,000,000. The proceeds of the sale of the new stock will be largely devoted to building and equipping the new station on the west side of the river, the site of which cost $190,000. It is expected that the new station will be a model one. Superintendent Church is now in the East inspecting the best plants of the large cities.

Three Edison Telephone Patents.

Last week Thomas A. Edison was granted three patents, each covering a "speaking telegraph," and as a consequence, according to one of Chicago's leading dailies, "the Bell telephone monopoly has secured a new lease of life." For the enlightenment of those who are desirous of obtaining reliable information as to the scope of the patents that constitute the "new lease," their specifications, drawings and claims are herewith presented. It is unnecessary to reproduce here the three specifications in full, but from the diagrams and claims presented those familiar with telephone construction will have no difficulty in understanding the instruments described.

The three patents, Nos. 474,230, 474,231 and 474,232, were issued on the same day, May 3, 1892. The application for No. 474,230 was filed April 27, 1877; that for No.

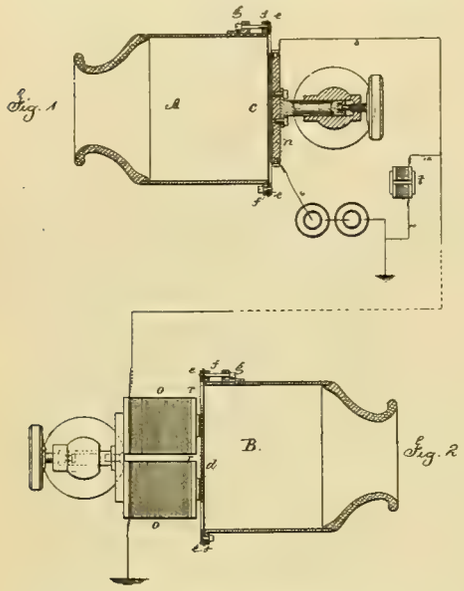


FIG. 1. THREE EDISON TELEPHONE PATENTS.

474,231, July 20, 1877, and that for No. 474,232, July 20, 1877. These patents were assigned to the Western Union Telegraph company of New York.

The instrument described in specification No. 474,230 was patented in foreign countries as follows: In Great Britain, July 30, 1877, No. 2,909; in France, Dec. 19, 1877; No. 121,687; in Belgium, Jan. 11, 1878, No. 43,984, in Italy, Jan. 19, 1878, No. 9,791; in Spain, May 6, 1878; in Austria-Hungary, Jan. 15, 1878; in Germany, Jan. 23, 1878, No. 14,308; in Russia, Feb. 15 (27), 1882, No. 1,161, and in Canada, Oct. 20, 1877, No. 8,026.

Fig. 1 is a reproduction of the drawings for No. 474,230, and the following are the claims allowed:

"1. In a speaking telegraph transmitter the combination of a metallic diaphragm and disk of plumbago or equivalent material, the contiguous faces of said disk and diaphragm being in contact.

"2. As a means for effecting a varying surface contact in the circuit of a speaking telegraph transmitter, the combination of two electrodes, one of plumbago or similar material, and both having broad surfaces in vibratory contact with each other."

The instrument described in specification No. 474,231 was patented in foreign countries as follows: In Great Britain, July 30, 1877, No. 2,909; in France, Dec. 19, 1877, No 121,687; in Belgium, Jan. 11, 1878, No. 43,984; in Italy, Jan. 19, 1878, No. 9,791; in Spain, May 6, 1878; in Austria-Hungary, Jan. 15, 1878; in Germany, Jan. 23, 1878, No. 14,308; in Russia, Feb. 15 (27), 1882, No. 1,161, and in Canada, Oct. 20, 1877, No. 8,026.

Fig. 2 is a reproduction of the drawings for No. 474,231 and the following is the claim:

"In a telegraphic apparatus operated by sound, the combination, with the diaphragm, of one or more contact points of plumbago or similar inferior conductor in the electric circuit, whereby the rise and fall of electric tension is proportionate to the pressure exerted upon the said point or points by the diaphragm."

The instrument described in specification No. 474,232 was patented in foreign countries as follows: In Great Britain, July 30, 1877, No. 2,909; in France, Dec. 19, 1877, No. 121,687; in Belgium, Jan. 11, 1878, No. 43,984; in Italy, Jan. 19, 1878, No. 9,791; in Spain, May 6, 1878; in Austria-Hungary, Jan. 15, 1878; in Germany, Jan. 23, 1878, No. 14,308; in Russia, Feb. 15 (27), 1882, No. 1,161, and in Canada, Oct. 20, 1877, No. 8,026.

Fig. 3 is a reproduction of the drawings for No. 474,232, and following is the claim:

"A spring forming or carrying one electrode of the circuit of a telephone and constantly pressing against the other electrode and diaphragm to maintain the required initial pressure between the electrodes, and yield to the movement of the diaphragm."

In patents No. 474,231 and 474,232 Mr. Edison refers to the use of a platinized point attached to a diaphragm and bearing upon a drum covered with chemically prepared paper. Figs. 2 and 3 illustrate diagrammatically the mechanical arrangement of the drum and point. The principle of this form of instrument is explained in Mr. Edison's patent, No. 158,787, granted Jan. 19, 1875, on a method of obtaining motion by electro-chemical decomposition. Referring to Figs 2 and 3, a few words as to the operation of the chemical instrument will not be amiss. When the paper is moved slowly by rotating the drum the waves of electricity coming over the line pass to the platinized springs, thence through the paper to the earth. If a negative current passes in the opposite direction, nearly all friction between the platina plate and the paper ceases, and the resonant box or diaphragm regains its normal position. When the positive current passes through the same channel, the normal friction of the paper is augmented and the chemical surface, acting upon the platina, serves to give a movement to the resonant box. Thus the mechanical force applied to move the chemical surface acts with the electric current to produce the vibration of the resonant chamber.

American Institute of Electrical Engineers.

For the first time in its history the American Institute of Electrical Engineers will hold its general meeting this year in Chicago. The arrangements are about finished, and the prospect for a large attendance and interesting meeting is excellent. The list of papers thus far prepared shows that the Chicago meeting will not be lacking in literary and scientific merit.

The annual meeting for the reception of yearly reports, the election of officers and other business of a similar character will be held at the headquarters of the institute, 12 West Thirty-first street, New York city, at 4 P. M., Tuesday, May 17th. It is expected that the session will occupy about two hours. After adjournment a subscription dinner will be served at "The Arena," 41 West Thirty-first street.

The general meeting will be held at the Grand Pacific Hotel, Chicago, on Monday, Tuesday and Wednesday, June 6th, 7th and 8th. The following named papers are in preparation for that occasion and others are promised, which will be announced in the regular programme to be issued later.

"Electric Coal Mining Machinery." Elmer A Sperry, Chicago.

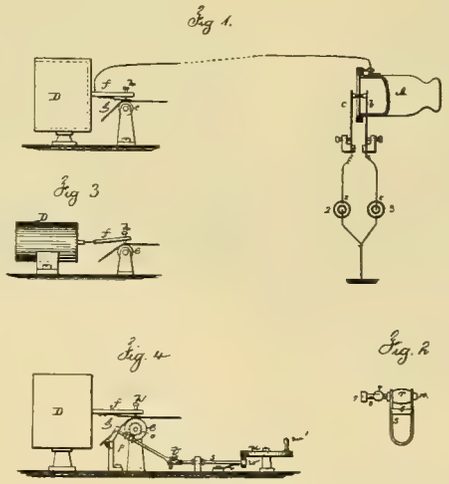


FIG. 2. THREE EDISON TELEPHONE PATENTS.

"Electro-Magnetic Field." M. I. Pupin, Ph. D., Columbia college, New York city.

"Long Distance Transmission for Lighting and Power." Charles F. Scott, Pittsburg, Pa.

"A New Rheostat." C. E. Carpenter, Minneapolis, Minn.

"A Dynamo Indicator, or Instantaneous Curve Writing Voltmeter." George S. Moler, Cornell university, Ithaca, N. Y.

"Electro-technical Education." Prof. R. B. Owens, University of Nebraska, Lincoln, Neb.

"The Magnetic Properties of Sheet Iron," Milton E. Thompson, Cornell University, Ithaca, N. Y.

"Selective or Individual Signals." Thomas D. Lockwood, Boston, Mass.

"Railroad Train Lighting." A. H. Bauer, Chicago.

"A Discussion of Circuits Containing Resistance, Self-Induction and Capacity." Frederick Bedell and Albert C. Crehore, Cornell University, Ithaca, N. Y.

"A Life and Efficiency Test of Incandescent Lamps." Prof. B. F. Thomas and Messrs. P. Martin and R. H. Hasslar, Ohio State University, Columbus, O.

"Notes on Wiping Contact Methods for Current and Potential Measurement." Prof. B. F. Thomas, Columbus, O.

"Series Electric Traction." Nelson W. Perry, New York city.

"Oil vs. Air as Insulation." Dr. J. B. Williams, New York city.

"Electrolytic Refining of Copper." Lieut. F. B. Badt, Chicago.

"The Photography of Alternating Current Curves." Dr. Edward L. Nichols, Cornell University, Ithaca, N. Y.

"The Reversal of Polarity in Plating Dynamos;" also "Dynamos for Continuous Current Circuits." Prof. Harris J. Ryan, Cornell University, Ithaca, N. Y.

"The Technical Education of the Electrical Engineer." Prof. D. C. Jackson, University of Wisconsin, Madison, Wis.

Papers are also expected from H. Ward Leonard, Prof. Elihu Thomson and Prof. Geo. D. Shepardson,

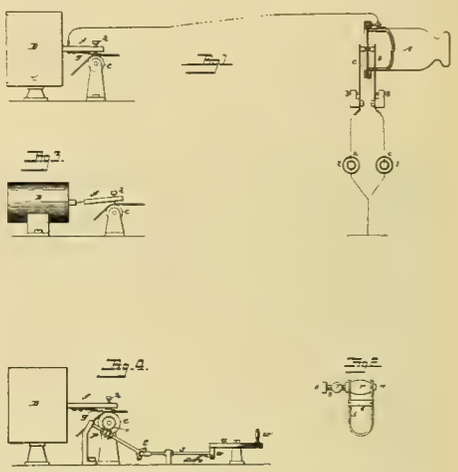


FIG 3. THREE EDISON TELEPHONE PATENTS.

the subjects of which cannot be announced at present.

Electricity at the World's Fair.

In accordance with Mr. Higinbotham's decision the grounds and buildings committee advertised for new bids for the incandescent lighting at the World's Fair on May 6th. The proposals received will be opened at 1 P. M. on May 16th. The advertisements also contain the statement that "proposals will only be considered when coming direct from the manufacturer." The new specifications are substantially the same as the old ones except that it is required that bidders shall figure on the whole installation, including the wiring. These two requirements will bar out the smaller companies and such bidders as Mr. Locksteadt, who was lowest in the first competition.

The New York *Sun* of May 3d contained a two-column letter from Charles C. Locksteadt in relation to the trouble over the incandescent lighting contract. Mr. Locksteadt gives his version of the affair at great length. He claims that, although he was at first told by the officials of the construction department that his was "the only sensible bid," he was afterward unfairly treated, while the representatives of the "trust," were given every opportunity to reduce their bids, although the figure finally reached—$5.95—was still higher than his. On the other hand, the construction department claims that it was thought impracticable to give Mr. Locksteadt the contract unless he was backed by one of the great companies, and that at one time in the rather complicated negotiations Mr. Westinghouse wrote a letter declining to assume the Locksteadt bid.

Much interest was manifested at the opening of the bids for the arc light conductors at the World's Fair on Wednesday of last week. Several out of town wire men were present, including Messrs. Requa of the Safety Insulated Wire & Cable company, Field of the Habirshaw company, and Marsh of the Standard Underground Cable company. There was a wide variance in the bids, due, undoubtedly, to the fact that in several instances the samples furnished did not comply with the specifications, which were given in the last issue of this paper. Some of the tenders were not accompanied by the required certified checks for deposit. A summary of the bids follows:

Simplex Electric company (by George Cutter)—Rubber covered wire, from $249 to $265 per mile, according to quantity; lead covered cables, from $525 to $550 per mile, according to quantity.

Central Electric company (Okonite)—Rubber covered wire, 4¼ to 7 cents per foot; lead covered cable, 10 cents per foot.

Chicago Electric Wire company (Cobb)—Rubber covered wire, 5¼ to 6 cents per foot; lead covered cable, 9¾ cents per foot.

American Electrical Works—Bid informal.

Norwich Insulated Wire company—Lead covered cable, 11¼ cents per foot.

Day's Kerite company (by F. W. Cushing)—Rubber covered wire, $210 to $230 per mile; lead covered cable, $515 per mile.

New York Insulated Wire company—Rubber covered wire, $23.50 to $41.25 per thousand feet; lead covered cable, $43 to $70 per thousand feet.

Bishop Gutta Percha company—Bid informal.

Knapp Electrical Works—Rubber covered, $163.50; lead covered, $534.50.

Electrical Supply company (Habirshaw)—Rubber covered wire, $179.50 to $288 per mile.

New Haven Insulated Wire company—Bid informal.

Washburn & Moen Manufacturing company—Rubber covered wire, $119.18 to $150.20 per mile, according to quantity and quality; lead covered, $268.66 to $331.80 per mile, according to quantity and quality.

Edison General Electric company—Insulated conductors, $34.75 per thousand feet; rubber insulation, lead covered, $55.80 per thousand feet; class B, lead covered, $94.50 per thousand feet.

Standard Underground Cable company—Rubber covered, $215 to $240 per mile; lead covered, from 7¼ to 7¾ cents per mile.

Western Electric company—Patterson lead covered cable (paper insulation), $500 per mile.

Safety Insulated Wire & Cable company—Insulated wire, $155 per mile; lead covered, $525 per mile.

John A. Roebling's Sons company—Lead covered cables, $6.85 to $10 per 100 feet; with rubber insulation, $784 35 per mile.

One of the most interesting features of the World's Fair will be a complete model of the entire plant of the H. C. Frick Coke company, of Scottdale, Pa. This company is said to be the largest of its kind in the world. The contract has been let to the Jones Bros. Electric company of Cincinnati, which is an expert in the making of models. The estimated cost of this model is between $3,000 and $4,000. The plant will occupy a space about 20 by 50 feet, made on a scale of one twentieth of an inch to the foot, and will be an exact fac simile of the original, including boilers, engines, piping, elevatend tracks, cupolas, cars, and all other machinery. The motive power for operating the miniature mechanism will be electricity.

In speaking of the large searchlight to be erected at the World's Fair by Shuckert & Co. of Nuremberg, Germany, the bureau of publicity and promotion says: It (the main reflector) will be seven and one-half feet, and the light will be of at least 25,000 candle power. It is expected that the searchlight at the World's Fair can be seen at least sixty miles away. Electrical Engineer Sargent is making plans for a tower 300 feet high, on which the big light will be mounted. At a height of 100 feet above the ground will be two six foot searchlights, and the three will suffice to illuminate the skies for miles around Jackson Park. Brilliant feats are accomplished with these search lights. Sheets of light can be projected with parallel, converging or diverging rays. When the rays are thrown out in parallel a clearly defined sheet of flame seems to be suspended in the darkness. By changing the reflector the rays are brought to a focus at long distance from the central station. These lights, turned on the buildings and alternately shot into the heavens or out across the lake, will produce brilliant effects.

It is not now considered to be likely that Chief Barrett will resign his position in the department of electricity at the World's Fair, as was rumored a few weeks ago. It is announced that on August 2d he will retire from the service of the city of Chicago. He will then have been connected with the city government for a term of thirty years, in which time he has brought the fire alarm telegraph service of Chicago up to a plane of efficiency probably unequaled by any other city in the world. After the date mentioned Prof. Barrett will devote the greater part of his attention to the World's Fair. On Sunday Prof. and Mrs. Barrett left for Colorado Springs. Their stay there will be determined by the condition of Mrs. Barrett's health, although Prof. Barrett expects to return to Chicago himself in a short time.

Carrying Express Matter on an Electric Car.

For several months an "electric express" has been in operation in St. Louis, running between Market street, South St. Louis, and Carondelet, and presumably doing a good business. The car in question makes two trips a day, has a capacity of 20,000 pounds, and the company operating it pays mileage to the owners of the road, and has its own wagons for delivering freight to and from the car at Sixth and Market streets, at Arsenal street, and at Carondelet. The charges for such service to the business public are very reasonable—10 cents each for parcels from the dry goods, clothing and boot and shoe houses, regardless of weight or size; 50 cents for a trunk, etc. The car is largely patronized by houses of the above named class, as well as by furniture stores, wholesale liquor dealers, grocers and others. It is said the system will be extended to some of the other suburban roads in St. Louis.

Electric Lighting at San Jose, Cal.

Probably nowhere on the Pacific coast can there be found a city within which there has been a more interesting electric lighting situation, or one in which the advent of a competitive company has been more bitterly opposed, than in the city of San Jose, Cal. It claims to be the first city in the would to be lighted by the tower system, and the handsome 200-foot iron structure erected over the intersection of two leading streets is a fitting monument to the faith that the residents of the Garden City, as San Jose is called, had in the future of the then new system of lighting. That was ten years ago, and since then the tower has witnessed many events, not the least interesting of which was the midnight fight between employees of the two rival companies at the top of the tower for its possession and the privilege of lighting it. The history of the tower has already been told in the WESTERN ELECTRICIAN. There can be no doubt but that the warfare that has been waged between the San Jose Light & Power company and the Electric Improvement company of San Jose has been very bitter, and indeed in municipal politics the principal factions are led by officers of, and are known by the names of, the respective companies. The younger or opposition company, and the one that has secured the city contracts and does the great bulk of the electric lighting business, is the Electric Improvement company of San Jose, whose plant is herewith illustrated. Though apparently in San Jose, the company's station is just outside the city limits, on the line of the South Pacific Coast railway, running from San Francisco to Santa Cruz. By means of this line redwood from the Santa Cruz mountains is unloaded at the fire room doors for $4.25 per cord, or slabs at from $2.75 to $3.00 per cord, or coal may be brought from San Francisco. Redwood is, however, burned almost exclusively. In the 63x27 foot boiler room there are five boilers, two of which are of the Heine pattern, 125 horse power each, and the remaining three are return flue boilers. Each boiler is equipped with pumps, etc., and in addition there are two Llewellen heaters and one Knowles fire pump. Two wells, 70 feet deep, having an abundance of water, are at the station. An exterior view is shown in Fig. 1.

FIG. 1. ELECTRIC LIGHTING AT SAN JOSE, CAL.

The area of the dynamo and engine room, which is illustrated in Fig. 2, is 63x47 feet, and on the side adjoining the boiler room is the power plant, the dynamos on the opposite side of the room being belted direct to their respective engines. One 16x24 Taylor-Beck engine, turning at 165 revolutions and with 110 pounds of steam, carries one Slattery incandescent alternator of 1000 lights, together with one of the new Wood 80-light arc machines. There are also two Westinghouse compound engines, in each of which the high pressure cylinder is 12x12 and the low pressure cylinder is 20½x12. Steam is supplied at 100 pounds. The first engine is run at 300 revolutions and carries one 1,000 light Slattery alternator and one 35 light Excelsior arc dynamo. The second Westinghouse engine carries 3 Wood arc dynamos, 50 lights each. Last is a 10x12 Ball engine, which, at 295 revolutions, drives one 600 light Slattery alternator and one Wood arc dynamo of 50 lights. At present the station load is 275 arcs and a maximum of 3,000 incandescents.

From the station the circuits are carried up to the business portion of the city, probably three-fourths of a mile distant, over an unusually fine pole line of 50 and 60 foot poles, and indeed the entire outside construction is thoroughly reliable and substantial. Four city circuits are maintained, one of which lights the 200-foot tower with twelve 2,000 candle power arc lamps. The other three circuits light eleven 150-foot masts with 36 2,000 candle power arc lights, four or five lamps on each mast, and in addition the city has 51 single lamps suspended 30 feet high over street intersections. The incandescent load is on three circuits. Two other circuits are extended over to Santa Clara, a distance of three miles. One of these circuits of 36 arc lamps lights the city of Santa Clara and The Alameda, a beautiful oak shaded driveway connecting the two cities. The other is an incandescent circuit furnishing light to business places in Santa Clara and also to a number of private residences along The Alameda.

The Electric Improvement company of San Jose is really an offshoot of the Electric Improvement company of San Francisco, and a number of stockholders of the latter concern also have holdings in the San Jose company. That such a good business has been built up in the face of such fierce opposition as has there existed is certainly creditable to its officers, principal among whom are A. J. Bowie, president (also manager of the Electric Improvement company of San Francisco), and H. J. Edwards, secretary and manager.

FIG. 2. ELECTRIC LIGHTING AT SAN JOSE, CAL.

The highest point at which a central station for electric lighting is located is claimed to be Pontresina, a locality of the Grisons Canton, Rhætia, situated at an altitude of 6,000 feet above the level of the sea. in a vale running parallel with the Inn valley, on the road leading to the celebrated Bernina mountain and pass. The motive power for generating the current is furnished by a stream of the same name. The inhabitants have formed themselves inot a co-operative society, and each lowly shepherd's hut is supplied with electric light and power.

Theatrophone Service in Paris.

One of the great attractions of the Paris Electrical Exposition in 1881 was a telephone installation so arranged that visitors could listen to the performances in progress at the Opera House, the Opera Comique, and the Theatre Francaise. So successful was the experiment that some one predicted at the time that the day was not far distant when it would be no longer necessary to attend a theater, but that the dialogue of the play could be brought to any residence by means of a telephone. "We will then subscribe for the Opera telephone, the Opera Comique tele-

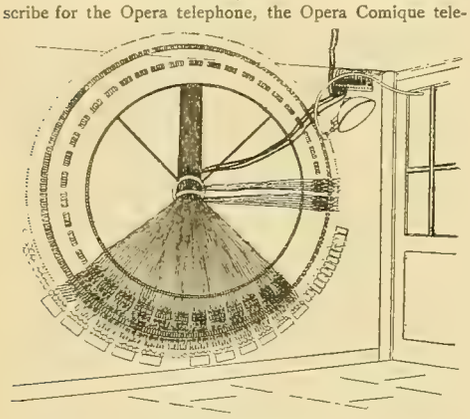


FIG. 1. THEATROPHONE SERVICE IN PARIS.

phone, as we now subscribe for those of the general company," said M. de Parville at that time.

The prediction has been fulfilled by the efforts of the Theatrophone company. This organization, on the payment of an annual subscription of 180 francs, installs in the homes of subscribers to the local telephone company apparatus by means of which the dialogue of the stage can be listened to. On each occasion on which the service is desired the subscriber must pay a special fee of 15 francs. Subscribers have the choice of participating in any performance in progress at any place of amusement connected with the company's exchange, and they have the privilege of changing from one theater to another as frequently as they may desire.

The company, however, does not limit itself to supplying amusement to subscribers' homes; it has located apparatus of the nickel-in-the-slot type in various public resorts.

The central exchange is situated at No. 23 Rue Louis le Grand, and the apparatus essential to the operation of the

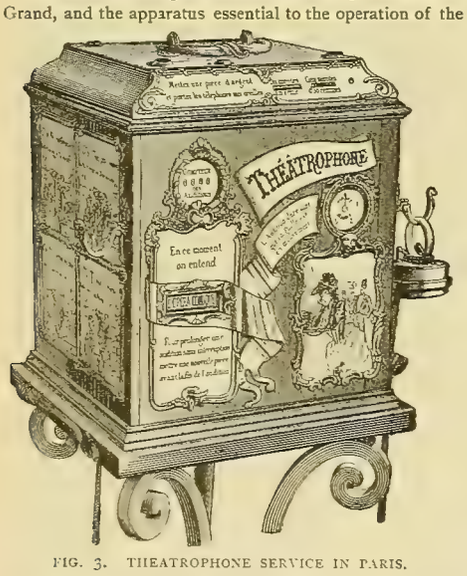


FIG. 3. THEATROPHONE SERVICE IN PARIS.

system is located in the basement The conductors end in the distributing device shown in Fig. 1. The several cables are distributed as follows: Lines connecting the exchange to the theaters, special wires, subscribers' lines, and the city wires connecting with the central telephone exchange, on the Avenue de l'Opera. The switch board used by the Theatrophone company is shown in Fig. 2. It is provided with ordinary annunciators and plugs. Its most important feature is a switch designed to act in connection with a number of needle telegraph repeaters, one being used for each theatrophone line. The current necessary for operating the several repeaters, as well as the needle indicator on the theatrophone, is secured from the incandescent lighting circuit.

The switch-board is manipulated by a single operator, whose work consists in supplying the demands of subscribers who wish to be connected with the several theaters, and in changing periodically the theaters connected with the public theatrophones. The general appearance of the latter is shown in Fig. 3. The usual information appearing on slot machines is presented for the guidance of amusement seekers. For a franc one can be entertained ten minutes, and for 50 centimes, just half that time. If a person is so pleased with the programme that he desires to prolong the hearing, he can drop in a new coin before the five or ten minutes already paid for have expired, and the play or the music can be heard uninterruptedly.

Wherever a public theatrophone is located there is placed a dial, Fig. 4, with the names of the several places of amusement with which the instrument is connected. The dials are connected electrically with the central exchange, and the hands of the several dials on the same circuit are turned simultaneously by a switch, to indicate the attraction at the theatrophone at that particular moment. It might easily happen, however, that the curtains at all the theaters might be down at the same time. The company therefore provides an attraction of its own to fill in the possible interim. All the lines are connected to the Theatrophone musical hall, and during the *entre acte*, to which the indicator points in Fig. 4, a song or piano solo is given by a competent artist.

The work at the exchange necessary in connection with the indicators is very simple. The telegraph repeaters at the switch-board indicate the position of the hands on the dials connected on each circuit. Thus the operator by a glance can tell, for example, that the Grand Hotel is listening to the opera at Les Bouffes; that the Cafe Reche is connected with the Opera Comique, etc. She can add to the good operation of the theatrophones by cutting her own instrument, which is of the Berthon-Ader type, out of the circuit, thus removing a certain amount of useless resistance. She can, however, put her instrument close to the line, and, as the result of induction, can hear clearly enough, though faintly, what is passing over the line.

The service given to subscribers at their homes involves no complications. The company's service extends only to those who are subscribers to the Paris telephone system. The Theatrophone company is connected with the main telephone exchange, on the Avenue de l'Opera, by a considerable number of lines. It falls on the operators of the latter to establish a connection between the subscribers' line and the wires of the Theatrophone company. The connection with the theater is then made at the switch-board.

When a subscriber of the telephone system is connected with the line of the Theatrophone company, the annunciators at the central telephone exchange are cut out, with the result that what passes over the line is heard much more distinctly. At the theatrophone central exchange an Ader relay is connected in the line. As its resistance is extremely small, and as it has no soft iron core, it does not interfere in any respect with telephone transmission. These relays operate with currents so weak that subscribers, by means of their ordinary battery, can call directly the office of the Theatrophone company, however far the distance.

The subscriber thus connected with the theater no longer sustains relations with the telephone system, but as he can always communicate with the exchange of the Theatrophone company, it is easy for him to obtain any connection he may happen to wish, and talk, between the acts for example, with a friend who is connected with another theater. The operator, too, at the Theatrophone exchange is always connected with the main telephone office, and can at any time secure any number she may wish.

At the theater the Theatrophone company has a small telephone room, where batteries, etc., are located. This apartment is connected with the exchange on the one hand and with the tran mitting instruments on the other. The latter are located either just back of the footlights or between the several incandescent lamps forming the footlights. An employe of the company is stationed at the theater at each performance, to see that the apparatus is working properly.

The illustrations shown herewith are reproduced from *L'Electricien*.

Lightning struck Frederick Eberhardt of St. Louis a few days ago just as he was passing through a doorway over which a horse shoe was nailed. The flash momentarily blinded him and the shock was so severe that he stood as if rooted to the spot. When he had partially recovered his faculties and attempted to call the other workmen in the brewery, he found to his amazement that he was unable to utter a sound. He had been struck speechless. The lightning which struck Eberhardt passed over an electric wire and through the horse shoe over the door before it reached him.

Electric Street Railways as Investments.[1]

By Lemuel William Serrell, M. E.

Of the forms of motive power that have been tried, to take the place of the horse, may be mentioned the gas and compressed air motor, the cable, the electric conduit, the storage battery and the trolley road. The gas and compressed air system, are probably the oldest, and for the past twenty years they have been pushed by their advocates and put upon roads, on trial, all over this country and Europe; yet to-day there are no roads in operation by

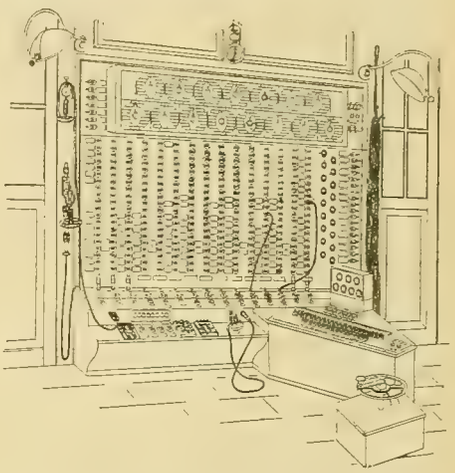


FIG. 2. THEATROPHONE SERVICE IN PARIS.

either motor—except experimentally—to show merits sufficient to cause their adoption.

There is no doubt that a suitable electric conduit will be invented some day, but we need no better instances of its failure in the past than the abandoned conduit in Fulton street, New York, and the receipted bills of the West End company, of Boston, for the sale of the old iron that had once been used for a similar purpose.

The history of the storage battery gives the same results. It has been favored because it is an ideal system. There is scarcely a large city in the country where storage battery cars have not been run experimentally, and yet it has not been adopted because it has proved impracticable, while the trolley road, starting side by side with the storage battery, with all the maledictions that could be hurled upon it, has established itself as the only practical method of electric traction. The reported deadliness of the overhead wire has been proved a myth, and the objections to the system now are only æsthetic ones.

Let us look briefly at what has been done in the case of electric trolley railways. Scarcely five years have elapsed since it was shown that the trolley system could be made a practical success as a means of propelling cars, and yet to-

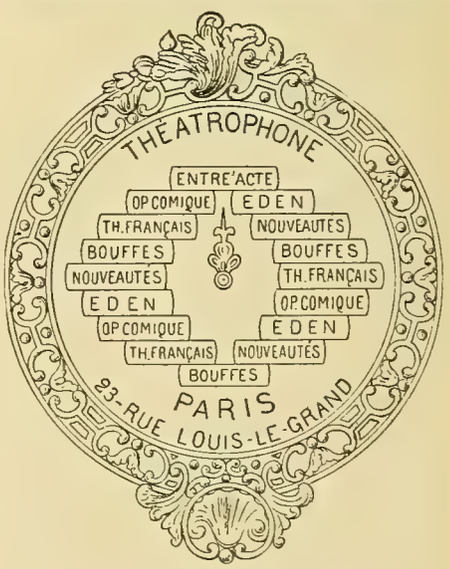


FIG. 4. THEATROPHONE SERVICE IN PARIS.

day more than 450 roads are reported as being operated by electric power, having a total mileage of more than 3,600 miles, and employing nearly 5,800 motor cars. Thus about three-eighths of the street railways in this country are now operated by the trolley system. The old tram rails are being replaced by better forms of construction, handsome cars measuring thirty feet in length replace the old style of horse cars, and a speed double that attainable with horses is used with perfect safety in equipping street roads with the trolley system. Many of our large cities are already so equipped, and it is estimated that $155,000,000 has already been expended. It has also been proposed that the experiment be tried to ascertain if electricity cannot be used practically to supersede steam on railways. Many of us doubtless will see this accomplished, although probably not until electricity can be generated directly from coal, without the use of the steam boiler, in

1. Abstract of a paper in the *Engineering Magazine*, May, 1892.

which event a train of cars so propelled, it is estimated, will move at least five miles for the same cost that is now required to move a train of the same weight one mile by steam. Neighboring cities, ten and fifteen miles apart, have been connected together by such roads. A 50-mile electric road is proposed between Worcester and Providence; another forty miles long is being built between Tacoma and Seattle, and an electric road is projected between Chicago and St. Louis, to be built in a straight line, over which a speed of more than a hundred miles an hour is expected to be attained.

Thus we see developing from the old tram roads a system of roads operated with electric power which bids fair to be of as great, if not of greater, importance to the world than the present steam railroads, which are a development from the same original tram road. The census of 1890 shows that the street railways of New York city carried during the year 2,000 million passengers, or more than the entire population of the globe, and about eight times as many passengers as were carried on the steam roads of the entire country, this number of passengers having been 250,000,000. The steam railway track mileage is about sixteen times as great as that of the street railway. The street car lines in the cities of Boston, New York and Philadelphia carry more passengers per annum than all the steam roads of their respective states. Cable roads are usually built in crowded cities, where it has become necessary to dispose of horses and the right for the overhead wire could not be obtained. No one would think for a moment, however, of building a cable road if a franchise could be obtained for a trolley road, as they cannot carry any more people, route for route, than the electric road, and cost nearly ten times as much to build.

The introduction of electricity as a means of rapid transit has done and is doing much to bring this class of securities before the investing public, and the list presented in the accompanying table, giving the recent market quotations of some of the leading street railway stocks and bonds, shows how such securities are looked upon by those who know their value.

The remarkable cheapness with which electric roads can be operated as compared with horse roads and the cheapness of the first cost as compared with cable roads has led to the building of more than 3,600 miles of such roads within the past five years. The earnings for the capital invested are larger for electric street railways than for steam, horse or cable roads, and the securities on such properties are now beginning to attract the attention of the general public. The cost of building and equipping street roads varies considerably with different local conditions. A comparison of the average cost of building and equipping cable, electric and horse railways, per mile of track, taken from the recent census reports, is given below:

Cable roads	$350,000
Electric roads	30,000
Horse roads	41,000

The above represents a fair average for paved streets in cities proper. For suburban travel the cost per mile of track and electric equipment need not exceed $20,000.

The earnings of the various properties may best be expressed by the ratio of their operating expenses to their gross receipts. It is hard to get figures giving this ratio for cable roads. The only ones published that I have been able to find are for Denver, Colo., where this ratio is reported at 77 per cent., while for the electric lines owned by the same company it is reported at 55 per cent. Cable roads cost almost as much as elevated railroads, yet in some places they both are bonded for more than $1,000,000 per mile and have dividend stocks. The same ratio for horse railroads, we find by taking the average of over fifty roads from the reports of railroad commissioners, is 80 per cent.

A large number of reports have been published on electric roads, placing this ratio at about 50 per cent. From my own investigation I have found that these figures were true for certain months, but they do not represent the average for the whole year, and that in the section of the country where snow must be removed from the tracks, the year's average is from 60 per cent. to 65 per cent. The increase in the net earnings in cities like Boston per revenue car mile run, for electric roads over horse roads, averages 50 per cent. This enormous increase of earning capacity has given a well merited "boom" to the electric railway, but at the same time has opened an opportunity for objectional speculation, the same as surrounded the steam railroad, which caused the wrecking of so many fortunes and gave the opportunity for great railroad steals, followed by reorganizations and "freeze-outs."

The Duke of Marlborough, in speaking of American railroads, says in substance that almost all the railroads in this country have passed through a period of private manipulation by the early promoters, who originally floated their gold bonds on the European market, built the roads as cheaply as possible, advertised the advantages of their land grants in Great Britain and Germany, induced immigration, and forced their capital stock, which did not represent as much money as the paper on which it was printed, on all the stock markets of the world, realizing great for tunes. All this would have been perfectly proper if the earning capacity of the roads had warranted it, and protection had been given to the bondholders, but in many cases the roads were over-bonded, and the managers were unscrupulous people, who, when they had the control of the voting tickets, caused the roads to default in the interest of their bonds, the financial prestidigitateurs, thus causing new fortunes to be made, and old ones to be lost.

Many electric roads have been built and bonded for more than they cost, the stock being all "water," but most of these are reorganized horse roads, whose earning capacity has been such as to warrant a large bond, though in some cases the over-zealous projectors have not left sufficient margin for maintenance, repairs and renewals. In such cases, if the management is honest and capable, the roads probably will yet be brought into a sound condition.

Electric railway securities are comparatively a new thing, and, being so little known, are looked upon as not being desirable. The skepticism that has surrounded the mysterious action of electricity has not furnished the same fertile basis upon which to float securities as the development of commerce by building steam railroads. Therefore the people who have attempted to make more than their share of profit by aping the plan upon which steam railroads were built probably will have a heavy burden to carry for some time. But there are elements of security in a well selected street railway bond which make it as good an investment as any waterworks or municipal bond, and safer than steam railways.

Bonds on electric railways may be divided into three classes:

1. Bonds on new roads built from new franchises, whose earnings are problematical.

2. Bonds on reorganized horse roads whose net earnings with horses have not been sufficient to pay the interest on their bonded debt when equipped with electricity.

3. Bonds on reorganized horse roads, whose net earnings with electricity are sufficient to pay the interest on their bonded debt, when equipped with electricity.

Projectors of a road of the first class need not expect to sell their securities, except at a great sacrifice, until the road shall have been in operation long enough to demonstrate its earning capacity, and even then the securities should not be purchased without careful personal examination and indorsement by responsible parties.

Bonds on roads of the second class may be considered as very good and safe investments where interest charges on the bonds do not exceed by more than one-fourth the net earnings of the roads when operated with horses. Capitalists will run very little risk in undertaking the financiering of roads of this class, when the above restriction is observed, and the cities are of good size and well known. The stock on such roads probably will be dividend-stocks from the very start.

Bonds on roads of the third class are of the best class, and are not excelled by any other form of investment. Such bonds should sell at a premium, and find a very ready market, and the stock should be worth par.

When the elements of security that surround street railway bonds become better appreciated they will be regarded among the best and most readily negotiable securities before the public. In cities from 25,000 to 40,000 people a comparatively local market must be sought, but well selected bonds on roads in cities having a larger population should find a ready sale with the general public.

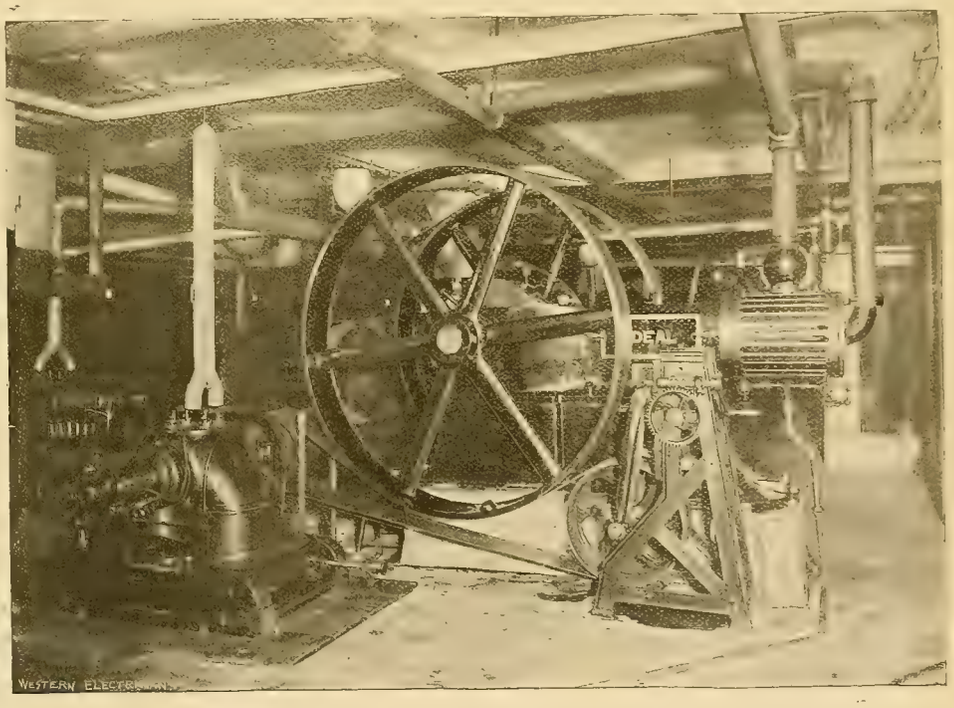
RECENT PRICES OF STREET RAILWAY SECURITIES.

CITY.	NAME OF ROAD	STOCK. Par.	STOCK. Bid.	STOCK. Asked.	BONDS. Bid.	BONDS. Asked.	MOTIVE POWER.
Albany, N. Y.	Albany R. R. Co.	100	112	115	103	...	Electric and horse.
Baltimore, Md.	Baltimore City Pass. Ry.	25	60	70	110½	111	Horse.
Brooklyn, N. Y.	Brooklyn City R. R. Co.	100	178	180	107	108	Horse, changing to electric.
Chicago, Ill.	Chicago " " "	100	324¼	325	99	...	Cable and horse.
" "	North Chicago City R. R. Co.	100	500	...	111	112	Horse.
" "	West " " " "	100	630	...	101	102	Cable and horse.
Cincinnati, O.	Covington and Cinn. R. R.	50	120	123½	110	114	Electric.
Cleveland, O.	Brooklyn St. R. R. Co.	100	170	175	...	...	Electric.
" "	Woodlawn Ave. and West Side	100	145	150	...	...	Horse, changing to electric.
New Haven, Conn.	State Street Ry.	25	103	105	105	107	Horse.
New Orleans, La.	Carrollton Ry.	100	118	122	113½	..	Mule.
New York, N. Y.	Broadway and Seventh Ave.	100	193	200	103	105	Horse, changing to cable.
" "	42d St. and Grand St. Ferry	100	245	250	102	105	Horse.
" "	Third Avenue	100	220	230	108	111	Horse, changing to cable.
Pittsburgh, Pa.	Pittsburgh Traction Co.	25	52	54	104¼	...	Electric.
Providence, R. I.	Union R. R. Co.	100	186½	190	...	...	Horse, changing to electric
St. Louis, Mo.	Benton-Bellafontaine	100	100	...	102	102½	Electric.
" "	Missouri R. R. Co.	100	230	240	102	105	Electric.
" "	Union Depot R. R. Co.	100	200	250	104	105	Electric.
Springfield, Mass.	Springfield St. R. R. Co	100	200	225	...	...	Electric.
Washington, D. C.	Washington and Georgetown	50	250	275	101	104	Horse.

Power Transmission in Siegel, Cooper & Co.'s Plant.

The accompanying cut shows an application of the "L. P. & D" system of power transmission that has just been made in a Chicago isolated electric lighting plant. In the Siegel, Cooper & Co. establishment, although it is one of the largest in the city, space for necessary electrical machinery is at a premium, and the new method effects a much desired saving. The power transmitter, which was manufactured by Perry & Demeritt of Montpelier, Vt., was put in operation by W. W. Nugent, western agent, on Thursday of last week and has been running, it is stated, with perfect satisfaction ever since.

The dynamo is a Western Electric 400-light incandescent machine. The total length of belt employed is 19 feet. The belt is of double leather 8 inches wide. The diameter of the dynamo pulley is 16 inches, that of the engine pulley, 72 inches and that of the transmitter pulley, 24 inches. The dynamo is driven by a 13x12 Ide engine running at 300 revolutions per minute. The belt contact on the engine pulley is 53 inches, and that on the dynamo pulley, 27 inches. The height of the dynamo pulley from the floor is 26 inches. The space between the dynamo and the engine pulley is 6 inches. The distance between the engine and the transmitter pulley, 1 inch. The floor space occupied by the engine, dynamo and transmitter is 8x11 feet. The 8 feet, however, could be reduced 3 feet, if the dynamo was set directly back of the engine. This arrangement would bring the engine, dynamo and transmitter into a space of 11x5 feet.



POWER TRANSMISSION IN SIEGEL, COOPER & CO.'S PLANT.

Western Electrician.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THAT was a remarkable and pathetic case in which James Grant, a telephone lineman, became insane while testing a Chicago telephone circuit, as the result, it is supposed, of lightning striking the wire leading to the instrument through which he was conversing. The unfortunate man's delusion that he was still at the telephone, after the shock, and that he was unable to leave it, was very pitiful, and was emphasized by his unceasing cry, "Hello! ring off." Accidents due to lightning conveyed to persons using telephones are not common, and that Mr. Grant should have received a shock by such means sufficient to turn his brain, and afterward cause his death, is surprising. It is conjectured by some that the lineman was only stunned by the lightning, and that the injury to the brain was caused by his fall. In any event, the case is an unusual one, and it is to be regretted that more detailed information regarding it is not to be obtained from the medical men.

SO MANY wild-cat schemes of long distance electric traction have lately been sprung on the public that it is a relief to learn that a carefully planned attempt to make electric power do the work of steam locomotives is about to be made in Baltimore by a well established company. So confident is the electrical company of the success of the venture that it has offered to put in the plant at its own risk, acceptance being contingent on successful operation. Some of the details of the plan are given in the interesting letter from Baltimore printed in this issue. The spectacle of powerful electric motors hauling idle steam locomotives and heavy passenger and freight trains down into a long tunnel and up a steep grade to the normal level of the railroad will, indeed, be a triumph of electricity. We have little doubt that it will be witnessed, and that a powerful impetus will be thereby given to the study of the problem of long-distance transportation by electricity. The success of this project means much to the electric railway interests of the United States, and the progress of the installation will be eagerly watched.

CHICAGO will be honored by the presence of many distinguished electrical engineers next month, when the American Institute of Electrical Engineers will hold its general meeting in the World's Fair city. This gathering promises to be one of the most important meetings in the history of the organization. A list of papers for which arrangements have already been perfected, is presented in this issue, and the secretary announces that he has assurances from other distinguished electricians that they will not only attend the meetings but participate in the discussions. Already it has been determined to extend the time for the meeting from two to three days. The members will visit the World's Fair site, inspect the buildings and grounds, and it is to be hoped that the eastern delegates will return to their homes with a better idea of Chicago enterprise and capacity. The meeting will no doubt serve to establish a better understanding between the representatives of the several sections of the country, and result in mutual advantage to all concerned. It will be noticed that the papers prepared for the meeting are contributed by experts from all parts of the country, an evidence that the organization is rapidly taking on a national character, and that its membership is no longer confined to any particular locality.

IN a well-digested paper in the *Engineering Magazine*, an abstract of which is given in another column, Lemuel William Serrell writes clearly and intelligently on "Electric Street Railways as Investments." Mr. Serrell, in emphasizing the value of electric railway securities, makes one particularly strong point that we do not recollect to have seen so aptly stated before. "The fact," he says, "that a road once located upon a principal thoroughfare in a city is fixed upon the line of personal travel, which cannot be changed by the building of a parallel line upon another street, has not been brought forcibly enough before us to be generally appreciated. The fact is that a street railway located on a principal thoroughfare, equipped with modern appliances for rapid transit, runs upon a highway through which people move, and they will ride on these cars rather than those of a parallel line in another street. The securities on such a property, when once on a paying basis, make a safer investment than steam railroads bonds, the value of which are always liable to be impaired by rate wars, and by the building of parallel lines." The author makes an able argument, and no unprejudiced reader can fail to conclude, with him, that "When the elements of security that surround street railway bonds become better appreciated they will be regarded among the best and most readily negotiable securities before the public."

THE relations of the great electrical companies continue to form the subject of many articles in the daily newspapers, mainly distinguished by a confusing incongruity. One day an authority in Boston rises up to declare that the new General Electric company is secretly buying up all the Westinghouse stock it can get, and that the two companies will shortly combine; twenty-four hours have hardly passed before some gifted journalist in New York is kind enough to inform us that the new Thomson-Houston Edison consolidation has set out to monopolize the electrical business of the United States, and that, "after the manner of trusts," it has determined to drive the Pittsburg company out of existence. Hardly have we ceased to wonder at this before some well-informed gentleman in Chicago adds another complication by boldly asserting that the Westinghouse company is about to consolidate with the new Siemens & Halske company, and that then it will be combination against combination. Meanwhile veracious chroniclers in various parts of the country do not hesitate to aver that the very highest officers of the government at Washington are interested in one of the companies and that the weight of their influence will be thrown in to make the situation still more interesting. No doubt some of these stories contain grains of truth, but their wild contradictions bear palpable evidence that they are mostly guesswork, and the public should take them at their true worth. It is not strange that when one of the statements referred to above was shown to Mr. Westinghouse by a reporter of a Pittsburg paper he laughed at it heartily. Most of these "fairy tales" are amusing as ingenious works of the imagination.

SCARCELY had the announcement been made of the issuance of the Edison "speaking telegraph" patents when the validity of the proceedings was questioned by opponents of the Bell company. It will be noticed that all of these patents have been pending in the patent office fifteen years, while the same inventions were patented by Mr. Edison in England, France, Belgium, Canada, Germany, Austria, Spain, Russia and Italy. It appears, too, that the English and Russian patents have already expired. There is a provision in the United States patent laws by which American patents "expire at the same time with the foreign patent, or if there be more than one, at the same time with the one having the shortest term." The English patents expired July 30, 1891, while the Russian patents ran out Feb. 15, 1892. The opponents of the Bell company will, no doubt, interpret the statute quoted as disposing of the American patents, and if the courts should sustain this position, the American patents would be worthless.

On the other hand, the Bell company may maintain that this provision can refer only to foreign patents in existence. At any rate, the Bell company will not give up its "monopoly," nor will it allow the Edison patents to be declared void without a struggle, and as it has already demonstrated its ability to protect its own interests, there is little danger but that they will now be zealously guarded. It is even hinted that, as a last resort, Congress may be appealed to to declare the patents valid, on the ground that their issuance was delayed by interferences in the patent office. This extreme measure is not considered at all probable. Whatever the outcome may be, there is reason to believe that the "rival" companies that have announced their intention of beginning operations will find the Bell interest opposing them at every step with the same vigor that has heretofore characterized its policy.

EDISON has just been allowed three new patents on the "speaking telegraph," and as usual, when telephone patents issue there comes from the daily press the plaintive cry that the Bell company has received "a new lease of life,' and "a longer life to the monopoly," etc., is insured. If one had not grown tired listening to these agonizing wails they would be rather amusing. One would naturally think, as time goes on, and as so much which should have enlightened the public, has been presented to it, that some of the Washington correspondents or the editors at home, would begin to have an inkling of the fact that the Bell company has not built up its enormously profitable monopoly on a foundation of a single patent, or even a half dozen patents.

The Bell company's strongest position is maintained and fortified through patents on the many details of its complex system rather than through its fundamental receiver and transmitter patents. The Bell company's position, too, is established very much in the same manner as is that of a newspaper—viz., through its subscribers. Every new subscriber for an instrument strengthens the company's hold on its patrons. Give the public the free use of both transmitter and receiver, and what then would be its chances of competing with a well established telephone system? Were the transmitter and receiver the only instruments required, the "dear public" might start a company that would be worthy to be named a competitor. But how about "fundamental" switch-board patents and "fundamental" underground telephone system patents, and patents innumerable on hundreds of details that, it is generally conceded, the Bell company has purchased and knows full well are absolutely essential to the installation and operation of a successful exchange? It is not the intention of this journal to defend the Bell company—that corporation has proven too clearly its ability to protect its own interests—but as there is nothing to be gained by ignoring the fact that the Bell company's position is perhaps the strongest of any monopoly in the world, the public may as well abandon the idea that all hangs on one or two fundamental patents.

Methods of Electrically Controlling Street Car Motors.

H. F. Parshall's paper before the American Institute of Electrical Engineers, April 19th, which has already been presented in the WESTERN ELECTRICIAN, was followed by a discussion, which, however, treated largely of the relative merits of the single and double reduction motors as compared with gearless motors for street railway work. An abstract follows:

CHAS. P. STEINMETZ: If we wish to speak upon the efficiency of motors, we should decide first what we mean by this term, for although electrical engineering has very exact methods of determination, there are so many meanings for efficiency that the term usually means nothing. One measures the resistance of the motor, and finds, say, one ohm. With 15 amperes current this means a loss of 15 volts, or 3 per cent. at 500 volts line potential. Then he begins to say what a beautiful motor he has of 97 per cent. efficiency. But he does not take into account that he loses perhaps 20 per cent. by hysteresis and Foucault currents, loses 10 per cent. by friction in the bearings, and wastes 30 per cent. besides by grinding the gears to dust, and gets scarcely anything at the wheel axle. Another one desires to proceed more correctly, and measures the "mechanical efficiency" of the motor. That is he applies a brake to the armature shaft, measures the electric power sent into the motor, and the mechanical power taken off from the motor shaft, and finds 87 per cent. "a very good motor." Whether in practical service under the strain of the gear thrust, the friction is the same, and how much he loses in the high speed gearing, nobody knows.

I have no exact data of the losses in the high speed gears of the street car motors used here. I remember only one record on an English system of geared street car motors—very carefully cut zig zag gears—which certainly do not waste much more power than the usual spur gears. There the loss amounted to about 40 per cent. In the data given on the efficiency of street car motors this loss is generally not included. Street car gears must be very wasteful, not only because of the rough usage they are exposed to when going through rain and dirt and over dusty roads, but from the fact that the transmission of power by gearing is at its best only when the height of the gear teeth is negligibly small compared with the radius of the gear. But in this high speed gearing the pinion must necessarily be small, and then the height of the teeth is very perceptible compared with the radius of the pinion.

In this case the gearing does not transmit with a fixed, but with a varying, ratio; the teeth touch each other first with their heads, slide over each other and come out of impact when touching each other with their feet. That means that the ratio of transmission for each tooth which passes another varies between the ratio of the maximum and the ratio of minimum radii of impact.

Suppose the pinion has 16 teeth, the motor revolves with 1,200 revolutions. Then 19,200 times per minute the leverage of the transmission goes up and down. Either the speed must vary, fluctuate as often—which is out of the question, because of the momentum—or as many times per minute ay the gears come out of impact and in again, alternately the one or the other leading. Every time they come in impact again—19 200 times per minute—it gives a blow against the teeth. This is what causes the rattling and hissing noise of high speed gearings, and their rapid destruction.

That the loss of energy in the gearing is considerable, we can see without any tests, if we consider in what very quick time steel and phosphor-bronze pinions are ground to dust, and rawhide gears torn to fibers. For the law of conservation of energy teaches us that where a display of energy takes place, a corresponding consumption of energy exists, and if such a tremendous energy is set free as to grind steel and bronze to dust, and to chop rawhide pinions rapidly to fibers, the consumption of energy must be correspondingly large, and the only source of energy is the motor. With regard to gearless motors, I have seen a number of test curves of such a motor, which showed an efficiency of 80 per cent., and considering the absence of the loss of energy in the gearing, I really cannot see how the double-geared motor can possibly be more efficient.

CHAS. G. CURTIS: There seems to be an idea that it is impossible even by the use of enough copper and iron, without reference to the weight of the machine, to accomplish the same result at a slow speed that is accomplished at a high speed. Now why should not a gearless motor, which revolves at one-tenth of the speed of the old style double reduction machine, be made to give the same power as the double reduction machine, provided enough copper and iron is put into it, the cross section of the iron increased and the number of turns of the armature sufficiently increased? Now I know of a gearless motor which was operated for several months, and tested by some experts who were not interested in any way, and who found by comparison that it took 16 amperes to make 18 miles an hour, while one using gears required 28 amperes to make 17 miles an hour. The latter was one that had been in use about six weeks without any renewal of the gear, and therefore the gears were probably more than half worn out. Then the test was made with another car where the gears had been used about two weeks, and it was found that the car required about 25 amperes. Some Stevens Institute young men made some tests on the same road—a long series of tests—and they found that the cars required about 26 amperes on an average, while this car that I speak of that was operated by a gearless motor ran along invariably with as low as 16 or 17 amperes, and the average of a long series of tests made it 16 amperes, as against 28. I do not see any reason why it should not be so, and when the characteristics of the machine are known, it is perfectly evident that it must be so. It is simply a question of having enough iron and enough turns on the armature. Now the increased turns on the armature would result in an increased resistance were it not for the fact that a larger wire is used. The same is true of the field. But it must be remembered that with the old double reduction machine the field required a good many ampere turns to bring it up to saturation, and in the new machines such as those made by the Thomson-Houston company to-day the ampere turns are less. The weight of this machine was 2,400 pounds, and the armature had no objectionable heating at 22 horse power. Probably 300 or 500 pounds could be knocked off that weight by a judicious rearrangement of the metal. As I say, the diminution in efficiency is purely a question of increasing resistance. All the other factors must be better in the gearless motor than in the geared motor. Hysteresis and Foucault currents, which are the only other losses that amount to anything, are reduced by the diminution of the speed. Prof. Short has called attention to the fact that the efficiency of gearing seems to increase enormously with the speed. That is shown in the peculiar phenomenon which takes place in the Thomson-Houston double geared cars. In order to get the maximum speed some of the field winding is thrown out. The power comes on suddenly, and the car jumps ahead, but there seems to be very little difference in the speed whether there are trailers on or not. In other words, the gearing seems to be the limiting element. Beyond a certain limit the gearing consumes an enormous amount of power. Below that speed it consumes about 30 per cent. My experience is that these gears, with the usual amount of dirt, will consume 30 to 40 per cent. at a speed not over 15 miles an hour. I have seen two 15 horse power Thomson-Houston motors with passengers hanging on to the steps make within two miles an hour of the same speed as if there were trailing cars on and no passengers. My experience is that the main difficulty with the whole problem is to get a mode of running at a slow speed or a half speed which is reasonably efficient, and at the same time be enabled to run at full speed. The only method which has been devised which is at all practical is that pursued by the Thomson-Houston company which I have referred to, which consists in cutting out some of the field winding and diminishing the strength of the field. But that is open to the objection that you cannot carry it beyond a certain point, because you get self-induction in the armature.

MR. HEWITT: I do not pretend to deny that the gearless motor can be made as efficient as any other motor, provided we have unlimited space and can put unlimited iron and unlimited copper in it. On a street car we have got a limited space and we have got to conform to that space, and that is the reason why, perhaps, more iron and more copper are not used. Another thing, if we use more iron and more copper we will have a more expensive machine. Mr. Short's motor, I believe, runs about three inches from the ground, two or three inches. But we certainly should not run a motor nearer than three inches to the ground because we are liable to strike something—a loose paving stone or piece of iron. Three inches is complained of by railway companies. And when we start with 30 inch or even 36 inch wheels we have very little space, but when we come to locomotives for high speed, 100 or 120 miles an hour, and can use 40 inch wheels and larger, we can have all the space needed. It seems to me that so far as street railways are concerned we have reached our limit with the single reduction motor, and with them I would like to see a better efficiency than we are now getting.

PROF. F. B. CROCKER: This question of the relative efficiency of single and double reduction gear motors is really a question of the relative efficiency of motors at different speeds, and is an old problem. Take a given motor. Of course the lower the speed the less the losses are. I have made a list of them—Foucault currents, hysteresis, friction and air resistance are all reduced at lower speeds. The only losses that are increased are the C^2 R effects; that is the heat due to the electrical resistance. There seems to be a great confusion as to whether we can run a motor at slow speed and get a reasonable efficiency. Now as I say, the only losses that are increased at low speeds, other things being equal, are the resistance losses, and as Mr. Curtis says, it does not require any great increase in the size of the wire to make up for this; for instance, number 12 wire increased to number 10. A machine wound with a number 10 wire does not occupy much more space than one wound with number 12, and yet that makes enough difference to materially reduce the resistance, and in the case Mr. Curtis spoke of it almost made up for the increased length of the wire. The facts that the Foucault currents and hysteresis are materially reduced at low speed is quite a saving. Another point Mr. Curtis spoke of—the reduction in the thrust on the bearings in gearless motors—is also quite important. Unfortunately, as Mr. Hewitt says, we must have some means of allowing the car to go at slow speed. We are supplied with 500 volts whether we are running at fast or slow speed. Therefore we have to introduce external resistance or resort to some peculiar method of overcoming this difficulty. But the single reduction gear or double reduction gear motors when standing still or running at low speed require practically the same resistance in series as gearless motors. It would be simply a question whether the rheostat had 20 ohms or 22 ohms. In other words, the rheostat would actually require a little more resistance in the case of high speed motors, on account of these motors having a little less resistance than low speed ones. Any motor running at less than its normal speed, whether that be high or low, requires regulation, which probably reduces its efficiency. But a motor can be designed to run at 200 revolutions almost as well as at a thousand. I agree with Mr. Steinmetz that the man who cannot design a motor of better than 35 per cent. efficiency had better not try to apply it to street car work. Any one can design a motor to run with better efficiency than that at any reasonable speed.

PROF. D. C. JACKSON[1]: One side of the subject that is eminently practical to the street railway manager has not been touched by Mr. Parshall. As it often determines the receipts of the electric car, its demands upon methods of motor control are worthy of full discussion. In the smaller cities and towns and in suburban places it is possible to run street railway cars at a high rate of speed and with a considerable interval between them. The cars can be placed on wheels of large diameter (33 and 36 inches) without detriment to the traffic. The motors can, therefore, occupy considerable vertical space, armatures of large diameter can be used, and the magnets can have four poles. The development of this type of machine has apparently led to the controlling device described by Mr. Parshall. Such motors admit of placing a large number of turns of wire on the armature and of using each turn to its greatest advantage.

In some of our large cities quite different conditions exist. Speed is limited to a maximum not exceeding ten to fifteen miles per hour, and much of the traffic is carried for short distances; in other words, it is shopping or pleasure traffic. This demands cars on close headway and easy of access. The floors must not be raised far above the street level, and the motors must, therefore, take up little vertical space, hence requiring armatures of small diameter. This limits the number of turns of wire on the armature, makes the utility of four pole magnets doubtful, and requires the field turns to be increased. To do their work properly, such motors, when mounted on 26" wheels, should give satisfaction equal to that given by 15 horse power or 20 horse power motors of the latest types placed on 33" wheels. I think nearly all who have studied the matter will agree that the conditions here defined must be met in New York city and Chicago before the electric car can compete with the grip car. In many of the smaller cities now operating electric cars, the same conditions are felt with greater or less force, and meeting the requirements means considerably increased traffic (receipts per car).

It is questionable whether it is not best to permanently connect the motor armatures in series with each other, and with their fields for such work. The starting and speed regulation can be very satisfactorily effected by a rheostat, while it is possible to put the fields of the two motors in parallel for fastest speeds. Practically this method of connecting has been used with excellent success. It retains the principal advantages maintained for two motors on each car, *i. e.*, added traction and decreased chances of trouble due to lack of harmony between the motors, and introduces no unnecessary complications.

While the magnetic and parasitic armature losses should be reduced with special care in street railway motors, at the same time the electrical resistances of armatures and field should with equal care be made the least that is consistent with meeting other requirements. Reducing the energy used in the rheostat by increasing the loss in the fields is not likely to meet universal favor, as it merely transfers the seat of trouble to a point more expensive to repair. Hence rheostat regulation, with or without auxiliary commutation of fields, seems likely to prevail with the majority. With proper design, such as Mr. Parshall would give us, the auxiliary commutation of the fields may serve an excellent purpose in economizing weight of copper.

1. Communicated.

Developing Plants by Electricity.

The employment of electricity in horticulture forms an interesting subject for experiment and investigation, and results have already been obtained that justify the hope that the idea may soon be turned to practical account on a scale of considerable magnitude. Spring vegetables have already been forced by its aid for market, and there is no doubt that roses and other flowers can be made to bloom more plentifully and more profitably with its assistance. The department of agriculture at Washington has been experimenting in this direction for some time past. It has been found that lettuce is particularly susceptible to the influence of the electric light, by means of which, it is said, it can be grown for market in two-thirds the usual length of time. Other vegetables respond likewise in varying degrees. But everything depends upon the proper regulation of the light, and how to do this can only be learned by careful study of the results produced under all sorts of conditions. The effect of electricity being to hasten maturity, too much of it causes lettuce to run to seed before the edible leaves are formed.

Electricity is not employed for such purposes as a substitute for sunlight. It is merely used in a supplementary fashion. The greenhouse that has the sun in the daytime is illuminated at night with arc lights, toward which the plants incline their leaves and flowers. It has been supposed hitherto that vegetables required intervals of darkness for their health and development, just as animals need sleep, but it has been shown that, supplied with electric rays, they will go on growing thriftily between sunset and daybreak.

The electric gardener usually employs opal globes to diminish the intensity of the light. When the lamp is left bare and permitted to shed its unshielded rays upon the plants the latter grow pale, run up quickly in sickly stalks and soon die. It remains to be discovered exactly how much light is beneficial, and during precisely what period of the development of the vegetables it ought to be applied.

The influence of the light upon the color and productiveness of flowers has been shown to be extraordinary. Tulips exposed to it have deeper and richer tints, flowering more freely and developing longer stems and bigger leaves. Fuchsias bloom earlier under like conditions. Petunias also bloom earlier and more profusely, growing taller and more slender. It is the same way with many other flowers. In fact, there is every reason for believing that the electric light will be very profitably used in future as an adjunct to forcing establishments for both flowers and garden vegetables. Already one market gardener in New Jersey is employing it with a success which he reports as marvelous.

The Behavior of Insulating Materials Under the Action of High Potential Differences.[1]

By H. Bleckly Bourne and W. Fox Bourne.

Electrical engineers have recently been devoting a great deal of attention to the transmission of energy by small currents at high pressures and it is clearly advantageous to increase the potential difference until the expense of insulating the apparatus neutralizes the saving in copper. The question of insulation is, of course, the main difficulty, for as we increase the potential difference many substances which are ordinarily considered insulators have to be regarded as fairly good conductors. Numerous experiments were shown to illustrate this point, the current being obtained from a hedgehog transformer capable of developing about 25 horse power at 100,000 volts, which had been lent for the occasion by Messrs. Swinburne & Co.

The question of sparking distance in air does not seem to be of any great practical importance, but as it has recently been referred to, the following figures, obtained at Messrs. Swinburne's works, may be of interest:

Sparking Distances between Needle Points.

P. D. in volts.	Sparking distance in inches.
3,000	0.11
14,900	0.5
24,000	1.0
39,000	1 6
50,000	2 2
62,000	2 8
74,000	3.5
92,000	4.5
97,000	5 0

Sparking Distances between Plates 2½ in. Diameter.

P. D. in volts.	Sparking distance in inches.
13,000	0 16
20,000	0.40
44,000	1.0
70 000	2.0
90,000	3 0
105,000	4 0

The above results were obtained on a cold, dry day, but can only be regarded as approximate, as the distance was found to vary a good deal with atmospheric and other conditions, so that concordant results could not always be obtained on different days. By striking an arc between electrodes of tin wire, which gradually melted, a flame of considerable length was exhibited, and it was pointed out that the length to which an arc could be drawn depended very largely on the current strength available.

It was next shown that for overhead work at very high pressures even oil insulators of the best design are quite useless. Wires from the transformer were connected to the stalk and groove of an insulator which had been dried and filled with clean rosin oil. Brush discharges immediately occurred over the surface of the porcelain, and when a potential of 60,000 volts was reached a spark jumped from the wire to the stalk. Two wires were placed near the ends of a piece of slate about a yard long, and sparks passed freely from the wires to the slate, and a sort of arc lamp was arranged with slate pencils for electrodes. A similar conducting power was shown to be possessed by vulcanized fiber and asbestos millboard. The discharge does not break down or perforate these substances. They behave exactly like conductors. A curious effect was shown with a long piece of slightly damp wood, numerous small arcs being formed, which finally ignited the wood.

The experiment with the oil insulator and other experments shown point to the fact that surfaces of insulating materials, unless absolutely clean and dry, have considerable conducting power. A discharge may sometimes take place on the surface of a non-conductor across a distance much greater than the striking distance in air, and once a discharge has started an arc is formed. A cable insulated with a layer of rubber a foot thick might be useless for 50,000 or 100,000 volts if it had even a small crack. This creeping discharge was also shown by the now familiar experiment in which a pair of disks are separated by a large sheet of glass. In one of the experiments shown the glass did not break, though the discharge passed through it, and it was found that if there ever had been a perforation the heat of the arc had fused the glass and entirely sealed up the hole.

The potential difference required to break down or perforate insulators is quite a different matter from the discharge over their surfaces. A number of samples of broken-down insulators were exhibited. They were materials which had been tried for use in condensers, and were in the form of thin sheets of mica, celluloid paper impregnated with various resins and waxes, etc., and were about six mils thick. They had been perforated with potential differences varying from 2 000 to 6,000 volts. A piece of cable insulated with a layer of vulcanized rubber of the best quality, rather over ⅛ inch thick, was shown. It had withstood 50,000 volts for 25 minutes. In such cases the time element is of great importance and the dielectric is usually found to become very hot before it breaks down. This fact indicates a very important difference between the effects of direct and alternating currents on insulators. Whenever, as in the case of a concentric cable, the two conductors are at all close together we have a condenser which is being rapidly charged and discharged. Now in the case of most solid dielectrics there is a good deal of soaking in and consequent loss of energy, which manifests itself as heat. This was made very evident in the case of a condenser which was tried at Messrs. Swinburne's works. This condenser was made of sheets of tinfoil insulated with paper soaked in paraffin wax in the usual way. Its insulation, measured with a steady electromotive force of 240 volts, was about six megohms and the active surface of plates was 5,000 square inches. When it was connected across a 2,000 volt circuit it was found to absorb more than a horse power, so that a considerable rise of temperature was not surprising. But it was also noticed that its capacity rapidly diminished and finally disappeared, which was, on investigation, found to be owing to the fact that the foil had melted and so become disconnected from the circuit. Another condenser, made with glass plates 1-10 inch thick, broke down with 2,000 volts after about five minutes, apparently owing to internal cracks caused by the heat evolved. In the case of the sample of rubber covered wire above referred to the compound in which the braiding had been soaked melted in five minutes, and the rubber became quite softened by the heat in about 15 minutes.

This heating effect is much less in the case of most fluid insulators, but seems to be more important in oils having a high specific induction capacity.

Some experiments were then arranged to show some actions of oils under high voltages. A plate was immersed in castor oil and a point supported a short distance above the surface. On switching on the transformer a distinct depression was produced on the surface of the liquid. Two plates were then arranged, one over the other, separated by a layer of castor oil, on which was floated some paraffin. When the plates had a difference of potential of 20,000 or 30,000 volts the castor oil rose in a sort of hill, owing to the fact that its specific inductive capacity is higher than that of paraffin, so that by its movement the capacity of the arrangement is increased. It was also shown that particles of sawdust in rosin oil were formed into chains, producing a discharge across a considerable distance.

The experiments were concluded by sending the current from the transformer through a number of vacuum tubes. These were, of course, brilliantly illuminated, but the current was not maintained for more than a few seconds, as an intense heating of the glass and electrodes ensues, which usually breaks the tubes. This fact renders it difficult to measure the power absorbed, but it was estimated, from the primary current and voltage, that a comparatively small tube may easily be made to absorb about 2 5 horse power while giving a light of only a few candle power.

1. Abstract of a paper read before the Old Students' Association, London.

Two Electrical Stories from Kansas.

George Harger, who lives just south of Kiowa, Kan., is the father of a six-year old boy who is an electrical wonder, according to a local chronicler. The boy has been known as "peculiar," ever since his birth, and those who nursed him when an infant were wont to say that he "made them nervous." His actions and habits were those of all infants, and he has never shown any mental traits different from those usually seen in the average boy.

His parents, and others who are intimately connected with the family, however, say that there has always been something uncanny about him. Whenever the child was taken up from the floor or bed a crackling noise was heard, and a slight shock or pricking sensation was felt, similar to that felt when a cat is rubbed on a cold day.

The boy is now old enough to take cognizance of his peculiarity, and he takes great delight in shocking those who come near him. He can greatly increase the force of the shock by rubbing his feet on the carpet, and after dark the electrical discharge is so strong that sparks are emitted when he slides across the floor and touches a piece of metal. The force of the shock seems to be greatly increased for several days before a storm of any kind, and his father now declares that he can foretell every change in the weather by watching his boy.

The little fellow amuses himself by touching all the dogs and cats about the place, and the result is that they all flee at his approach. There is no animal magnetism about it, for he does not attract anything, but there seems simply to be a surcharge of electricity in his body at all times.

The salt marshes which extend for several miles in each direction north of Hutchinson, Kan., are a favorite resort for thousands of wild geese every season, as they apparently find certain food substances there which please their taste. It is a favorite hunting ground for men from all sections of the country, and every spring and fall, and late into the winter, the place is besieged by men who are bent on supplying the market with wild geese and ducks.

Some time ago the city concluded to use the electric light for the streets, and some of the lamps were placed high above the buildings, so that they could cast their light to great distances. These lamps can be seen for miles from the city, and have been the guide of all the men who have been belated among the marshes. But they have lately become the guide to something else, and the result is that several geese have become almost annihilated by flying against the pole and rods around the lamps. A story comes from Hutchinson that a policeman, while standing under a lamp on his beat was startled to have some heavy body dash down at his feet, barely missing his head. As he stooped down to see what it was, he was knocked flat by some heavy body striking him square on the back. When he recovered sufficiently from his fright to gather himself together he found that he had been hit by a wild goose.

During that night four of the wild fowl were killed by being dashed to death against the poles, and for several nights thereafter more were killed. The policeman who made the discovery took the geese as a part of the perquisites of his office, and regaled his family and friends upon the game for some time.

The Brush Electric Light company of Minneapolis is to light the hall for the Republican national convention, About 100 arc lights will be required for the entire building.

Novel Electric Lighting Proposition.

Thomas Wolfe, agent of an eastern company, says the *Kansas City Times*, is the latest man to introduce a proposition, and it is his purpose to place before the council at its next meeting an entirely new scheme by which he claims that the city may ultimately become its own purveyor of electric light. Mr. Wolfe proposes to put in a 1,200 horse power plant to cost in the neighborhood of $250,000. This he proposes to sell to the city for the sum of $250,000, payable in bonds of the city, bearing such rate of interest as is necessary to float them. The bonds are to run twenty years. After making this sale to the city Mr. Wolfe proposes to turn around and lease the plant for thirty years, in consideration for which lease he agrees to pay the interest on the bonds given by the city, also to create a sinking fund for the ultimate purpose of paying off the bonds when due. In the meantime he proposes to light all city lamps, both street and building, for nothing, and at the end of his thirty years' lease to turn over the plant to the city free of incumbrance, and in good running condition. For the faithful performance, of his agreements Mr. Wolfe declares his willingness to put up $25,000 in gold in any bank elected by the city, to be used in case of default in any way on his part. Mr. Wolfe stated to a reporter that he proposed to make his money out of private consumers, charging them at the rate of ½ a cent per hour, meter rate, for each lamp burned. He figured that at such a rate electricity would be cheaper than gas or coal oil and could be introduced into 5 000 homes in the city.

Taxation of Patent Rights.

Judge McPherson of the Pennsylvania Supreme Court has handed down an opinion holding that the Westinghouse Electric & Manufacturing company, notwithstanding the varied powers conferred by its charter, is nevertheless exclusively for manufacturing purposes. He discusses at great length the patent right feature, which he says "presents a question of great importance which has been not decided by any court of last resort, so far as we are aware, and which deserves and has received our consideration." He sustains the contention of the company's counsel, and holds that the right to tax patent rights does not exist in the state, because "as a tax upon the right itself we think it cannot possibly be supported, because it restricts and interferes with a right granted by Congress in the exercise of power exclusively committed to the government of the United States by the federal constitution. The tax is not only derogatory from the dignity but subversive of the powers of the government and repugnant to its paramount sovereignty."

The court expressly states, however, that the opinion is restricted to the intangible right existing in the patents, and does not extend to tangible articles manufactured under patent rights. The judgment in each case is wholly in favor of the company. The amount involved in the Westinghouse case was $8,839.90 for 1888; $14,694.46 for 1889, and $16,739.57 for 1890.

Storage Battery Work in France.

Another attempt to reconcile the storage battery with the requirements of traction work is being made by a street railway company in Paris. The plan under consideration differs somewhat from the methods usually employed, in that the motor car is devoted entirely to the machinery and batteries, without carrying any passengers. These cars will haul one or two trailers. The motor trucks are peculiar in being composed of two wheel trucks, two of which are flexibly connected beneath the center of the car. The car body rests on rollers, one at each corner of the trucks, thus allowing the axles to turn through a considerable range and conform to the curves of the tracks without producing undue friction. The regulation of the car is effected by commutating both the motors and the batteries. The two motors are in series at starting, and are thrown in multiple for the second speed. The remaining speeds are made by the different combinations of the batteries. These are divided into four trays, and are used first, four in series; second, two in multiple series of two; third, four in multiple. These, with the two speeds of the motors, give four speeds for the car, the highest of which is only permitted outside of the city limits.

Dispersing Fogs by Electricity.

The experiments in fog-clearing by electricity which have been made at Sandy Hook recently have been more fruitful in possibilities than in actual results, says the *Buffalo Express*, but they have proved conclusively that electrical discharges have a marked effect on fogs. The largest area cleared by one discharge is said to have been nearly two acres. The fog is described as falling in the form of rain, and the atmosphere after the process as being clear as after a summer's rain-storm. The surrounding fog, however, closes in over the cleared space in a few minutes, and it would require discharges made at intervals of two minutes to keep the air practically clear. Strange to say, the denser the fog, the easier it can be cleared by electricity. When one thinks how much London would give for the abolition of her smothering fogs, the commercial value of these experiments becomes apparent. And, by the way, the demonstration of electricity's power as a fog-precipitator goes several steps towards vindicating the claims of the rain-producers, for the principle is the same in both cases.

The *New York Herald* says that an electric light wire in front of James Clark's house, in West Seventh street, Plainfield, N. J., came in contact with the iron pole on May 4th and transmitted the current to the ground. The influence was felt for a distance of twenty feet in the roadway, and it is said that horses that were driven over the place received such severe shocks that they were thrown down.

Electrical Fixtures.

The cuts illustrate several of the specialties handled by the Utica Electrical Manufacturing & Supply company of Utica, N. Y.

In Fig. 1 is shown a device which may be employed for connecting converters or transformers to the main line. This can also be used where branches are to be taken from the main line. It will take wire from No. 0 down. The advantages these connectors are that they will make a contact of three-quarters of an inch in length to two inches. They dispense with soldering and leave the main line in good shape. The connectors can also be used in case of emergency on lines of alternating or any high tension current when the weather will not permit linemen to make the usual connections. This connector

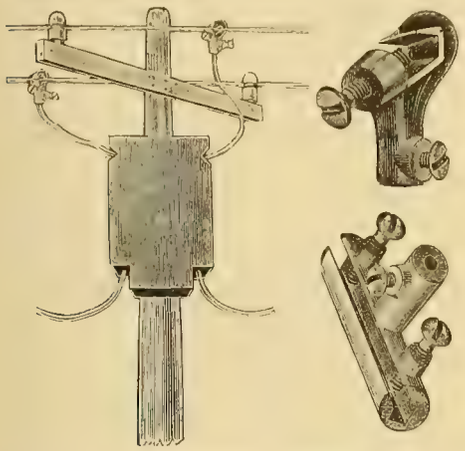


FIG. 1. ELECTRICAL FIXTURES.

can be put on an insulated wire and the pointed screw will penetrate through the covering, thereby making good contact. The connectors and screws are made of brass, thereby preventing all chances of rusting.

Fig. 2 shows the "Hercules" switch, No. 1, which has double contact, is quick acting, and can be used either on arc or incandescent circuits. This switch is mounted on a slate base, is inclosed in a water-tight iron case, and with it currents from 25 to 100 amperes can be safely handled. The "make or break" of contacts is not dependent on a slow or fast movement of the operator's hand. The case is provided with porcelain bushings for protection of wires in entering and leaving the box. The outside dimensions of the case are 8x8½ inches. Figs. 3 and 4 represent, respectively, the Utica company's automatic magazine fuse box and lighting arrester. A few words as to the manner of operation and re-fusing will make clear the construction of the box. The cut shows the box with the two upper fuses burnt, and, as will be readily seen, as soon as one fuse is melted another is by gravity thrown automatically in circuit. This action is performed eight times before it

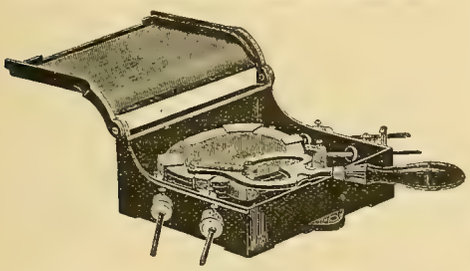


FIG 2. ELECTRICAL FIXTURES.

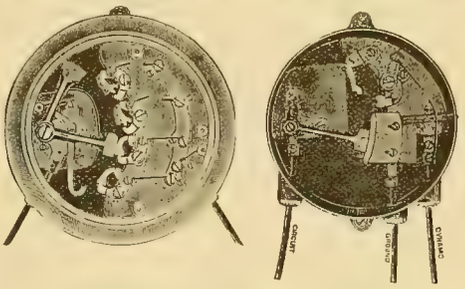
is necessary to replace a fuse. As soon as the four upper fuses are blown, the first contact arm will be out of circuit and will throw the second arm automatically into circuit, thus giving a second magazine with four additional fuses. After the eight fuses in the magazine are blown, there are still two main fuses, which can be seen at the extreme right and left of the cut, connecting the circuit and magazine with a resistance coil placed in a circle on the inside of the case. These two fuses will eventually, if the circuit remains overloaded, blow also and open the circuit. There is no arcing when a fuse blows, because the instant it melts the current will pass through the main fuses and the resistance coil, taking its regular course again as quick as contact is made with the fuse. There are no magnets to burn out, and the contacts and conductors are made of bronze metals of ample proportions. The box can be used on primary, secondary or direct circuits. The carrying capacity of the above described magazine fuse box is from 1 to 30 amperes.

The lightning arrester shown in Fig. 4 is especially designed for the protection of high or low tension, direct or alternating dynamos. It is very simple, not introducing extra resistance in the line. The contacts are large enough to carry heavy discharges of lightning. The only injury to apparatus by lighting is the melting of a fuse wire, which can be readily replaced.

In Fig. 5 is shown the Utica company's new pole stand

FIG. 5. ELECTRICAL FIXTURES.

for the Wood and American arc lamps which it is manufacturing and placing on the market. The following claims are made for this stand: It is perfectly rigid and the pole top is protected from weather; the lamp is perfectly insulated from the pole stand at both top and bottom, by means of slate and porcelain, thereby protecting the trimmer; there is perfect insulation from the main line, the wire for connections being carried through hard rubber tubes placed inside of the standards; the lamp can be removed from the stand by simply loosening a set screw at the top of the frame. The hood is manufactured of galvanized iron painted with weather-proof paint, white inside and black outside. The switch is mounted on a slate base, fastened on the top part of the pole stand, is of novel



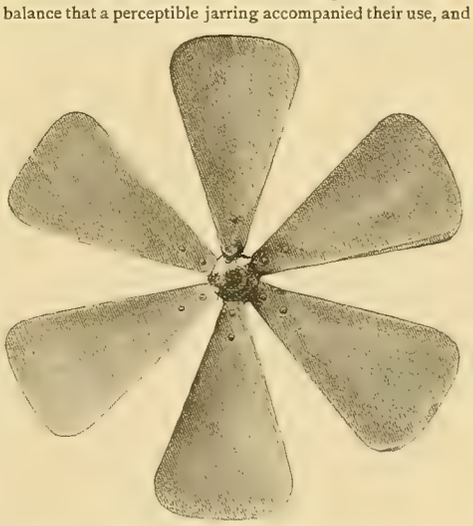
FIGS. 3 AND 4. ELECTRICAL FIXTURES.

design, and can, it is stated, be operated without causing an arc.

Motor Fan.

Illustrated herewith is a new brass fan for electric motors which has just been put on the market by Holmes, Booth & Haydens of New York and Waterbury, Conn.

Such fans as heretofore made were apt to be so out of balance that a perceptible jarring accompanied their use, and



MOTOR FAN.

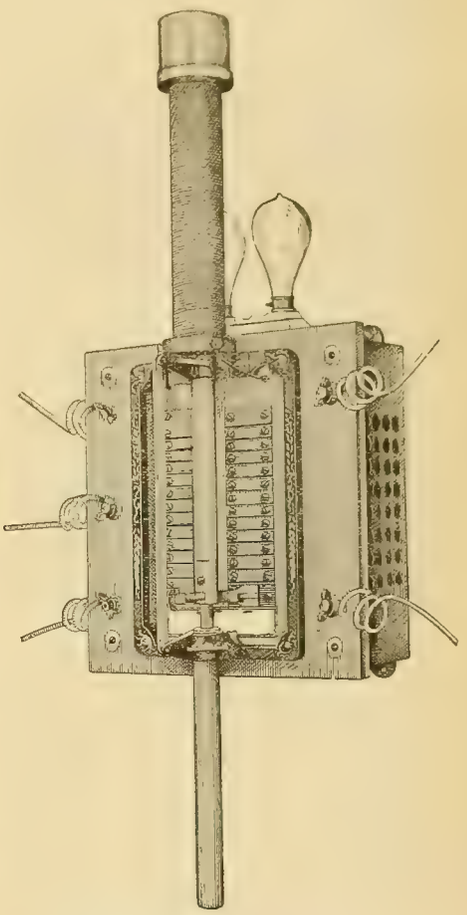
the blotches of solder, carelessly affixed to the blades to effect a balance oftentimes, produced noise enough to shame a Japanese humming-top. Holmes, Booth & Haydens have endeavored to form a fan that will distribute its breeze, and not throw it, as it were, like a gleam from a search light as many fans do.

This fan is finished in the lamp department of Holmes, Booth & Haydens, and is decidedly ornamental in appearance. It is made in sizes from 5 to 15 inches, and is lacquered or silver plated. Fan guards are also manufactured for any sized fan.

New Whittingham Automatic Motor Starter.

The Automatic Switch company of Baltimore, Md., is introducing a new automatic motor starter, differing essentially from the automatic switch heretofore manufactured by this company. The switch has been quite efficient in connection with motors of the smaller horse powers when used by careful persons; but for the larger horse powers and in general use it has in some cases failed to work satisfactorily. The company has, therefore, for some time been experimenting with the object of eliminating the weaknesses of the automatic switch, and it now calls attention to the new Whittingham automatic motor starter shown in the cut. This device, it is believed, will meet all requirements, having been subjected to the severest tests.

The operation of the motor starter may be readily understood by referring to the illustration. The solenoid magnet



NEW WHITTINGHAM AUTOMATIC MOTOR STARTER.

furnishes the power for operating the heavy contact bar, which slides up over the resistance plates, and acts against the control of the dash-pot at the bottom of the starting box, thus making a gradual movement over each succesive resistance contact. When the top contact is reached the power of the magnet is automatically weakened, and only enough magnetism developed to hold the contact bar firmly in its place. The energy consumed in the magnet when the bar is in its final position, with the motor running, is only about forty watts. When the current is cut off, the magnetism ceases, and the contact bar falls to its original position at the bottom of the resistance plates, ready to start the motor again when the current is turned on.

In elevator, pumping, or other work of intermittent character, this automatic motor starter will be found of great service, since it is only necessary to arrange for the opening and closing of a simple switch. Elevators should have a small wire cord running from the basement to the top floor, and passed over a pulley. A weight of about fifteen pounds should be attached to each end of the cord. This cord, with its weights, is sufficient to operate a suitable swap switch carrying current to the motor starter. When the elevator is not in use, the motor can be stopped by using the cord on any floor.

The Wenstrom Electric & Dynamo company equipment, which was offered at public auction at Baltimore, was withdrawn. The highest bid was $150,000.

The Keystone Reversible Elevator Motor.

The feature of this elevator rigging is that the motor is operated without a rheostat, or other outside resistance, the current being turned into it by means of the switch mechanism used in reversing the motor.

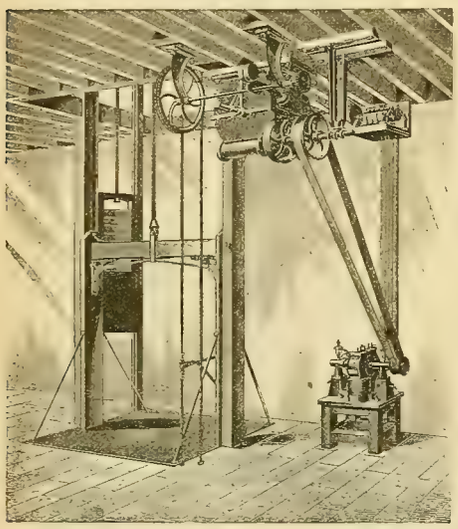
The controlling and reversing switch of this apparatus is connected to and operated simultaneously with the brake mechanism, by the hand rope, or by means of any of the ordinary devices used in starting and stopping elevators, the motor receiving the full force of the current without damage to the armature.

The motor only runs while the elevator is in use, consequently a minimum quantity of current is consumed.

All parts of the machine are constructed in a carefu manner and especial care is taken with the armature bearings, which are made of extra length and size, and they are provided with either sight feed oil cups or automatic self-oiling bearings and with ample oil cellars, so that there is no waste of oil therefrom.

The Keystone motor is adapted to be connected with elevators or hoists of ordinary construction, either by belt, as illustrated in the accompanying cut, or by gearing or by coupling the armature directly to the end of the driving shaft of the elevator or hoist, as desired.

The Keystone Electric company of Erie, Pa., the manufacturer, builds these elevator motors in standard sizes of 3, 5, 7½, 10 and 15 horse power. Other sizes are made to order.



KEYSTONE REVERSIBLE ELEVATOR MOTOR.

Fighting an Electric Company.

Chicago property owners on the north side of Forty-sixth street, from Cottage Grove avenue to Michigan avenue, have filed a protest against the Englewood Electric Light & Power company, which is now engaged in placing a line of poles in front of their residences. The electric light company began the work which aroused the indignation of the property owners last week. Their protests were of no avail, however, as the foreman of the company's gang was armed with the required permit granted by the commissioner of public works in pursuance of ordinances passed by the Board of Trustees of the Town of Lake, July 8, 1888, and of the Town of Hyde Park Sept. 1, 1888.

The discontented property owners take the stand that the ordinances on which the permit is based were passed four years ago, and that since then electric light and telephone companies have been restricted to the use of alleys and business streets while the better resident sections have been exempted from the erection upon them of poles and wires.

John Cheshire, one of the property owners, filed a bill in the circuit court to restrain the city from permitting the company to proceed with the work. Commissioner Aldrich, it is claimed, had no power to issue such a privilege.

An Electric Vegetation Destroyer.

A novel as well as an extremely interesting exhibit was made yesterday at the works of the Memphis Electric Light & Power company, says the Memphis *Commercial* of May 4th. It was the operation of an electric brush devised by Captain Sharp, ex-superintendent of the Mississippi Valley Railroad company. About 6 o'clock quite a party of gentlemen had assembled to witness the exhibition, and they were highly entertained as well as instructed. The brush is a wire affair resembling an ordinary scrubbing brush. It was connected by a wire about one hundred feet in length with a dynamo in the works of the electric light company. A current of 2,500 volts and nine and a half amperes was turned on, every wire of the brush being charged, and with an ordinary wooden handle the operator would drag it over the grass, killing the latter instantly. Its purpose is to destroy vegetation, and it can be utilized in various ways. One of the principal uses to which it will be put will be the destruction of grass around the rails of railroads, which has always been an annoyance to railway companies. By means of this device it is claimed that the expense of cutting and destroying the grass will be greatly curtailed.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 7.—The affairs of the General Electric company, or, as many people continue to call it, the "Thomson-Houston-Edison company," are being rapidly arranged for business under the reorganization. A dispatch from Albany on Monday announced that the company had just filed in the office of the secretary of state a certificate of increase of capital to $50,000 000, and paid into the treasury $15,000 more, making up the total of the one-twentieth of one per cent. tax. The document is signed by Eugene Griffin, S. Dana Greene, Joseph B. Ord and James Jackson, a majority of the directors, and recites that the meeting at which the stock was increased was held in the Drexel Building on the previous Saturday. On Wednesday a meeting was held in Boston and the officers and directors of the company were elected. C. A. Coffin was made president; Eugene Griffin, first vice-president, and Samuel Insull, second vice-president. A. S. Beves was elected treasurer and assistant secretary; E. J. Garfield, secretary; J. P. Ord, controller; E. Clark, auditor, and B. F. Beach, Jr., and W. F. Pope, assistant treasurers. The directors elected were J. Pierpont Morgan, C. A. Coffin, Thomas A. Edison, D. O. Mills, F. L. Ames, T. Jefferson Coolidge, Eugene Griffin, Henry L. Higginson, H. McK. Twombly, C. H. Coster and F. S. Hastings. Mr. Twombly was made chairman of the board.

By this allotment of officers a Thomson-Houston man is made president. There had been gossip in Wall street to the effect that Mr. Coffin was to be general manager, with Mr. Twombly as the official head of the company, but Wednesday's meeting showed that there had been a change in the programme, and it had been decided to give Mr. Twombly the chairmanship. Mr. Twombly represents heavy financial interests in the consolidated company.

The Washington dispatches to the daily papers of May 3d containing the information that three patents had been allowed upon applications filed years ago by Thomas A. Edison, assignor to the Western Union Telegraph company, brought sadness to the hearts of those who fondly imagine that the Bell company maintains control of its gigantic business through one or two patents. The applications for all three of these patents were filed in 1877, but their issuance has been delayed all this time. These inventions of Edison have been granted foreign patents, some of which have already expired. The interesting question is therefore raised whether an American patent, issued after the expiration of a foreign patent, is valid, the application for the American patent having been filed prior to the date of the grant of the foreign patent. Several Circuit Court judges have decided this question in the negative. It will now in all probability be taken to the United States Supreme Court for decision.

At a special meeting in Chickering Hall on Monday evening the American Geographical society discussed the advantages and desirability of a northern magnetic survey. The speakers were Prof. W. T. Trowbridge of Columbia College, Prof. Meyer of Stevens Institute, Gen. Greely of the Signal Service, and Col. W. H. Gilder. Col. Gilder, who with Lieut. Schwatka won fame in bringing back from the northern regions information respecting Franklin and his expedition, again proposes to make a journey to the north, this time at the head of a party to make a magnetic survey of the region immediately surrounding the northern magnetic pole. Prof. J. C. Mendenhall, of the Coast and Geodetic Survey, in a letter to Col. Gilder, expressed his entire approval of the expedition. Prof. Trowbridge said that as a result of the expedition the magnetic pole might be definitely located. He said that in his opinion all magnetic surveys on land should be prohibited, as the true importance and the benefit to be derived were on the sea alone, for the mariner, who is dependent upon his compass. Prof. Meyer explained that one thing it would be sought to establish at the point when the needle assumes the vertical position was whether the so-called pole was fixed or moving. The American Geographical society of this city, the National Academy of Sciences at Washington, members of the United States Coast Survey, and a number of other scientific men are interested in the proposed expedition. Although some funds have been pledged for fitting out the party and for carrying on the work, nothing definite has been determined upon in the way of plans, the money required, the exact route, etc.

A new electric light company has been organized in Newport, R. I, with a capital of $200,000. The officers are: Directors, Theodore A. Havemeyer, Frederick W. Vanderbilt, Robert Goelet, Louis T. Lorillard, A. C Titus, Gardiner B. Reynolds and Henry H. Fay. Mr. Havemeyer is president, with G. B. Reynolds treasurer, and H. W. Darling secretary. From the above slate it will be seen that the cottage element has an overpowering preponderancy. Already alterations have been begun on the company's station at the Richmond mill, at the south end of the harbor.

The Metropolitan Telephone & Telegraph company on Tuesday re-elected the following named directors: Leonard F. Beckwith, Charles F. Cutler, Joseph P. Davis, Thomas T. Eckert, William H. Forbes, George J. Gould, Norvin Green, Edward J. Hall, Jr., John E. Hudson, John Jameson, Charles A. Tinker, John Van Horne and William H. Woolverton. Mr. Van Horne presided at the meeting, and John H. Cahill was secretary. There was no opposition to the ticket.

A bill has been laid before Congress for an appropriation to increase the candle of the electric light on the Statue of Liberty to 100,000 candle power.

The first session of the special commission appointed by the Supreme court to determine whether the route laid out by the Board of Rapid Transit commissioners should be built was held May 6th. Many property owners were present. Orlando B. Potter objected to both routes.

F. M. Knox, on behalf of Charles A. Dana and other Madison avenue property owners, appeared in opposition to the building of the east side road. Other property owners who object to the east side route and the Broadway road were represented.

John Schuyler, as a representative of the Terminal Underground Railroad company, objected to that part of the east side line being built from Union square through Fourth avenue to Forty-second street. He declared that his company, which was formed in 1886, before the Rapid Transit act was passed, had secured the right of way under Fourth avenue by getting the consent of a majority of the property owners. He asked for a day to be heard in objection to the east side route. After much argument the commissioner decided to let Mr. Schuyler file a brief, wherein he might set forth the claims of his company.

Samuel S. Spencer, one of the Rapid Transit commissioners appointed in 1891, was a witness. He was at one time president of the Baltimore & Ohio Railroad. He gave a detailed account of the work of the Rapid Transit commissioners in their prosecution of the work of preparing plans for the proposed railroad and the examination of the different routes proposed. Among the plans were the underground arcade, overhead, and double-decked underground.

To the viaduct system, he said, special attention had been given, as this had seemed the most feasible. The commissioners had gone over every foot of the ground which would be covered by the proposed routes. They had decided that a successful rapid transit road must necessarily run through the center of population and business

They were, however, compelled to abandon the idea o a viaduct system, Mr. Spencer said, on account of the enormous cost of such a line. The route would have to be close to Broadway, and the cost would be more than $10,000,000 per mile.

Mr. Spencer said that a company had offered to build such a road, providing the franchise could have been secured. After careful consideration the commissioners had decided that the viaduct route was impracticable, and that the underground west side route was the best one. This route is from Bowling Green up Broadway to Fifty-ninth street, up the Boulevard to its junction with Eleventh avenue, up Eleventh avenue to One Hundred and Ninetieth street, and across to the city limits.

It is believed the special commissioners will report in favor of the west side road, and that the franchise will be sold and the road built and put in operation.

G. W. S.

Baltimore, Md.

BALTIMORE, May 7.—The proposition of the Thomson Houston company to run the trains in the Belt Railroad company's tunnel under the city has excited a great deal of interest here. The bold offer of the electric company was accepted last Saturday. There were present at the conference President Gilmore, of the Belt Line; President Mayer, Vice-president King and General Counsel Cowen, of the Baltimore & Ohio Railroad company, the lessee of

the tunnel, and Edward F. Gile, the representative of the Thomson-Houston company.

Vice-president King, who was seen after the conference ended, said: "The proposition to move great trains through the tunnel is certainly a bold one; whether it will prove to be practical remains to be seen. The offer of the Thomson-Houston company is the first attempt on such a large scale, and I am not prepared to doubt that it can be done. The wonderful developments in electrical science which are being made almost daily show that what seems to be impossible to-day is practicable to-morrow. At any rate as the Thomson-Houston company is so confident of success as to be willing to make the entire outlay without any return in case the experiment is a failure, there can be no objection to let them see what they can do."

When asked how soon work would be begun, Mr. King said: "I have not learned, but of course they will be ready to move the trains by the time the tunnel is opened, which we expect will be in December next. I know nothing of how the power is to be applied except that eighty-ton electric motors and a copper wire will be used."

According to Agent Edward F. Gile of the Thomson-Houston company a special type of electric locomotive will be built. "The locomotive," said Mr. Gile, "will resemble a steam locomotive up to the top of the wheels, except that it will lack the piston rods and other driving apparatus of the ordinary engine. Above the wheels there will only be a cab for the engineer, which will be entered from the side. The locomotive will be a double-ender, to be driven in either direction, and will probably have a cow-catcher or some such device on each end. There will be four sets of driving wheels with armatures attached to the axle of each wheel, thereby saving the loss and inconvenience of gearing apparatus. Each electric locomotive, of which there will be three, will weigh about eighty tons, considerably more than the largest steam locomotives of the B. & O. road, and its traction power will be correspondingly greater. It has not yet been definitely decided how the current will be transmitted. It may be by a copper strip between the rails, or by copper plates overhead, or by a large copper wire. I think probably the latter method will be adopted, and if so the wire will be covered in such a manner that a man cannot get his hand to it, and it will therefore not be dangerous. The locomotives will be capable of pulling a freight train of 1,200 tons through the tunnel at a speed of fifteen miles per hour, and a passenger train of 500 tons at a speed of thirty miles per hour. Indeed, while it is very seldom that trains will weigh anything like so high as the figures given, the company will be on the safe side and make the locomotives capable of even more than the guaranty."

The Thomson-Houston company guarantees that its plant and system shall be successfully installed and operated before it is paid for by the Belt Line company, after which it will be turned over to the railroad company's own officials to operate. The provision is that the electric company shall supply such an equipment as will meet with the approval of General Manager Odell and General Superintendent of Motive Power Hazelhurst. The Thomson-Houston company proposed to guarantee the transportation of freight trains of a maximum weight of 1,300 tons at the rate of fifteen miles up the grade in the tunnel, and passenger trains of one-half that weight at thirty miles an hour. The electric motors are to do the whole work of moving trains in the tunnel, and the locomotives will not be used while in the tunnel, so that there will be neither smoke nor gas to create discomfort and annoyance to travelers. After the motors haul the trains from Henrietta street to the Mount Royal avenue exit, they will be used to help the locomotives as far as Huntington avenue, where the heavy grade ends. The grade of the tunnel is downward to the south from Huntington avenue to Henrietta street, and the motors can be used to check the speed of trains, although such assistance will hardly be necessary. There is no grade on the line from Bay View to Philadelphia equal to the grade in the tunnel. The power of each motor is to be guaranteed as equal to a draw-bar pull of 32,000 pounds. There will be four engines in the power house of seven hundred horse power each. B.

Boston, Mass.

BOSTON, May 7.—An important circular has been issued by the superintendent of streets, in which he calls attention to the new ordinance concerning poles for electric wires, and states that it will be enforced on and after June 15th.

This new ordinance provides that the superintendent of streets shall, when authorized by an order of the board of aldermen, issue permits to open and occupy portions of the street for the purpose of placing and maintaining poles for the support of wires on the terms set forth in another section (No. 8), and in addition, the person applying for the permit shall keep the poles well painted and in good condition, to the satisfaction of the superintendent of streets; shall place the wires on the poles not less than 25 feet from the ground; shall keep the name of the person owning the pole distinctly painted on the crossbars used and occupied by him on the pole, and also on the pole, at a point not less than six feet nor more than eight feet from the ground; shall allow the departments of the city the exclusive use of the upper crossbar and top of each pole, free of charge, for the purpose of placing wires thereon, shall not suffer or permit any other person to place or keep wires on the poles or fixtures, without permission being first obtained in writing from the board of aldermen; shall not remove any pole erected under this order until, and shall remove any pole when directed by the board of aldermen so to do; and that on the violation of any term of this condition the superintendent shall remove the poles at the expense of the person owning them. M.

Cincinnati, O.

CINCINNATI, May 7.—The City & Suburban Telephone company began last October making preparations to place their wires in underground conduits, and already more than 122,000 feet of single duct have been laid. These subways are of terra cotta, with manholes and distribution ducts. At the new exchange, in the Albany building, the company is now erecting a Western Electric multiple switch-board, on which it will be possible to handle 5,000 subscribers lines. The moving of this exchange from its present quarters in the Masonic building to the company's building will necessitate the abandonment of all the apparatus of the old Exchange, including the switch-board, with capacity for 3,000 lines.

The fitting up of this old Exchange is reported to have cost $108,000 to set up, all of which will be abandoned in the move. This removal, with the consequent new apparatus and the underground work, is estimated to cost not less than $750,000, and will require two or three years of hard work before the poles and wires can be abandoned in the heart of the city.

Cincinnati's telephone experts claim to have a better central exchange equipment than any other city in the United States, with a population of more than 250,000, and last year's record shows the handling of 20,130,700 messages, or an average of 15 calls per day, per subscribers at an average cost of one cent per message.

The police and patrol system of the city is operated and maintained by the Telephone company at an estimated annual loss of $1,000, while the Fire department is furnished instruments free of charge, and all city wires are carried on the Telephone company's poles free of charge.

Under the contract with the city the Telephone company must construct and maintain free of cost, and for the exclusive use of the city, one duct throughout the entire length of its underground conduit system.

As the city offices are soon to be removed from the present temporary quarters to the new city buildings, it will be necessary for the Telephone company to put up a new exchange equipment at the new buildings, and abandon the equipment at the present exchange in the temporary city building.

A Cincinnati man comes to the front with the claim that he has succeeded in utilizing aluminum in electro-plating. John Messinger, who has been conducting these experiments, says that he began the work at the solicitation of an electric light company, which wished to find some way of plating carbon with aluminum to improve the quality of the light. He has failed up to this time to secure adhesion between the carbon and this metal, but claims to have found a means of plating iron, steel and copper. He thinks no one has done this heretofore. The deposit is hard as nickel, never tarnishes, and does not fuse readily. C. E. E.

Milwaukee, Wis.

MILWAUKEE, May 7.—In the Circuit Court the Kaukauna Electric Light company has brought suits to compel some of its stockholders to pay the balance due on subscriptions to the capital stock. The defendants and the amounts claimed are as follows: John Schultheis, Sr., $365; John Schultheis, Jr., $936.50; H. B. Tanner, $775; H. C. Tanner, $87.50.

The annual meeting of the Johnson Electric Service company was held recently, and a dividend of 8 per cent. was declared. The old officers were re-elected as follows: William Plankinton, president; I. M. Bean, vice-president; W. S. Johnson, secretary and treasurer The board of directors consists of the officers and Jacob Friend and Francis Hinton. During the evening a banquet was held at the new Pabst hotel, many of the stockholders and a number of other prominent citizens being present. Mr. Johnson explained to the guests his device, in use at the Pabst, by which steam may be turned on or off in any room from the office. C.

PERSONAL.

E. L. Smith, of the Crown Electric Manufacturing company, of Bridgeport, Conn., was a visitor at the New York office of the Western Electrician last week.

Arthur L. Bayley has resigned the position of president and manager of the Pennsylvania Electric Engineering company of Philadelphia. For the present Mr. Bayley's address will be at Towson, Md.

J. H. Cook, formerly of the Sunbeam Incandescent Lamp company, has accepted the position of manager of the Chicago office of the Buckeye Electric company of Cleveland, O. The company's Chicago office is at 437 Rookery.

NEW INCORPORATIONS.

Jordan Electric Train Signal, Portland, Me.; capital stock, $150,000; manufacturing and selling signals and all devices; Geo. F. Gould, Portland, Me.

Korsmeyer Plumbing & Heating company, Lincoln, Neb.; capital stock, $27,000; dealing in plumbing appliances, gas fixtures, gas ranges, electric light fixtures, and doing a general plumbing business.

Dewey Electric Heating company (incorporated in West Virginia), Syracuse, N. Y.; capital stock, $200,000; manufacturing and selling electrical apparatus, etc.; C. H. Duell, Kirk building, Syracuse, N. Y.

Cardarelli Electric Light Crane company, Sumter, S. C.; capital stock, $6,000; manufacture and sell electric light cranes; to sell right to manufacture cranes under the Cardarelli patent; H Harby, president, Sumter, S. C.

Haverhill & Amesbury Street Railway company, Haverhill, Mass.; capital stock $250,000; to construct a street railway single or double track, and operated by any power except steam, and connecting Haverhill, Merrimac and Amesbury.

Ukiah Electric company, San Francisco, Cal., capital stock, $30,000; to generate and deal in electric light, operate telephone and telegraph lines, deal in real and personal property, patents and machinery; George Johnson, San Francisco, Cal.

Hammond Electric Railway company, Hammond, Ind.; capital stock, $100,000; constructing, owning, operating and maintaining street and horse railroads, switches and side tracks upon and through cities and towns within the state of Indiana; Sidney Stein, Chicago, Ill.

National Construction company, New York, N. Y., (incorporated in West Virginia); capital stock, $1,500 000; building and maintaining wagon, plank and toll roads, steam, electric, cable, and horse railways; erecting wharves, piers, breakwaters, jetties, etc.; J. B. Floyd, Charlestown, W. Va.

Mountain Bank Coal company, New Whatcom, Wash.; capital stock, $300,000; to acquire, hold and dispose of coal and mineral lands; develop and operate coal and other mines; operate electric light plants, gas works, water works, etc.; Jerry Neterer, New Whatcom, Wash.

Columbus & Magnetic Springs Electric Railway company, Magnetic Springs, O.; capital stock, $25,000; constructing, maintaining and operating a railroad between Magnetic Springs and Columbus; furnishing by electrical process, light, heat and power, etc.; Edwin R. Hotsenpiller, Magnetic Springs, O.

Western Electric-therapeutic Alarm company, Washington, D. C. (incorporated in West Virginia); capital stock, $500,000; buying, owning, using, vending and controlling patent rights relating to electric alarm and electro-therapeutic apparatus, or any other system of electric alarms; Joseph Ruffner, Charlestown, W. Va.

Railway Equipment company, Chicago, Ill.; capital stock, $100,000; to purchase, sell and manufacture machinery and merchandise used by electric, steam and horse railways; construction and equipment of such roads, mining and other plants; dealing in electric heating, apparatus, goods and appliances of all kinds; W. R. Mason, 617 Pullman Building, Chicago, Ill.

Commercial Electric Light company, Columbus, Ind.; capital stock, $20,000; to adopt, manufacture and use electricity for both power and illumination by any or all of the processes now known or in use, or as the same may be developed or perfected by further invention or improvement in the course of the application of electricity to either power or illuminating purposes, and the purposes of said corporation are to obtain contracts and privileges from cities, towns and individuals for furnishing public and private lights to all consumers, and to furnish power to all persons or corporations at prices to be mutually agreed upon; B. F. Gottschalk, Columbus, Ind.

ELECTRIC LIGHTING.

Abingdon, Ill., will soon be lighted by electricity.

Mattoon, Ill., will erect an electric light plant of its own.

Wapakoneta, O., will put in a $20,000 electric light plant.

The town of Brewton, Tenn., has contracted for an electric light plant.

The city of Grand Island, Me., has advertised for bids for lighting the city by arc lights.

Mayor Jones of Waterville, Me., in his annual address makes the assertion that in erecting and operating an electric light plant the city has increased its lighting

capacity 186 per cent. and decreased the annual expense 16 per cent.

Cumberland, Md., will soon have another stock company to erect an electric lighting plant.

A small storage battery enables a hackman in Oakland, Cal., to illuminate his hack with electric lights.

The new station of the Concord, N. H., Gas and Electric Light company has just been put in operation.

At a recent meeting of the voters of Hingham, Mass., $500 was appropriated for additional electric lights.

Wheeling, W. Va., is now illuminated by 480 arc lights. The current was turned on for the first time on April 23d.

The electric light plant at Paw Paw, Mich., will be doubled in capacity. The Citizens are putting the light in their houses.

The Cleveland Electric Light company, has, it is said, made an agreement with the Electrical Workers' union to employ none but union men.

The Eureka, Cal., Electric Light company gives notice of its intention of changing its principal place of business from Eureka to San Francisco, Cal.

The city of Cuthbert, Ga., has voted an issuance of $35,000 of bonds to secure the erection of an electric light plant and the construction of waterworks.

The Vermont Electric company of Burlington, Vt., is reported to be making arrangements to utilize the large water power at the gorge above Winooski.

The city council at Calvert, Tex., at a recent meeting, closed a contract with the electric light company to light the streets of the city for a period of three years.

Negotiations are now being completed by which the Manitou electric light plant will be moved to Colorado Springs. The plant will do service for both towns.

On May 3d lightning struck the Allegheny county Electric Light company's works at Pittsburg and burned out seven dynamos, injuring the plant to the extent of $7,000.

The city of Beatrice, Neb., has made a contract with the Rapid Transit & Power company for thirty arc lights to burn all night and every night, at $8 per light per month.

The corner-stone of the new Sunday school building of the Nostrand avenue Methodist Episcopal church of Brooklyn was recently laid in the evening by the light from an arc lamp.

After thinking the matter over, the Portland, Me., authorities have decided to discontinue the use of lamp posts for arc light conductors and substitute cedar poles 14 feet high. There are about 75 lamp posts used for the purpose in that city.

Work on the introduction of the electric light in the Vatican at Rome has begun. The grand staircase is to be splendidly illuminated upon occasions of state. There is already an elevator in the Vatican, and the pope has a telephone convenient for use.

A New Mexico jury has decided in the case of the Electric Light company against Goldstein and others, tried at Albuquerque, that an electric light company must stand the cost of wiring a customer's store for lights. An appeal will undoubtedly be taken from this verdict.

The Atchison, Kan., *Champion* points out that preachers should advocate the introduction of electric lights in their churches in order to prevent a large portion of their congregations from falling asleep. By using electricity, gas, which vitiates the air and induces drowsiness, is done away with.

The Oakland, Cal., Gas, Light & Heat company has offered to pay the city $30,000 in advance for its electric light plant, and at the expiration of fifteen years to pay $5,000, in consideration of which the company is to have a franchise for lighting the city for five years at the rate of $7.25 per lamp.

Within twenty-four hours after the destruction by fire of the sheds and electric light plant of the Long Island Railroad company at Long Island City a new dynamo and engine were secured from the Ball Electric Light company, and the lights were in operation, the entire plant being in a box car.

The Walla Walla, Wash., Electric Light & Gas company will spend $60,000 on improvements. Water will be taken from the creek five miles above the city, and pipes laid 5,500 feet, to where the generating plant will be located. This will give the company nearly seventy-five feet of pressure, and 225 horse power will be brought into the city by wire.

At a recent meeting of the General Council of Louisville a contract with the gas company for lighting the streets by electricity for five years at $84 a light per year, was approved by the councilmen, but was referred to a committee in the upper board, some of the members thinking the price too high, although $100 a light had been formerly agreed upon.

In the course of a letter on municipal electric lighting a Cleveland correspondent of the New York *Evening Post* says: "It is a comparatively easy matter to get the people to vote for the expenditure of money in public improvements, whether wisely or not. Certainly in this city the idea of a municipal electric lighting plant is very popular, and a proposition to establish one would undoubtedly receive popular approval."

The gas and electric light commissioner, in making his annual report to the Massachusetts legislature, says: "The taxpayers in any city who demand that wires shall be placed underground should realize the fact that this move means increased cost for lights and larger taxes to pay for same." He finds that during 1891 there were 3 accidents caused by electricity, with 1 fatal case; with illuminating gas, 30 were injured, with 16 fatal cases.

In an eastern city where electric lights have just been introduced a local paper published a number of interviews in relation to the new illumination. Here is one of them, from a policeman: "We have had a number of peculiar complaints since the lights were turned on. A colored lady living on Chapline street came down the other night at 10 o'clock and wanted a game of base ball in front of her house stopped, as it annoyed a neighbor who was ill."

An isolated electric lighting plant is being installed in the new establishment of A. H. Revell & Co., Wabash avenue and Adams street, Chicago. Two standard Edison dynamos, respectively of 30 and 45 kilowatts' capacity, driven by an Ideal engine, will furnish the current. The building is wired for 30 arc and 800 incandescent lamps, the convertible system being used. At first the load will be thrown on the down-town station of the Chicago Edison company, which secured the contract for putting in the plant.

The Narragansett Electric Lighting company seeks the exclusive franchise of using the streets of Providence, R. I., for electric light wires for twenty years. It agrees to adopt any new electric system it may be commanded to substitute for its own, and promises, if the order is not obeyed, that it will regard the exclusive right as forfeited. It proposes to pay the city a quarterly tax of 2 per cent. on its total earnings for the first five years, and at the rate of not less than 2 per cent., nor more than 3 per cent., for each succeeding five years of the twenty.

The Edison Light & Power company has commenced placing its wires under ground in San Francisco. Work was begun on Montgomery street, between California and Pine, and will be confined to the business district. It is the intention to lay the pipes throughout the city, the business portion being attended to first. On Market and Kearney streets cement conduits will be laid above the pipes. These will contain the wires connected with the arc system, and as soon as practicable other thoroughfares where arc lights are in use will have the wires put underground.

The following clipping from a Cincinnati paper illustrates the business methods of a Kentucky gas company: Fred Baschang has filed suit in the Chancery Court against the Newport Light company, enjoining and restraining it from cutting off his supply of gas at his place, 921 Monmouth street, because he put electric wires in his place of business and has begun to illuminate in the greater part with electric light and greatly reduced the quantity of gas he has heretofore consumed, continuing to use the gas as far as necessary. The injunction was granted.

The plant of the Citizens' Electric Light company of Louisville, was temporarily disabled recently by an unusual accident. The company is making extensive improvements, and was digging the foundation for a 500 horse power engine. The excavation was being made near the wall. The recent rains have rendered the soil very soft, and when the workmen reached a depth of about four feet the earth slid into the hole carrying with it the botton of the wall and the floor of the room above it. In falling the debris carried away a branch of the main steam pipe which leads from the boiler to the engines, and the dynamos were thus deprived of power. An alarm of fire was turned in, but the engines were not needed.

Thargominda, a town in Queensland, Australia, is to be lighted by electricity. This is believed to be the first town in Queensland to be supplied with electric light. In speaking of this installation, a Melbourne contemporary gives some interesting particulars of central station practice in that distant region: "It is calculated that the cost of oil, according to the state of the roads, is from £1 to £1 5s. per tin. The expense of running the electric light plant, after first cost, will be comparatively small, there being plenty of water thirty feet below the surface and wood about two miles from the engine. The incandescent system is used throughout, lamps up to 500 candle power being employed. Provision has been made for duplicating the plant as the demand increases. The plant is also to be used for power during the day, fans being very much needed in the locality for purposes of ventilation. Thargominda is about 1 000 miles from Brisbane, and has a population of about 1,300."

Judge Hopewell of the District Court at Omaha has issued an order to compel the Omaha Thomson-Houston company to supply lights to the Millard hotel. The trouble between the hotel people and the lighting company is of long standing. In the early part of 1890 Markel & Swobe entered into a contract for the lighting of the hotel at the price of $375 per month. The contract continued in force until April, 1891, when Markel sold his interest in the Millard to Thomas Swobe, and about that time Swobe and the lighting company fell out. Swobe said the lights were not up to the standard guaranteed in the contract, while Superintendent Wiley said that Swobe had nothing to say in the premises, as the contract was not with him, but with the old firm. The upshot of the whole matter was that Wiley said that he would cut off the current and leave the hotel dark. Swobe dared Wiley to do this, but for fear that he would, a temporary injunction was obtained from Judge Wakeley, who was then upon the bench. Matters remained in that condition until April 30th, when Judge Hopewell decided to let the injunction stand, but at the same time he ordered Swobe to pay $375 per month for the use of the lights, and he also ordered Mr. Wiley to furnish just the same kind of lights that he agreed to in his contract.

ELECTRIC RAILWAYS.

Jacksonville, Ill., has a new electric railway.

Racine, Wis., is to have an electric street railway.

Anna and Jonesboro, Ill., are to be connected by an electric railroad.

Ventura and Ojai, Cal., will soon be connected by an electric railroad.

The electric railway company of Lexington, Ky., has decided to carry weather signals on its cars.

The new Janesville, Wis, electric road will be formally opened on May 25th with music and fireworks.

Work will soon be commenced on the construction of an electric road between Fostoria and Tiffin, O.

The Eickemeyer-Field electric railway system is to be introduced in Long Island City, N. Y., by the Steinway Street Railway company.

New York capitalists are said to be negotiating for the purchase of the Norfolk, Va., street railway, with the intention, if the deal is closed, of changing it to an electric road.

The power house of the Baltimore and Pikesville electric railroad will be built on Retreat street. Work will be pushed rapidly forward, and the road will be in operation in a year.

The Rochester, N. Y., Railway company has discarded the idea of distinguishing the cars on different routes by varying colors, and is now painting all its cars one color.

The McKeesport Pa., Electric Railway company has agreed to raise the wages of its workmen 33 per cent. if they will consent to a corresponding increase in the hours of labor.

The North Avenue Electric Railroad company, of Baltimore, and the Baltimore, Hampden & Lake Roland Railroad company have consolidated under the name of the Lake Roland Elevated Railroad company.

The power house of the Quincy, Ill., electric railroad was struck by lightning on May 4th, the shock ruining one of the three generators used. On account of this three cars were laid off for want of power.

An electric street railway connecting the towns of Urichsville and Dennison, O., will be built within the next three months by a Pittsburg firm. The distance is two and one-half miles. Work will be commenced in June.

The stockholders of the Baltimore Traction company have confirmed the action of the board of directors in authorizing the executive committee to equip with electricity such of the company's lines as the committee deems proper.

San Francisco's first electric railway—the San Francisco and San Mateo line—was opened with much ceremony on April 26th. A number of guests were invited to attend exercises, which included an inspection of the line, speech-making and a luncheon.

The sale of the South Orange horse railroad of Newark, N. J., has been perfected, and as soon as possible the road will be equipped with the overhead electric system. Of the price, $1 500 000, the sum of $500,000 is to be paid in cash and $1,000,000 in bonds.

It is said that the Northwest Thomson-Houston company is negotiating with the officials of the Oshkosh, Wis., Street Railway company for the purchase of the road. President Barber of the street car company refuses to make any statement regarding the matter.

The Haywards electric railroad of Oakland, Cal., has been opened for business. When the first car was run the wildest enthusiasm prevailed all along the line, and at San Leandro bonfires were lighted, and half the town turned out to welcome the arrival of the first train.

It is proposed to construct an electric road from Columbus, O., to Magnetic Springs. The route runs along the west side of the Scioto through Warrensburg. The line will cost about $200,000, and the funds will be advanced by Columbus capitalists. A line running from Warrensburg to Delaware is talked of in connection with the road.

In Columbus, O., the lines owned by the Consolidated Street Railway company have been purchased by a syndicate composed of wealthy New Yorkers and Philadelphians and Columbus capitalists. The Columbus street car system is to be equipped with electric motors. The total cost of the property to the new owners is about $2,500,000.

The Sixteenth street branch of the Oakland, Cal., and Berkeley electric railroad is almost completed. Cars will be run down Sixteenth street from Grove to Center, out Center and Peralta to Eighteenth street, and then across the marsh to the depot platform. A saving of from eight to ten minutes will be made in the time between the depot and Broadway.

A franchise has been granted C. W. Williams to build a three mile electric street railway from the Illinois Central depot at Independence, Ia., past Rush park to the Iowa hospital for the insane. The cost of the project is $40,000. It is to be completed by July 4th, for the grand celebration and races.

The Worcester, Mass., *Spy* says that the people of that state will soon have a chance to see the trial of a long distance electric railroad. What have hitherto been independent electric roads have now been brought under one management, giving a line from Graveland to Haverhill; and from that point on to Lowell and Lawrence—forty miles or more in all.

It is reported that the survey for the proposed air line electric railway between Chicago and St. Louis has been completed. It is asserted that the company has been given the right of way for almost the entire route. The road does not touch a town in the entire distance. The managers say that work will be begun at once on the middle section, and that a coal mine will be secured at either Illiopolis or Edinburg, as a source of fuel supply.

The Holyoke, Mass., *Democrat* states that a motor man on the new electric road in that town known as "Big Jim" Kennedy lost his situation in a peculiar manner. It seems that ever since the advent of the electric cars in the city Dr. Julia M. Patten has had a great ambition to run one for a few miles. To gratify the lady's whim Kennedy allowed her to run a car for a short distance one day when she was the only passenger. The management of the road did not appreciate this bit of gallantry, and discharged the man. Now Dr. Julia is sorry.

Judge Shiras of the United States Court at Dubuque, has denied the application of the Thomson-Houston company for a receiver for the Dubuque Electric Railway Light & Power company. The judge said that the complainant had not made such a showing as would justify the appointment of a receiver. There was no evidence that the road would be better operated by a receiver than it is now. The complainants will make another application with an amended petition.

The Council Bluffs Electric Motor company is in trouble, the cause of which is the alleged failure to pay for its share of the paving on the streets on which the line is operated. From all appearances there is likely to be a general warfare against the railway company, which will either bring about the settlement of the claims against it or stop its business. Should the company adopt the latter course, the result will be to stop the operation of about ten miles of street railway, including the line across the Missouri river to Omaha.

At the first annual meeting of the stockholders of the Eureka Springs, Ark., Electric Light & Street Railway company, Powell Clayton, E. T. Watkins. W. E Penn, J. D. Jordan, C. F. Ellis, T. F. Hawley, L. V. Badger, R. H. James and John A. Bridgeford, were elected directors for the ensuing year. After the stockholders' meeting the board of directors elected the following officers for the ensuing year: J. D. Jordan, president; T. F. Hawley, vice-president; R. H. James, secretary, and T. N. Claflin, treasurer.

California has long been in the rear in the matter of electric street railways, but now that an opening has been made the motor seems to be receiving encouragement on all sides. The Oakland *Tribune* says: "Congratulations are in order for the promoters of the new Haywards electric road. They have carried to completion an enterprise of very considerable magnitude, and they have done it without outside help. It is purely an Alameda county affair, and it will result in a very material benefit to Oakland and to the rich country which lies along the road. It will be a valuable feeder to the business of Oakland, and it will attract a considerable increase of population by the easy access it will furnish to the centers of life on both sides of the bay."

An electric mountain railway is now approaching completion in Upper Savoy. The line starts from Etrembières, on the Bellegarde and Annecy railway, and runs in a circular sweep through Monnetier to Veyrier, a branch being run up the Grande Salève. The gradients range from 16 per cent. to 35 per cent, with curves ranging from 165 to 115 feet radius. The generating plant comprises three Thury dynamos, coupled to turbines. The motors are four-pole, each car being provided with two 33 horse power motors and two sets of gearing. Along the track inverted Vignole rails, supported on iron posts and brackets, form the electric conductor. A 15 per cent. loss on the line is allowed for.

The electric railway will be extensively introduced into Canada at an early day. It has already been tested upon several roads in the smaller cities and in suburban traffic, and will next be introduced into Montreal, Toronto and Hamilton, according to the *Canadian Electrical News*. The contract for construction and equipment has been let in Hamilton. The power house is in course of erection, and track laying is under way. In Toronto, matters are being delayed to give opportunity to dispel from the minds of the mayor and some of the aldermen the theory of the "storage battery" as compared with the trolley. The news comes from Montreal that the street railway will be converted to the trolley electric system at once; it is expected that the change will be effected by the 1st of September. In addition to these larger undertakings, there are also a number of smaller ones in process of development. Commenting on this the same paper says: "To us it seems a matter of regret that Canadian electrical manufacturers do not seem to have made preparations to make the greater part at least of this apparatus and reap the profits which will probably find their way into American pockets. There is also the benefit which would result to our workmen from the making of these goods in Canada. We see it stated that an American firm has been given the order for cars for the Hamilton road."

ELECTRIC MINING.

The Sperry Electric Mining Machine company of Chicago has closed a large contract with Joseph Slater of Nelsonville, O., for the complete electrical equipment of an extensive mine which he will open near Straitsville, O.

A late improvement in the art of making tin plates consists in putting the plate blanks to be cleaned inside a vessel formed of perforated conducting material and connecting the vessel to one pole of a dynamo or any other source of electricity. The vessel containing the plates is then immersed in an electrolytic liquid, and a current of electricity is transmitted through the plates in such a way that hydrogen is set free from their surfaces. The plates are then rinsed in clear water, and dried by rapid heating.

According to the *Helena Daily Journal* the steady and successful operation of the Gold King stamp mill at Telluride, Colo., by electric power, from the last of May, 1891, to the present, has been of incalculable benefit, not only to the mining interests of San Miguel, but to those of the State and country in general. It has never been operated a winter through before, but has run this winter twenty-four hours per day and six days in the week from the time it started last spring. During the time the total stoppage of the mill by reason of the deficiency of power has averaged less than sixteen minutes per day, and of the whole amount of time lost 80 per cent. has been due to necessary work on the turbines and in changing the source of the water supply for mill purposes. Its success has inspired confidence in investors, and its first fruits are seen in the letting of the contract for the building of a 130-stamp mill on Bear creek.

The Boston & Montana Consolidated Copper & Silver Mining company has just contracted with the Thomson-Houston Electric company of Boston, Mass., for an electrolytic plant for the refining of copper. The capacity of this new plant will be over one million pounds of electrolytic copper per month. F. B. Badt, manager of the western power mining department of the Thomson-Houston company, arranged the details of the plant with Frank Klepetko, the superintendent of the Boston-Montana company. Mr. Badt says the equipment will be made at once. According to a dispatch from Great Falls, Mont., D. B. Caulfield, representing Lewishon Bros., of New York, who are heavy stockholders in the Boston & Montana Consolidated Copper & Silver Mining company, has reached that town and will take charge of the construction of the electrolytic refining plant which this company will erect in connection with its smelter just completed. Dynamos and other machinery are in process of manufacture at the Thomson Houston factory at Lynn, Mass. The company has issued $600,000 in bonds for this construction.

TELEGRAPH.

It is proposed to make Los Angeles, Cal., the western terminus of the new through telegraph line across the continent. The Eastern and Pacific Postal companies and the Bennett-Mackay Cable company are acting in combination, and it is stated that a decision has been reached to have a thoroughly equipped through line from the East to the Pacific coast, giving every facility for the transaction of telegraphic business.

TELEPHONE.

The Omaha Telephone company will erect a new building at Eighteenth and Douglas streets.

The Commercial Telephone company of Newnan, Ga. has been incorporated to construct a telephone line from Newnan to West Point, Ga., with an office at La Grange.

Recently the Telephone & Telegraph Construction company of Detroit received an order from the Board of Public Works to remove an objectionable pole in twenty minutes. The pole was removed.

The Grand Rapids, Mich., exchange now has 1,500 instruments in use, and new applications are coming in at the rate of four or five a day. It is probable that Grand Rapids will be connected with the long distance wire between New York and Chicago.

The Sunset Telephone company of Oakland, Cal., is erecting a line along the California and Nevada railroad. The line will extend along the road to Pinole and then branch westward. The poles are rough-hewn trees, and the people express some dissatisfaction at their appearance.

MISCELLANEOUS.

New Jersey has a state electrical subway commission.

It is said in Boston that the next dividend on Thomson-Houston stock will be $1.20 per share, as against the present rate of $1.

Electrically transmitted power is to be introduced in the large plant of the Walter A. Wood Harvester company at St. Paul, Minn.

There are so many electric wires in Boston that each police station has been provided with a patent wire cutter, which can be used for severing live or dead wires without imperiling the user's life.

The recent thunderstorms effected considerable damage to electric wires throughout the West. In several instances central stations were injured to such an extent that factories depending upon them for power were obliged to shut down for some time.

It is said that all the electric wires in Minneapolis, save the railway trolley wires, will be under ground before summer is over. The two telegraph companies have been granted permission to string some overhead wires on account of the national convention, but they will settle down after the convention is over, and bury their wires rapidly.

The jury in the case of W. S. Leckie against the Seattle, Wash., General Electric company brought in a verdict for the defendant. Leckie, whose store on Second street was burned last year, endeavored to show that the fire was started because the defendant's wires had not been properly insulated. He asked damages to the amount of $37,025.

It is stated that Mr. Sims is preparing drawings for adapting the Sims-Edison electric motor and propeller to life-boats. The propellor is to be placed in the bow, and it is suggested that a cable of from three to four miles in length shall be coiled in the boat. The boat would be provided with a search light, and the current for propelling the vessel would be generated from a shore station, which might be several miles from the starting point of the life-boat.

Messrs. Merton & Co., metal dealers, London, have sent to the *Engineering and Mining Journal* their annual circular, from which it appears that the production of copper for 1891 was 274,714 gross tons. Of this the United States furnished 128,179 tons, or 46.7 per cent. of the world's production. After the United States, Spain and Portugal take rank, with a production of 53,915 tons. The production of Chili has fallen in eight years from over 41,000 tons to 20,000 in 1891. All of South America added 29,140 tons; Japan, 17,000, and Germany 16,250 tons.

It is said that reliable results can be obtained in measuring high temperatures by means of a thermo-couple formed by twisting together the ends of two wires, one of platinum and the other of a platinum rhodium alloy containing 10 per cent. of the latter metal. An accuracy of 1° in 1,000°, it is asserted, can be obtained. For temperatures above 1,000° wires of iridium and iridium alloyed with 10 per cent. of platinum may be used as a thermo-couple up to 2,000°. The apparatus employed consists of a thermo-couple in circuit with a D'Arsonval galvanometer, and is calibrated by placing the couple in some material whose melting point is known, and noting the deflection obtained.

Recently there were placed on file in the King county auditor's office at Seattle Wash., two deeds to the Union Electric company, aggregating in consideration $986,303. They deeded the entire plants of the Seattle General Electric company, in the sum of $486,303, and of the Union Electric company, valued at $500,000. An official of the Union Electric company gives the information that there will be no change in the management of the two companies before July 1st. An entry on the records was also made in a trust deed for $500,000 in 6 per cent. bonds to run 29 years from the Union Electric company to the New York Guarantee & Indemnity company.

Damage to steamship machinery is often due to the rapid revolution of the engine when the propeller screw is thrown out of water by the pitching of the vessel. In order that the slowing of the machinery may be done in an automatic manner, an English inventor has devised an arrangement in which the sea water operates the controlling mechanism. The contact making device consists of a tube in the stern of the vessel, connected with the sea, and having a floater acting upon an electric coil. When the water about the stern of the ship is at a low level, and the screw is uncovered, the water in the tube flows out, and the floater falls, and the electric circuit is completed. The current acts upon a distribution valve of a governor, admitting steam to one side of the piston, and partly shutting the throttle valve, thereby throwing the top and bottom of the low pressure cylinder into communication and equilibrium. When the water rises in the tube, and the propeller becomes immersed, this electric contact is broken and the controlling valves put back to their normal position.

TRADE NEWS.

Cummings & McCoy, a new firm of electrical engineers and contractors, have started in business at 26 Howard street, Detroit. Competent and energetic, the young men start out with excellent prospects of success.

The iron-clad motor of the Erie Machinery & Supply company, Erie, Pa., is deserving of its name, and a glance at the little machine will substantiate the makers' claim, that all the wires are arranged so as to prevent injury insulation.

The large drygoods firm of J. N. Adams & Co., of Buffalo, had an "opening" all of last week and was brilliantly illuminated by one hundred Ward arc lamps, manufactured by the Electric Construction & Supply company of New York.

N. L. Schloss, manager of the New York office of Thos. H. Dallett & Co., manufacturing Billberg motors and generators, is about to sever his connection with the company. Mr. Schloss is well-known in the electrical trade in New York.

J. C. Knight, of the Electric Construction & Supply company of New York, returned last week from a short trip to Boston and vicinity, at which place he closed a contract with the West End Street Railway company and Edison Illuminating company for a number of Ward lamps.

To describe in the manner it deserves the new catalogue just issued by the Brush Electric company of Cleveland, one should have served at least a short apprenticeship as an art critic. This compilation is indeed a most creditable one, and is indicative of good taste alike on the part of the Brush company and the compiler, Will H. White.

The Crown Electric Manufacturing company of Bridgeport, Conn., is about to place on the market a socket that is simple in construction, strong and compact. The company reports a brisk business for the Crown socket, which they shipped in large quantities last week to New Orleans, Cincinnati and many western cities. The company recently secured the Eastern Electric Supply company of Boston, to handle the socket for the New England states.

There is no question but that copper was tempered by the ancients, as samples of edge tools and relics of all

kinds composed of pure copper have been found. The Eureka Tempered Copper company of North East, Pa., claims that it has discovered a method of tempering its product and is able to supply the trade with any and all kinds of copper cast solid, and tempered to any gauge that may be demanded. This company's bars are highly recommended by a number of electrical firms.

For a year and a half the Standard Paint company of New York has been selling what is known as the Livingston compound for insulating wire and cable. This compound has been adopted by several of the largest wire and cable manufacturers in the world. It has no offensive odor, is waterproof, and a good insulator. The Standard Paint company is still manufacturing P. & B. insulating compounds, which are thoroughly water, acid and alkali proof, used largely for general insulating purposes and painting moulding.

The Westinghouse Electric & Manufacturing company has established its Chicago offices at 106 Pullman Building, with Geo. O. Fairbanks as manager of the Chicago agency. The Chicago offices of the Sawyer-Man Electric company and the United States Electric Lighting company will also be in the same offices and under the same management. Mr. Fairbanks will have charge of the railway as well as the lighting and power business of the company, and he will be assisted in the territory tributary to Chicago by B. F. Stewart, J. H. Gates, T. W. Burroughs, C. S. Cook and E. Dryer.

After all is written and said about the new catalogue of the Electrical Supply company, Chicago, the strongest encomium, to their taste, is the response of the trade in orders. This, more than all else, is a recompense for the time and money expended in the publication. All the kind and generous things said have reached the heart (if corporations have souls they must have hearts) but the orders reach the pocketbook and unmistakably indicate that this catalogue of electric light and power supplies has found a warm place in the hearts of station managers and buyers generally. This is the company's third catalogue within the year, the other two being the electric railway catalogue number 31, and the house goods catalogue number 44.

BUSINESS.

The Marion Manufacturing company has recently established an office and factory at 31 South Canal street, Chicago, for the manufacture and sale of electric specialties.

By this time the trade has received the new general catalogue of Worthington pumping engines, steam pumps and other hydraulic machinery. This compact and handy little pamphlet was issued April 1st.

The "Perfect battery excitant" is furnished with all cells made by the Fitch Battery & Electric company, Oneida, N. Y. A trial of this new excitant will doubtless lead to an indorsement of the manufacturer's claim that the Perfect excitant is destined to supersede to a large extent sal-ammoniac.

Those who wish to know something definite as to what are the properties of pure aluminum, and also of the alloys, should drop a line to the Cowles Electric Smelting & Aluminum company, Lockport, N. Y. This company has just issued a neat little pamphlet that is well worth reading.

The Crowell Clutch & Pulley company of Westfield, N. Y., reports a lively spring trade. The claims made for the friction clutch pulleys manufactured by this concern are simplicity, strength and ease of adjustment, large friction surfaces, small number of parts, and the occupancy of a small space on the shaft.

The Union Electric Works, 205 South Canal street, Chicago, are making extensive arrangements for the manufacture of the Crowdus battery and motor, and hope to have a full line ready for the market not later than June 1st. This company has just issued a new pocket catalogue that is very complete and attractive.

C. A. Daigh of the National Electric Manufacturing company, Eau Claire, Wis., spent several days last week at his Chicago office in the "Rookery." Mr. Daigh, since he assumed charge of the National company's affairs, has made a number of changes in the service, and reports the outlook for business as being very bright.

An office for the Chicago Motor company has been opened in Club Room 10, Grand Pacific Hotel, Chicago, and the factory removed from the Springer building to the new Standard building, on South Canal street. Additional capital has been secured, and with unexcelled facilities this company is placed in the front rank as manufacturers of electric apparatus.

The Ball & Wood company, New York, since the shipment of its first improved Ball high speed engine, in October last, has been running twenty-four hours each day to keep up with its orders, and now has between twenty and thirty engines on the floor under construction. Important additions to the company's works are in contemplation. The company reports many large shipments during the last few weeks.

While work is being done on a very handsome permanent office and salesroom, the Railway Equipment company will occupy No. 11 Adams street, well known as the former headquarters of the Electric Merchandise company. For a short time the new company has had temporary offices in the Pullman building, but from this on until the permanent rooms are ready, Mr. Mason can be found at the number indicated.

The Laramie Electric Gas Light & Fuel company, of Laramie, Wy., has placed a contract with the St. Louis office of the Pond Engineering company, for enlarging and remodeling its steam plant. A new steel boiler of 128 horse power capacity, with stack, rocking grates, and improved furnace, will be installed. The three old boilers of 70 horse power capacity each will also be provided with rocking grates and improved boiler settings.

The Mosher Electric Manufacturing company, Chicago, recently received an order for two arc lamps for an incandescent circuit from the Helsingfors Electric Lighting company, limited, of Helsingfors, Finland, Russia. The order was dated January 15th, and the lamps have just been forwarded by express. The Mosher lamp is now burning in Canton, China, in different cities in all of the European countries, in South and Central America, and in fact in nearly every country on the globe.

According to the Buffalo *Courier* the Tonawanda Electric Railway company is negotiating with the Pullman company for the purchase of a number of double deck cars for use as trailers in the summer time. It is expected that thousands of people will patronize the road in the summer season for pleasure, and find much enjoyment in riding on the double deck cars and camping and picnicking in the numerous groves along the route. The groves will be trimmed for the occasion and facilities arranged for picnic parties. Connection will be made with the Grand Island ferry, and a considerable travel to and from the island is expected.

The Bryant Electric company of Bridgeport, Conn., has secured the Paiste single-pole switch and the K. W. cut-outs. W. C. Bryant was in Chicago last week completing arrangements for the establishment of a branch in Chicago, in order to facilitate shipments and give the western territory more attention. Thos. G. Grier, who has conducted the Paiste business in the West for the past year will manage the western business for the Bryant Electric company, with offices and storeroom in the Monadnock building. A complete line of the company's specialties will be kept in Chicago, and customers can rely upon having orders filled promply. A large consignment of Paiste single-pole porcelain base switches, both five and ten amperes, has recently been received, and other large shipments are on the way. Mr. Grier is popular with the trade, and he will no doubt handle the Bryant business successfully.

W. C. McKinlock, well known through his connection with the Central Electric company, Chicago, and later, as general manager of the Southern Electric Supply company, St. Louis, has organized a new electric supply house with office and salesroom at 313-315 Dearborn street, Manhattan building, Chicago, to be known as the Enterprise Electric company. Mr. McKinlock organized the St. Louis company some four years ago, and has been largely instrumental in building up a business that is highly creditable to his sagacity and energy. Associated with Mr. McKinlock in the new company as incorporators are F. P. Hill, late of the Southern company, St. Louis, and W. F. Richardson, who has recently left the employ of the Central Electric company, Chicago. It is understood that Mr. Hill will be elected secretary of the new corporation. The local agency for Kerite wire has been secured, and it is expected that other valuable contracts will be closed at an early day. While the promoters of this new enterprise are all young men, each one is familiar with some branch of the electric supply business, and it is their belief that another strong company can be built up in Chicago.

ELECTRICAL PATENTS.

Issued May 3, 1892.

483,911. Telephone Exchange Apparatus. John J. Carty, New York, N. Y.

Consists of a metallic circuit telephone line, including the differential coils of the telephone and transmitter-inductorium of a subscriber's station, with a key for closing the line at the center of the coils of the telephone to ground, and a branch from the line to ground through a circuit-closing device and a battery.

473,923. Solenoid and its Electrical Connections. Henry H. Hosford, Cleveland, O.

A solenoid so connected that the position or sign of the poles may be changed without making and breaking the energizing current.

473,932. System of Electrical Conductors. Charles J. Kintner, New York, N. Y.

One end of the system connected to the pole of the generator and passing through an insulating conduit. House mains are tapped from this line, the current returning and passing to ground by a concentric conductor. Other pole of generator connected to ground.

473,955. Electric Arc Lamp. Charles A. Pfluger, Chicago, Ill.

A gravity feed arc lamp.

473,956. Electric Arc Lamp. Charles A. Pfluger, Chicago, Ill.

473,960. Electric Clock Motor. Anthony Reckenzaun, Stockwell, England.

A motor to produce constant motion upon a spindle.

473,966. Telephone Switch. Charles E. Scribner, Chicago, Ill.

Consists of a battery placed in the circuit of the connecting cords at the central office, an electro-magnet at each of the subscriber's stations, the armatures of which operate switch levers, as the circuit of the battery is closed to line.

473,975. Electrical Annunciator. Frederick W. Steeg, St. Paul, Minn.

474,001. Station Indicator. James H. Dean, Minneapolis, Minn.

A paper sign strip is rolled from one roller to another by means of a motor, the action of the motor being controlled by the striking of a lever upon a lug on one of the rails of the railroad.

474,003. Electric Lamp Hanger. Elbert Dills, Sprague, Wash.

474,008. Apparatus for Maintaining Constant Speed in Motor Mechanisms. John W. Gibboney, Lynn Mass.

474,031. Mode of Arresting Electric Locomotives. Sidney H. Short, Cleveland, O.

The current is switched off from both motors, and owing to the difference in the residual magnetism of their fields (as no two motors have the same residual magnetism), the field polarity of the weaker motor is reversed and it operates as a motor to run the car backward by the current supplied by the more powerful motor acting as a generator.

474,037. Trolley Wire Circuit Breaker. Johan M. Andersen, Boston, Mass.

474,049. Insulating Support for Electric Railway Wires. Abraham A. Shobe and William Embley, Jerseyville, Ill.

An insulating standard, to which the trolley is attached, sliding upon an insulating bracket, attached to the side of the conduit, to permit of the use of jointless trolley wires in conduit systems.

474,050. Electric Switch. James J. Wood, Fort Wayne, Ind.

474,067. House Telephone System. Charles E. Scribner, Chicago, Ill.

A battery having each of its poles carried to each of the different stations and so arranged that one station may signal to another for telephonic communication.

474,073. Electric Resistance Box. Aloys Wirsching, New York, N. Y.

474,091. Electric Arc Lamp. William B. Luce, Brookline, Mass.

A single magnet serves the double purpose of lifting-magnet and feed-magnet.

474,139. Heat Regulating Device. Alfred B. Morse, Easton, Mass.

474,140. Thermostat. Alfred B. Morse, Easton, Mass.

474,149. Thermostat. Lewis G. Rowand, Camden, N. J.

474,165. Regulator for Dynamos and Motors. William H. Elkins, Boston, Mass.

Consists of an arrangement of three brushes on a side so connected to the terminals that the electromotive force of each terminal may correspond with the electromotive force of either one of the three brushes, or by means of a variable resistance may be graduated to any electromotive force between those of the brushes then in contact.

474,166. System of Electrical Distribution. William H. Elkins, Cambridge, Mass.

Consists of two sets of brushes and two independent circuits, supplied with current from the same armature.

474,169. Regulating Propellers of Vessels. Adolph Hellinger, St. Louis, Mo.

474,214. Telephone Receiver. Arthur T. Collier, Caterham Valley, England.

474,218. Conduit Trolley. James J Cosgrove, Jr.

474,230. Speaking Telegraph. Thomas A. Edison, Menlo Park, N. J Assignor to the Western Union Telegraph company, New York, N. Y. Filed April 27, 1877. (Model.) Patented in England July 30, 1877, No. 2,909; in Canada Oct. 20, 1877, No 8,026; in France Dec. 19, 1877, No. 121,687; in Belgium Jan. 11. 1878, No 43 984; in Austria Hungary Jan. 15, 1878; in Italy Jan. 19, 1878 No. 9 791; in Germany Jan. 23. 1878, No. 14 308; in Spain May 6, 1878, and in Russia Feb. 15-27, 1882, No. 1,161.

474,231. Speaking Telegraph. Thomas A. Edison, Menlo Park, N. J. Assignor to the Western Union Telegraph company, New York, N. Y. Filed July 20, 1877. (Model.) Patented in England July 30, 1877, No. 2,909; in Canada Oct. 20, 1877; No. 8,026; in France Dec. 19, 1877, No. 121,687; in Belgium Jan 11, 1878, No. 43 984; in Austria-Hungary Jan. 15, 1878; in Italy, Jan. 19. 1878. No 9,791; in Germany Jan. 23, 1878, No. 14,308; in Spain May 6, 1878, and in Russia Feb. 15-27, 1882, No. 1,161.

474,232. Speaking Telegraph. Thomas A. Edison, Llewellyn Park, N. J. Assignor to the Western Union Telegraph company, New York, N. Y. Original application filed July 20, 1877. Divided and this application filed Feb. 18, 1886. Serial No. 192,456. (No model.) Patented in England July 30, 1877, No. 2,909; in Canada Oct. 20, 1877, No. 8,026; in France Dec 19, 1877, No. 121 687; in Belgium Jan. 11, 1878, No 43 984; in Austria Hungary Jan. 15, 1878; in Italy Jan 19 1878, No. 9 791; in Germany Jan. 23, 1878. No. 14,308; in Spain May 6 1878, and in Russia Feb. 15-27, 1882, No. 1,161.

474,266. Electric Arc Lamp. Alfred L. Shepard, London, England.

474,291. Torpedo Launching Apparatus. Jean B. G A. Canet, Paris, France.

Consists of a spring actuated lever for operating the firing mechanism and a spring retaining catch for the lever, operated by the armature of an electro-magnet.

474,319. Insulator. Charles F. Goodrich, Chicago, Ill.

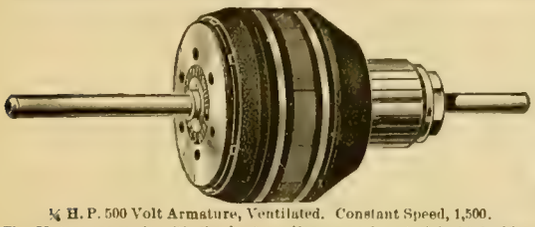
494,323. Telephone Circuit. Hammond V. Hayes, Cambridge, Mass.

474,328. Electric Motor Mechanism. Samuel E. Mower, New Haven, Conn.

474,331. Bicycle Electric Car. Eben M. Boynton, West Newberry, Mass.

The car is so suspended from the motor that it is entirely independent of the same, permitting the latter to undulate without compelling the car to partake of the undulation.

CROCKER-WHEELER ELECTRIC COMPANY,



SLOW SPEED MOTORS.

¼ H. P. 500 Volt Armature, Ventilated. Constant Speed, 1,500.

The Motors are made with the best appliances and material obtainable, and embody every improvement of merit, with the intention that they shall be the Standard of their class.

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Offices, Covington, Ky. Factories, Muncie, Ind.

STANDARD SCREW GLASS INSULATORS,

Glass Break Knobs, Floor Insulators, Battery Jars.

ARC LIGHT GLOBES FOR ALL SYSTEMS.

WORK ON SPECIAL DESIGNS SOLICITED.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

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61 to 65 Hampshire Street, BOSTON, MASS.

HENRY A. CLARK, Treasurer and Gen'l Manager.

HERBERT H. EUSTIS, President and Electrician.

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"Crescent" Overhead Line Wire. It will Surprise You.

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MANUFACTURERS OF ALL KINDS OF

SEAMLESS RUBBER WIRES AND CABLES,

FACTORY AND MAIN OFFICE, TRENTON, N. J.

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ALL SIZES AND QUALITIES

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WANTED.

A young man with thoroughly practical knowledge of the Electrical business, now manager of the New York office of a well known electrical company, desires a change with a view to New York representation. Can furnish best of references.

Address "**L**," care WESTERN ELECTRICIAN.

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An experienced armature repairer and winder for Edison, Western Electric and Excelsior Dynamos, and Sprague and Eddy Motors. Address

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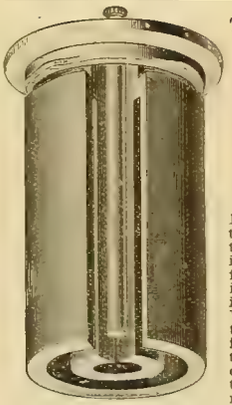

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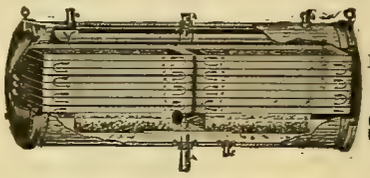

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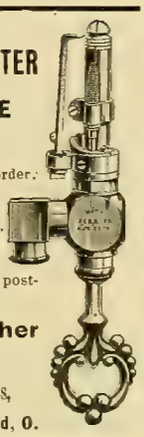

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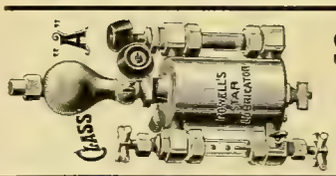

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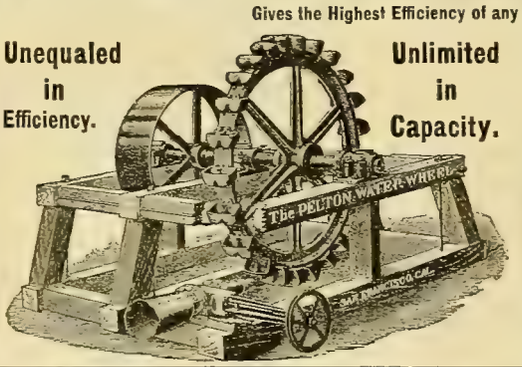

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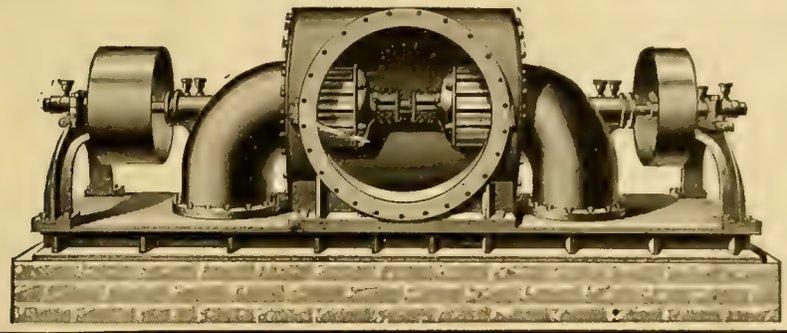

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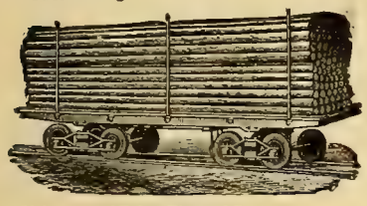

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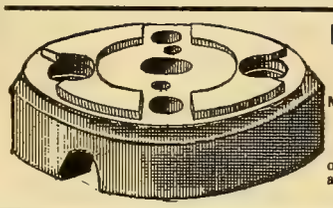

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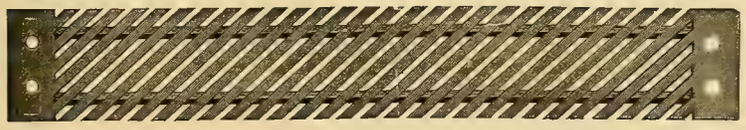

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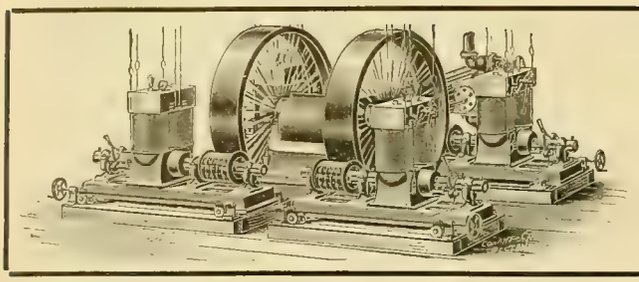

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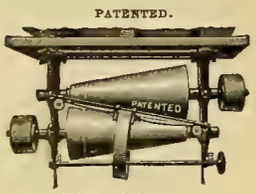

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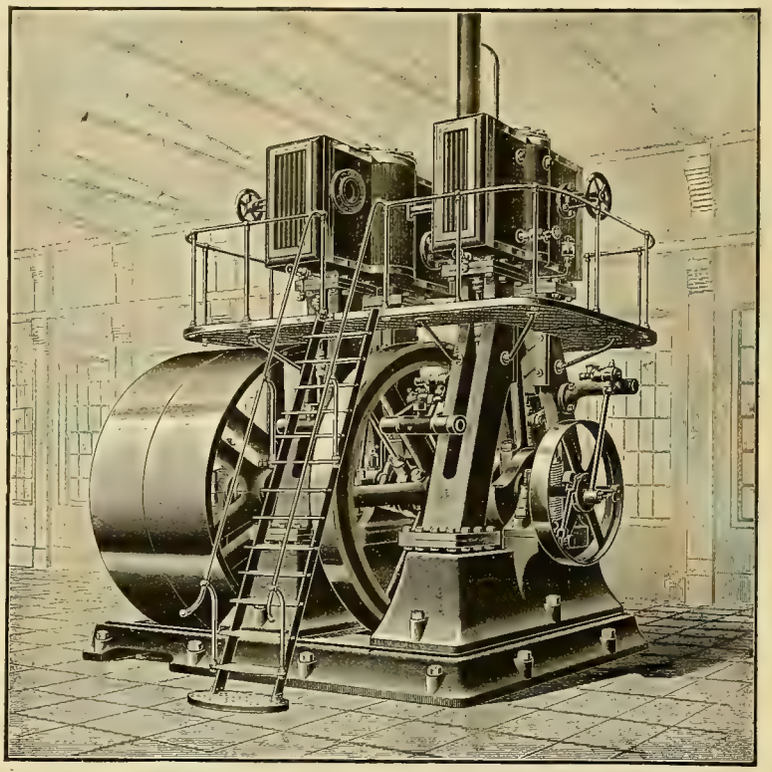

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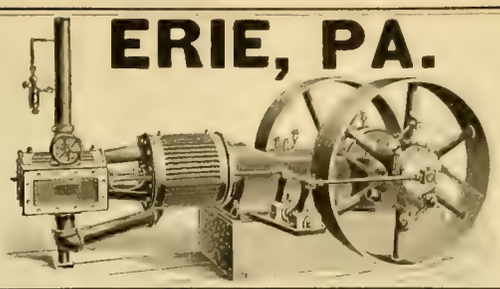

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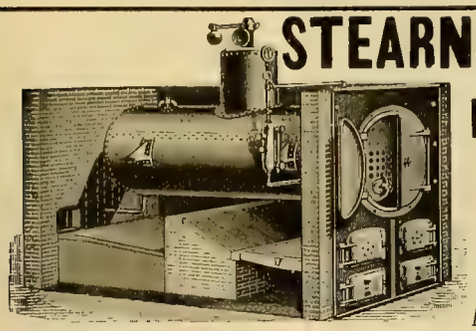

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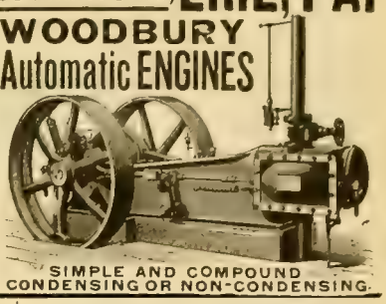

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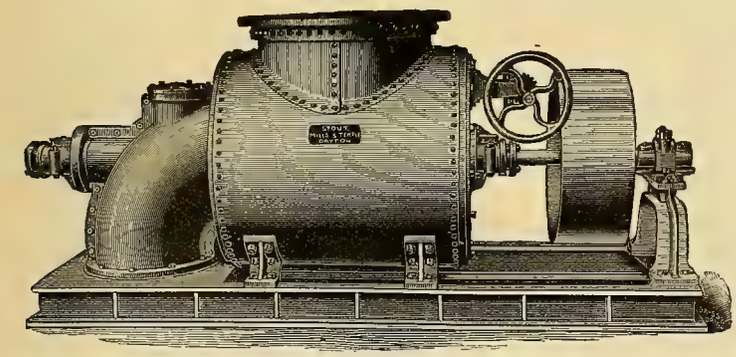

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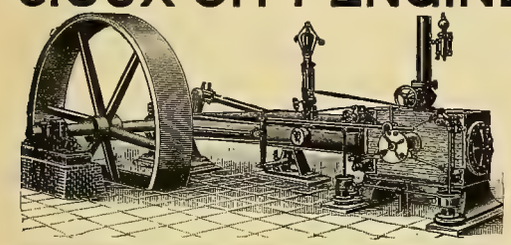

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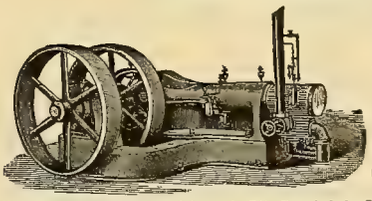

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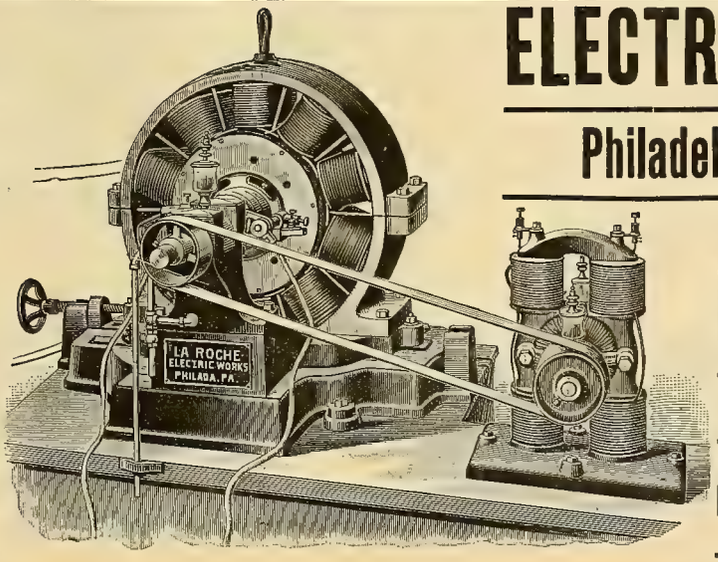

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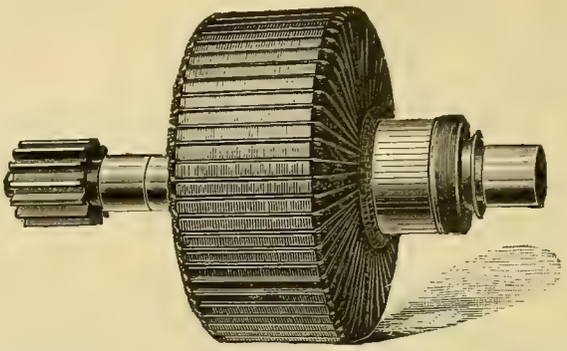

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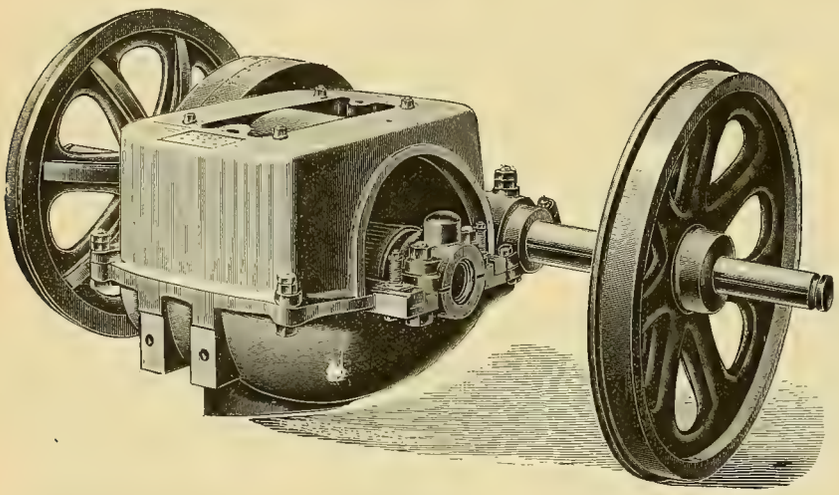

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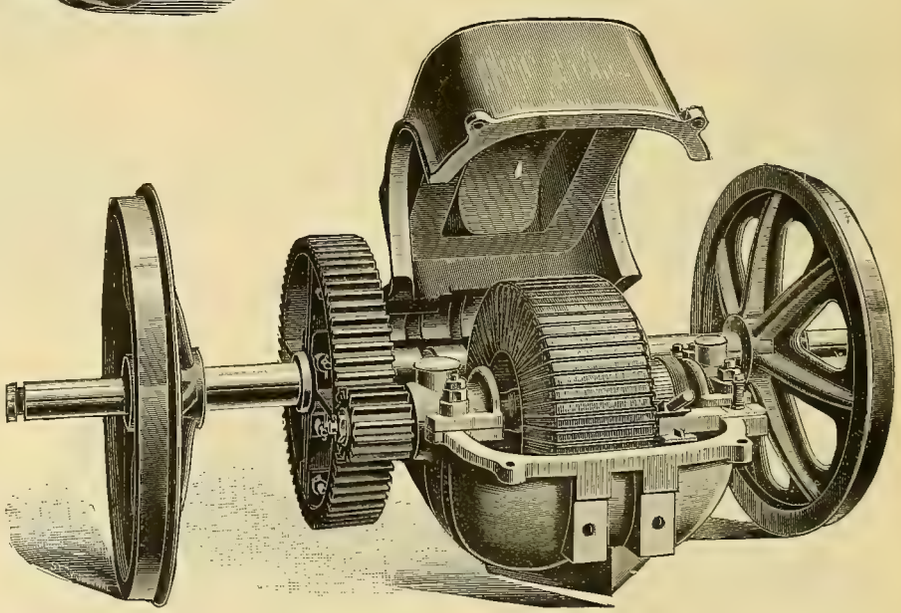

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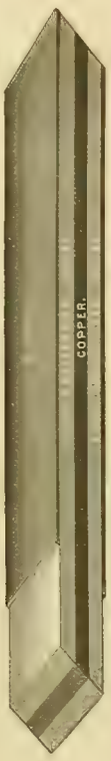

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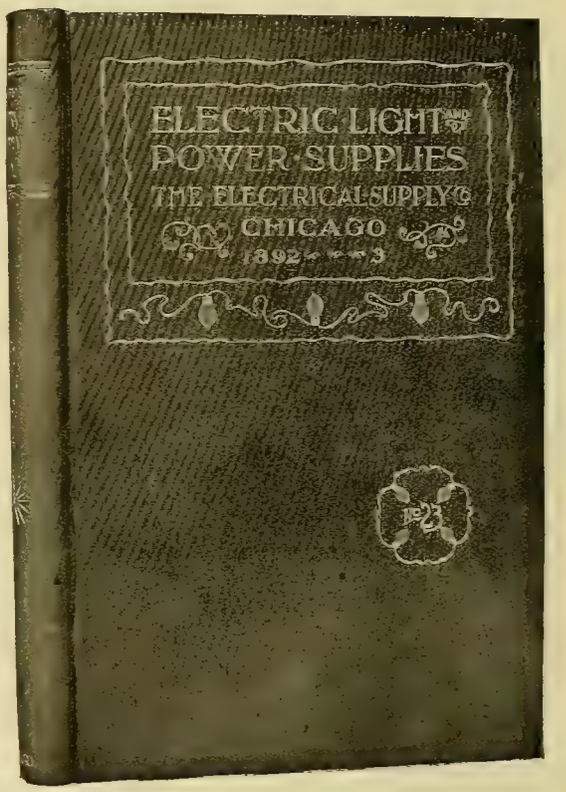

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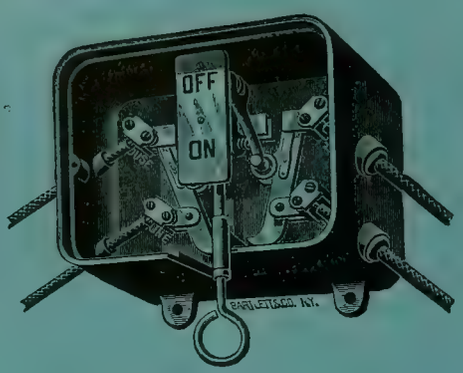

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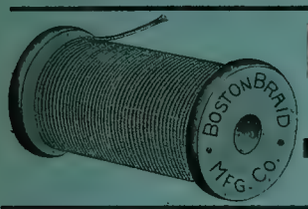

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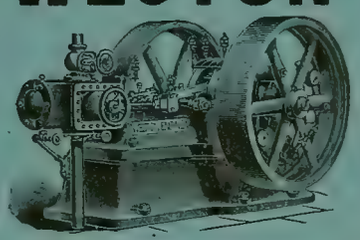

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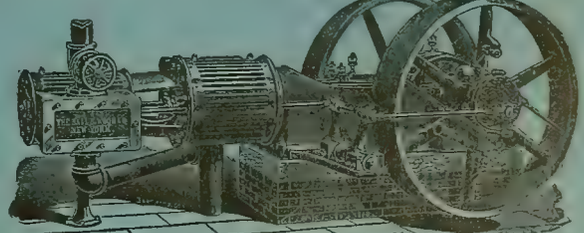

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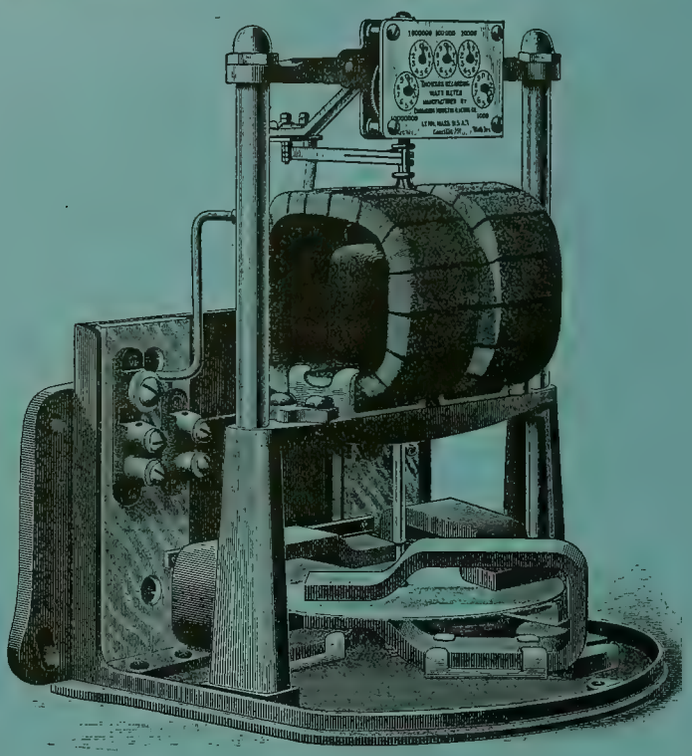

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Detroit Electrical Works.
Electric Gas Lighting Co.
Electrical Construction Co., The
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co. W. R.
Partrick & Carter Co.

Arc Lamps.
Beggs, J. E., Mchy. & Supply Co.
Brush Electric Co.
Duplex Electric Co., Ltd.
Easton Electric Co.
Electric Cons. & Supply Co.
Fort Wayne Electric Co.
Great Western Elec. Supply Co.
Rose Electric Light Supply Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Knapp Electrical Works.
Samson Cordage Works.

Batteries.
Central Electric Co.
Detroit Electrical Works.
Electric Gas Lighting Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Hirlimann, C. J.
Law Telephone Co.
Partrick & Carter Co.
Premier Electric Co., The.
Pumpelly, J. K.
Western Electric Co.

Battery Jars.
Central Electric Co.
Detroit Electrical Works.
Electric Gas Lighting Co.
Electrical Supply Co., The.
Hemingray Glass Co.
Hirlimann, C. J.
Law Telephone Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Detroit Electrical Works.
Electric Gas Lighting Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Detroit Electrical Works.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Chicago Rawhide Mfg. Co.
Jewell Belting Co.
Link Belt Machinery Co.
Page Belting Co.
Shultz Belting Co.

Boilers.
Lane & Bodley Co., The.
Stearns Mfg. Co.
Weston Engine Co.

Books, Electrical.
Electrician Publishing Co.

Brass Goods.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cross-Arms.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Lond, H. M. & Sons Lumber Co.
Railway Equipment Co.
Schindel & Schindel.

Cables, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Roeblings Sons Co., J. A.
Western Electric Co.

Clutches, Friction.
Falls Rivet & Machine Co.
Hill Clutch Works.
Lake, J. H. & D.

Cordage.
Samson Cordage Works.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Washington Carbon Co.
Western Electric Co.

Construction and Repairs.
Andrae, Julius.
Chicago Electric Motor Co.
Electric Cons. & Supply Co.
Electrical Construction Co., The.
Knapp Electrical Works.
Rae, Frank B.
Smith, Thos. G. Jr.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
American Engine Co.
Ball Engine Co.
Ball & Wood Co., The.
Brush Electric Co.
Detroit Electrical Works.
Diamond Electric Mfg. Co.
Edison General Electric Co.
Electric Cons. & Supply Co.
Electrical Eng. & Supply Co.
Falls Rivet & Machine Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Keller & Degenhardt.
Lake Erie Engineering Works.
Lane & Bodley Co , The.
La Roche Electric Works.
Morse & Co., A. M.
Pearson & Co., W. B.
Racine Hardware Mfg. Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Short Electric Railway Co.
Sioux City Engine Works.
Smith, Thos. G. Jr.
Taylor Engine Co.
Thomson Houston Electric Co.
Waddell-Entz Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Weston Engine Co.
Williams Engine Works.

Copper Wires and Tapes.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cutter, Geo.
Detroit Electrical Works.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Roebling's Son's Co., J. A.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cut-Outs and Switches.
Andrae, Julius.
Bryant Electric Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Electric Engineering & Supply Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Perkins Elec. Switch Mfg. Co.
Star Electrix Co.
Van Nuis, C. S.

Dynamos.
Brush Electric Co.
Detroit Electrical Works.
Diamond Electric Mfg. Co.
Duplex Electric Co., Ltd.
Easton Electric Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
La Roche Electric Works.
Lovell Mfg. Co., Ltd.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Rose Electric Light Supply Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Waddell-Entz Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Lava Gas Tips.
Smith, A. T.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Rae, Frank B.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical and Mechanical Engineers.
Pierce, Josiah Jr.
Rae, Frank B.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
La Roche Electric Works.
Queen & Co.
Western Electric Co.

Electrical Specialties.
Andrae, Julius.
Bryant Electric Co.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Electric Engineering & Supply Co.
Fletcher & Fletcher Electric Co.
Hussey & Co.
Ries Electric Specialty Co.

Electrical Intelligence.
Keller & Degenhardt.
Rae, Frank B.

Elevators.
Link Belt Machinery Co.

Engines, Steam.
American Engine Co.
Ball Engine Co.
Ball & Wood Co., The.
Lake Erie Engineering Works.
Lane & Bodley Co.
Morse & Co., A. M.
Pearson & Co., W. B.
Racine Hardware Mfg. Co.
Smith, Thos. G. Jr.
Sioux City Engine Works.
Stearns Mfg. Co.
Taylor Engine Co.
Weston Engine Co.
Williams Engine Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.

Fan Outfits.
Chicago Electric Motor Co.
Edison General Electric Co.
Emerson Electric Mfg. Co.
Premier Electric Co., The.
Stanley Electric Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Furnace Grate Bars.
Kelly Bros.

Fuse Wire.
Electrical Supply Co.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

Gas Lighting, Electric.
Detroit Electrical Works.
Electric Gas Lighting Co.
Fletcher & Fletcher Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.

General Electrical Supplies.
Andrae, Julius.
Bryant Electric Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Cons. & Supply Co.
Electric Engineering & Supply Co.
Electric Gas Lighting Co.
Electrical Eng. & Supply Co.
Electrical Supply Co., The.
Fletcher & Fletcher Electric Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Western Electric Co.

Globes and Electrical Glassware.
Brookfield, Wm.
Hemingray Glass Co.
Phœnix Glass Co.

Graphite Specialties.
Dixon Crucible Co , Jos.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Andrae, Julius.
Brookfield, Wm.
Bryant Electric Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Cushing, F. W.
Edison General Electric Co.
Electric Gas Lighting Co.
Electric Engineering & Supply Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Hemingray Glass Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Johns Mfg. Co , H. W.
Kartavert Mfg. Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Partrick & Carter Co.
Railway Equipment Co.
Standard Paint Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables, Magnet Wire.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing, F. W.
Cutter, Geo.
Day's Kerite Insulation.
Detroit Electrical Works.
Eastern Electric Cable Co.
Edison General Electric Co.
Electric Gas Lighting Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
New York Insulated Wire Co.
Roebling's Sons Co., J. A.
Sperry Elec. Mining Machine Co.
Waddell-Entz Electric Co.
Western Electric Co.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Edison General Electric Co.
Electric Engineering & Supply Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Co.
Illinois Electric Lamp Co.
Knapp Electrical Works.
New York and Ohio Co.
Sawyer-Man Electric Co.
Somoff, J. L.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Mechanical Machinery.
Ferracute Machine Co.

Medical Batteries.
Detroit Electrical Works.
Partrick & Carter Co.

Mica.
Bowers Bros.
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mine Signals, Electric.
Detroit Electrical Works.

Mining Apparatus, Electric.
Edison General Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

Motors.
Brush Electric Co.
Crocker-Wheeler Electric Co.
Chicago Electric Motor Co.
Detroit Electrical Works.
Diamond Electric Mfg. Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Eng. & Supply Co.
Emerson Electric Mfg. Co.
La Roche Electric Works.
Lovell Mfg. Co., Ltd.
Porter Leavitt Electric Motor Co.
Premier Electric Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Thomson-Houston Electric Co.
Waddell Entz Electric Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Becker Mfg. Co., John.

Office Furniture.
American Desk & Seating Co
Andrews & Co., A. H.

Oil Cups.
Powell Co., The Wm.

Oil Purifiers.
Gravity Purifier Co.

Pins and Brackets.
Central Electric Co.
Electrical Supply Co., The.
Loud, H. M. & Sons' Lumber Co.
Railway Equipment Co.
Schindel & Schindel.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co., The.
Lefmann, Julius.
Loud, H. M. & Sons' Lumber Co.
Milliken Bros.
Railway Equipment Co.
Schindel & Schindel.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Detroit Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co.

Securities, Electrical.
Perry & Noyes.

Separators, Steam.
Hine Eliminator Co.

Silk Braid.
Boston Braid Mfg. Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway.
Detroit Electrical Works.
Johns Mfg. Co., H. W.
Railway Equipment Co.
Schindel & Schindel.

Tapes, Insulating.
Andrae, Julius.
Central Electric Co.
Cushing, F. W.
Crescent Ins. Wire & Cable Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Standard Paint Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Detroit Electrical Works.
Western Electric Co.

Test Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.

Transformers.
Diamond Electric Mfg. Co.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Detroit Electrical Works.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Stilwell & Bierce Mfg. Co.

Typewriters.
Densmore Typewriter Co.

Universities.
Institute of Technology.

Water Wheels.
Leffel & Co., The Jas.
Pelton Water Wheel Co.

Wire, Bare.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Railway Equipment Co.
Roebling's Sons' Co., J. A.
Sperry Elec. Mining Machine Co.

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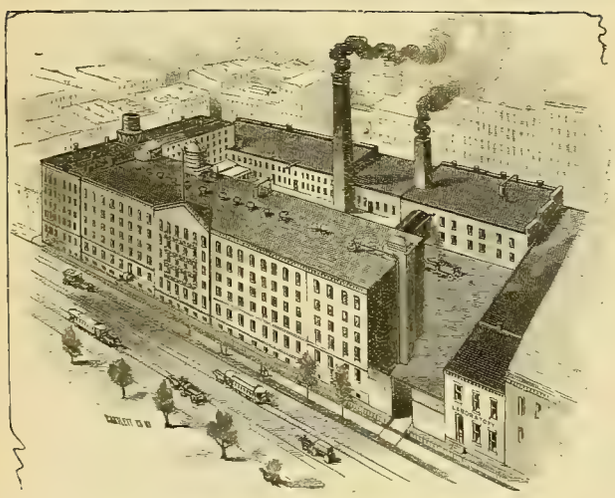

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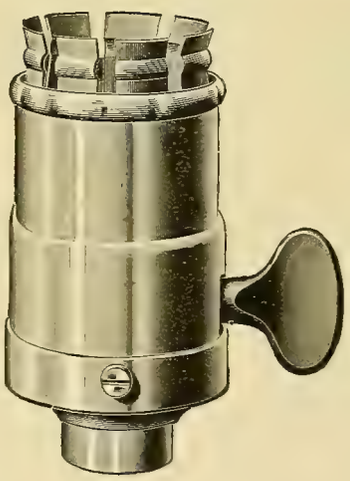

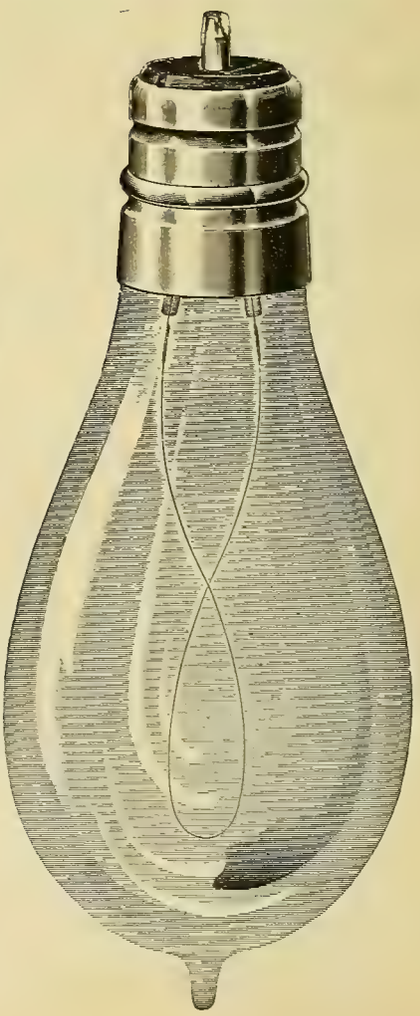

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We have about 150 cells 300 ampere hour Pumpelly Storage Batteries with rubber jars. Some of these batteries have been used a short time, and some not at all. We will dispose of them in a lot, or to suit, at less than the cost of the material. Good for experimental use, etc.

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TO THE ELECTRICAL TRADE:

GENTLEMEN:—As the "Samson" (French) Battery, owned and handled by this Company in the United States, broadens into greater success and value, it is, perhaps, not surprising that unprincipled parties should try to imitate it. Seldom, however, can commercial men be found so low down in the scale of respectability as to **DARE TO ANNOUNCE THEIR PIRACY** of a patented and labeled article, specially belonging to another.

There is one concern, however, slightly known as the Peru Glass and Carbon Co., somewhere out in Indiana, which has attempted an imitation of the **SAMSON** Battery and its regular label, upon which a vulgar picture of "Hercules" is printed, thus appropriating a name which is the property of still another concern. This Peru concern at first pronounced this production "identical with the **SAMSON,**" in fact, **CALLED IT THE SAMSON,** but for some reason ***has since decided that no label is necessary.*** This is the form of its written notice to persons in the trade:

"We have just worked out a new battery we call the Hercules, which is identical with the Samson, with the exception that "we have made quite an improvement on the cover of the jar, by an ingenious device that holds the carbon from the bottom of the jar."

In view of this outrage, we beg to announce:

This "Hercules" Battery, so called, sent out by the above named concern, is not in any respect of value or efficiency **THE SAMSON**; it is only a gross pretension and a deceptive imitation, calculated to deceive the trade ***by adopting the appearance*** of **THE SAMSON.** In proof of its inferiority, note the following comparative assertions by Prof. A. E. Dolbear of Tufts College, and by Prof. C. F. Brackett of the College of New Jersey:

RESPECTFULLY,

COPY.

COLLEGE HILL, March 26, 1892.

. . . . From all this I conclude that for sustained service, recovery after service, and electrical output, the SAMSON cell is superior to the Hercules; indeed, I know of no ammonium chloride cell that approaches the SAMSON in desirable qualities. Respectfully submitted, A. E. DOLBEAR.

P. S —After twenty four hours' rest I find the electromotive force of the Hercules to be 1.23 volts and the SAMSON 1.40 volts.

It will be seen that the latter had fully recovered. A. E. D.

COPY.

College of New Jersey, Dept. of Electrical Engineering.
PRINCETON, N. J., April 19, 1892.

. . . . I hand you herewith the curves showing the results of the tests. The curves in question are the upper ones on the sheet and are marked $S\frac{F}{V}$ and $H\frac{F}{V}$ respectively.

. . . . An inspection of the current curves will show the decided superiority of the SAMSON as respects output. . . . It appears from the foregoing details that the Samson cell is in every way greatly superior to the Hercules. It has much less internal resistance, a much greater sustaining power as respects voltage, consequently it affords a much greater current, and this through a very much longer time, and lastly, its power of recovery is very much greater. Indeed, I know of no open-circuit battery cell which can compare with it. C. F. BRACKETT.

BEWARE!

Of the deceptive and worthless imitations of the SAMSON Battery! They may look some like the GREAT SAMSON, but possess none of its superior qualities. One genuine imported SAMSON cell will, in actual work, out-wear half a dozen cheap imitations.

The Electric Gas Lighting Co., Boston, Mass.

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(You may thank us for it), and indications are it will soon fall apart, each fellow pulling for himself. Then

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Electrical Supply & Construction Co.,
917 Liberty St., Pittsburgh.

Standard Electrical Works,
161 W. Pearl St., Cincinnati.

Central Electric Co.,
116 Franklin St., Chicago.

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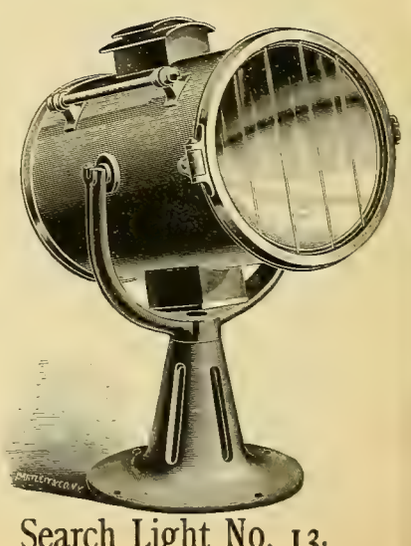

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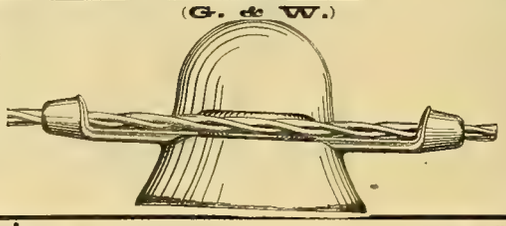

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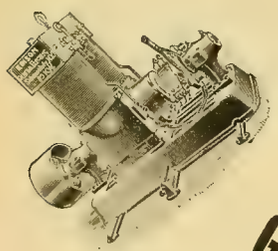

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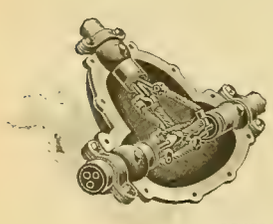

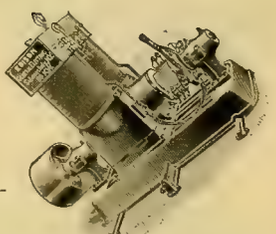

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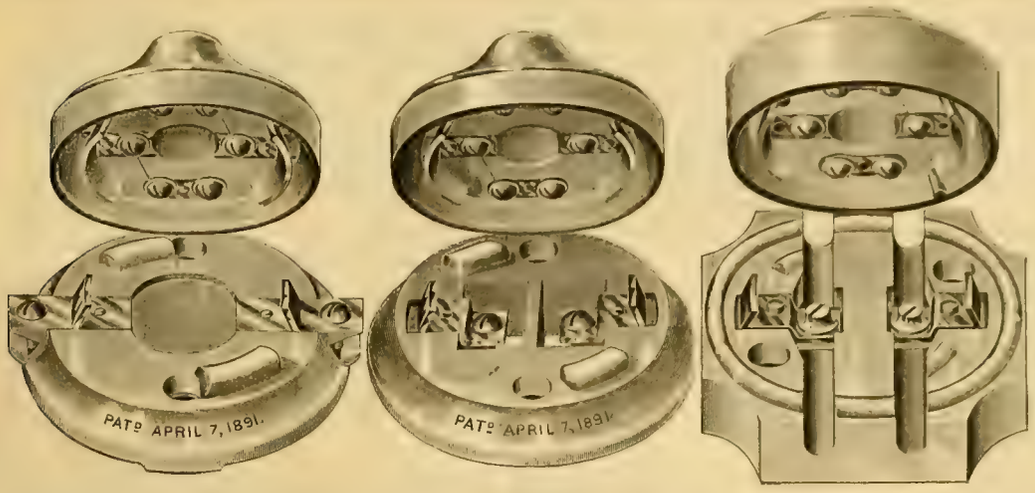

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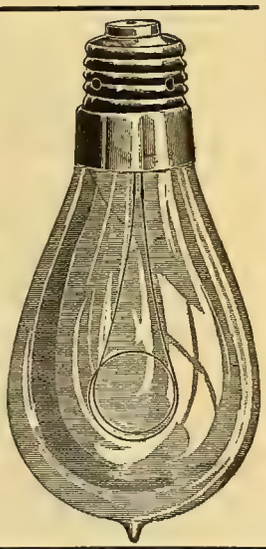

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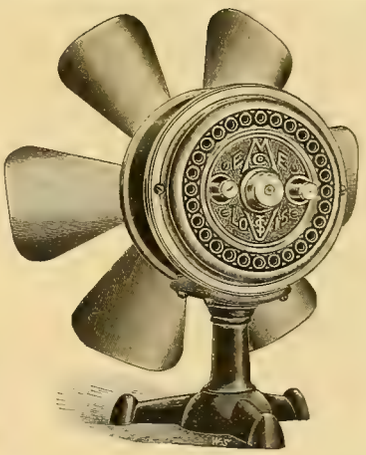

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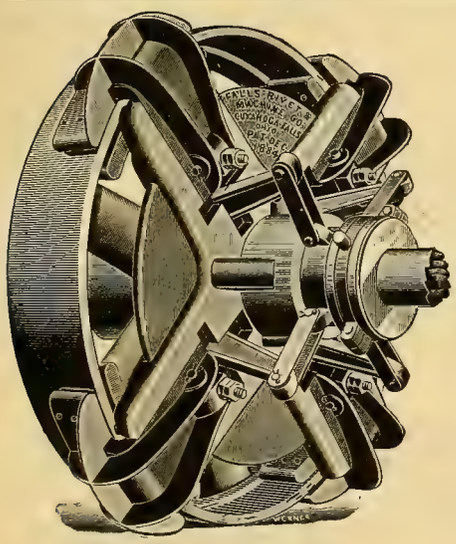

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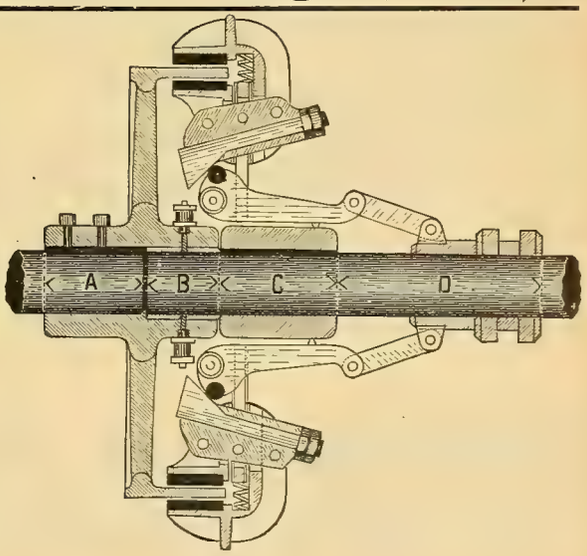

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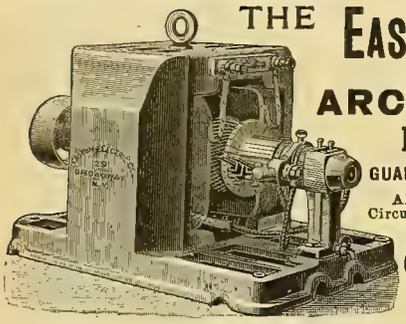

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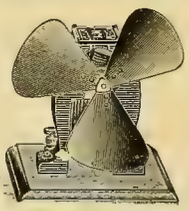

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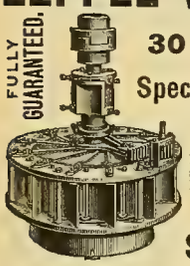

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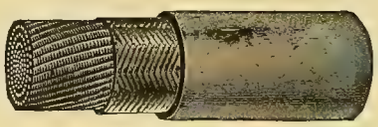

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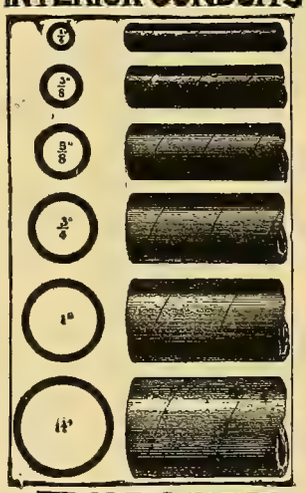

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NOTICE!!!

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We call the attention of users of electric railway and lighting apparatus to the attempts being made by the Edison-Thomson-Houston electric combination, or Trust, to secure, by threat and otherwise, a monopoly of the electric lighting and power business, which they are not entitled to, and cannot secure by means of their patents. If they could succeed in frightening users into entering into contracts binding them to take only the apparatus supplied by the Trust, then such users would be subject to a contract, which they might have some difficulty in setting aside.

A proposed contract submitted by the Trust to one of our customers indicates that they intended to bind such customer to use exclusively apparatus manufactured by the Trust, and on such terms and for such prices as the Trust might name from time to time; and it is a fair presumption that the Trust would exact a margin of profit greatly above what is generally considered a fair manufacturing profit, in order to pay dividends on their immense capitalization (fifty million dollars capital stock, ten millions of which is preferred) and the interest on the proposed issue of ten millions of bonds.

The users of electric lighting and power apparatus, however, by refusing to purchase, except upon the terms and conditions on which they ordinarily purchase machinery, i. e., with the right to go into the open market unhampered to purchase their future supplies, or repairs, or alterations (as they should do), will always be free to select the best apparatus and details.

The Westinghouse Electric & Manufacturing Company sells all of its apparatus and makes all of its contracts on the above basis, and has never done otherwise, relying for future sales upon the merit of its apparatus.

We suggest the following as worthy of your careful consideration:

1. Enter into no contract with any electric light or power company except with respect to each purchase, and see that there are no hidden limitations or unreasonable provisions.

2. See that every contract contains a clause substantially as follows, for your protection as to patent matters, which clause is inserted in all of our contracts:

"The company shall at its own cost and expense defend any and all suit or suits that may be instituted by any party against the purchaser for the alleged infringement of a patent or patents, when such alleged infringement shall consist in the use of any apparatus, machinery or device, or parts thereof, manufactured or sold by the company, for which the purchaser shall have made all payments when due, provided that immediate notice of the institution of such suit or suits be given in writing by the purchaser to the company, and that the purchaser shall permit the company, through its counsel, to defend the same, and shall give all needed information, assistance and authority to enable the company to do so, and thereupon, in case of an award of damages in such suit or suits, the company shall pay such award, but the company shall not be bound to defend any such suit or suits, nor to pay any damages therein when the same shall arise by reason of the use of parts not furnished by the company."

3. Bear in mind that the agents of the Trust and its stockholders are numerous, and that specious arguments may be advanced, and threats used, to induce you to bind yourself to purchase apparatus only of the Trust.

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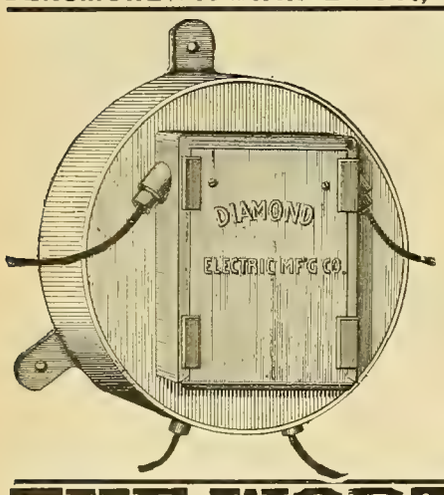

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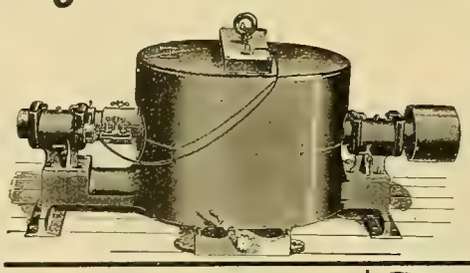

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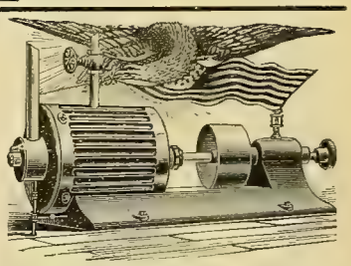

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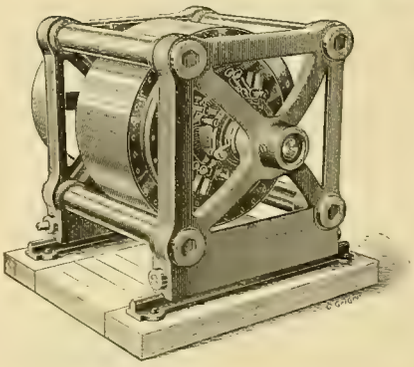

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Vol. X. CHICAGO, MAY 21, 1892. No. 21

New Central Station in Chicago.

Although the site of the central station illustrated in the accompanying pictures has served as the location of an electric light plant for the last seven or eight years, the equipment herewith shown is entirely new. At the time of the fire in the Adams Express building on Dearborn street, Chicago, early in last December, when the station of the Central Electric Light & Power company and the Fort Wayne company's office were burned out, the Central company had already purchased the old Sun plant at 21, 23 and 25 Plymouth place from the Chicago Arc Light & Power company. The company had taken no steps to utilize the plant, but the fire made it necessary that it be put in use, and that very quickly. Through the energetic and unceasing work of Manager W. H. Harding and his assistants, the company had 1,800 lights burning eighteen hours after the fire, and within a week all the customers were supplied.

It is the present plant of the Central Electric Light & Power company on the site of the old Sun station that is shown in the illustrations. The station is essentially a Fort Wayne installation, and R. T. McDonald, general manager of that company, is president of the Chicago company. A general view of the interior of the station is shown in Fig. 1. The steam plant consists of three tubular boilers, 5 by 16 feet, equipped with Murphy furnaces, and two boilers, 62 inches by 18 feet, supplied with Hawley down draft furnaces. These furnish steam for two 100 horse power Ideal engines and three Williams engines with cylinders 17½ by 24 inches. Two Worthington pumps, one Dean pump and a 500 horse power Excelsior feed water heater complete the steam equipment. The engines are all supplied with steam separators.

The generating machinery comprises five Slattery alternators—two of 2,000 lights capacity and three of 1,200 lights—and one 80 horse power Wood generator. The machines are belted directly, as shown in the illustration. A glimpse of three of the alternating dynamos is given in Fig. 2. All of the steam piping is duplicated, in order to provide against the contingency of a break-down.

A view of the switch-board is given in Fig. 3. It is conveniently arranged and supplied with a full outfit of measuring instruments. By it any machine can be connected with any circuit, but it is impossible to multiple arc the machines. The company has about fifteen miles of wire underground, and the longest circuit is one and one-half miles in length. In general Norwich paper cable is used.

About 7,000 16 candle power lamps are wired from this station. The company also supplies a few arc lamps and about 22 horse power in motors, although the power service has only been established about two weeks. Thomson-Houston and Edison motors are used. The station is the second largest one for incandescent lighting in the city, and the business has been growing at a healthy rate ever since the present plant was put in operation about December 15th. Before the year is out it is proposed to open another station in the Adams Express building on Dearborn street, in the rear of the company's office. As before stated, R. T. McDonald is the president of the company, and William H. Harding is treasurer and manager. The late Judge Driggs was vice-president. F. L. Webster is the superintendent. The company is operated on liberal and progressive lines, and its future is bright.

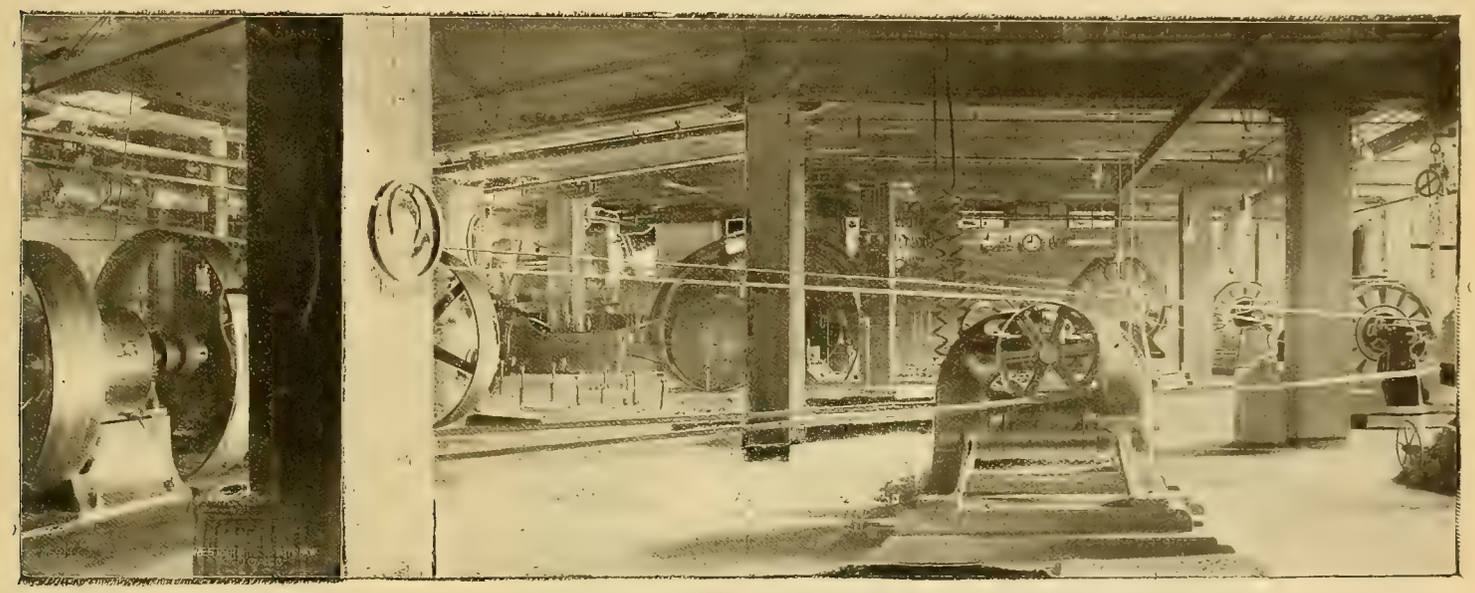


FIG. 1. NEW CENTRAL STATION IN CHICAGO.

Litigation over an Electric Railway.

Francis E. Hinckley of Chicago has filed his answer in the case instituted by Charles F. Pfister for the appointment of a receiver for the Milwaukee Electric Railway company. Of the company's capital stock of $500,000, he claims 2,998 shares of $100 each. He alleges that the original company, the Milwaukee Cable Railway company, had made considerable progress in the construction of its lines, all of the money being advanced by him before it was changed into the Milwaukee Electric Railway company. Altogether he advanced more than $80,000, he alleges, and the company owed him upwards of $100,000 when it changed its name. Hinckley avers that Pfister and John A. Hinsey attempted to obtain the property and franchises of the Milwaukee Electric Railway company for a trifling sum, and that in furtherance of this plan Pfister insisted upon having a power of sale granted to him, to be exercised in default of payment of a loan of $125,000. Pfister, it is alleged, required the deposit as collateral security of 1,501 shares of stock by Hinckley and 1,001 shares by Hinsey, thus giving him a majority of the 5,000 shares. It is further alleged that at that time Oscar Æpli, a clerk in Hinsey's office, and H. H. Field, Hinsey's attorney, were directors of the company, and that, with their assistance, Hinsey was enabled to control the affairs of the company. Hinckley declares that it is his belief that Hinsey entered into an agreement that, with the aid of Æpli and Field, he would prevent the certification of more bonds, and thus prevent the company from borrowing any more money. The sale of bonds to August H. Vogel is said to have been only a pretended sale, and the power of sale and pledge of bonds to Pfister are claimed to have been unauthorized and void. Hinsey, by the way, is not contesting Pfister's suit for the appointment of a receiver.

Electricity at the World's Fair.

Great interest centered in the opening of the second set of bids for the incandescent lighting at the World's Fair, which took place in Chief Burnham's office on Monday at 1 P. M. Among those present were Captain Eugene Griffin, B. E. Sunny and John I. Beggs of the Thomson-Houston-Edison company, and George Westinghouse, Jr., and C. A. Terry of the Westinghouse Electric & Manufacturing company. These two companies were the only bidders. The specifications allowed competitors to furnish tenders on the direct current system entirely, on the alternating system entirely, and on a plan combining both systems. The specifications seem to require 89,622 lights, but, as a few arc lamps and several thousand 10 candle power lamps for decorative purposes are included, it is difficult to give an idea of the exact lamp capacity required. The proposals are for "installing, operating, maintaining and removing" the plant. The time of operation varies in the case of the several buildings, but generally it is for the period of the fair, with a reasonable margin.

In the letter accompanying its bids, the Edison General Electric company took occasion to declare that it made the tenders without waiving any of its rights under the acceptance of its proposition of April 14th. This company's bids were as follows: Direct current system, $577,485.96; part alternating and part direct, $525,384 60; all alternating, $480,694. The company, in addition, offered to deduct $1.50 per lamp capacity for inside wiring not actually placed in position, and agreed to do additional inside wiring in any of the buildings at $3 per lamp capacity. It also agreed to furnish additional capacity of generators, mains and distributing appliances for $4.10 per lamp capacity for the alternating system and for $5.18 per lamp capacity for the direct current system.

The Westinghouse company, understanding that the lowest bid would be accepted, whichever system was figured on, elected to bid on the alternating system entirely. An abstract of its reasons for doing so follows: First, the cost would be less; second, it was desirable to have only one form of generators and one switch-board, thereby reducing complication and securing greater certainty of operation and less cost for attendance; third, less space for central station apparatus would be required; fourth, the alternating system reduces the first risk, as, by using converters, only wires carrying a potential of 100

volts will be placed in the buildings, and all the circuits in the buildings will be electrically separated from the wires leading from the dynamos; fifth, there is greater danger from the two systems combined, as the mains of the two systems would be adjacent in many places, and if an accidental connection were made between feeders, great fire risk and danger of injury to persons would ensue; sixth, by the direct system a pressure of 400 to 500 volts would be required, on an economical basis, increasing the risk of fire and of injury to persons; seventh, should the direct current potential be reduced to safe limits, twenty to fifty times more feeders and mains would be required than by the alternating system, and these wires, on the elevated railway structure, would be unsightly and difficult to maintain. The bid of the Westinghouse company for the entire installation was $399,000. It offered to deduct the sum of $2 per lamp capacity for inside wiring not actually placed in position; to do additional inside wiring for $3.50 per lamp capacity, and to furnish additional capacity of generators, mains and distributing appliances for $1.75 per lamp capacity.

The bid of the Westinghouse company was so much lower than any one of those put in by the Edison company that the construction department officials quickly came to the conclusion to recommend that it be accepted. Assuming that 89,622 lights are enumerated in the specifications, the offer is at the rate of about $4.45 per lamp. The best previous offer of the Edison-Thomson-Houston company was $5.95 per lamp.

The bids, with the construction department's recommendation, were referred to the committee on grounds and buildings on Monday afternoon. The committee considered the matter for two hours, and then adjourned until Tuesday at 11 A. M., when a four hours' session ensued. Both meetings were fruitless of result, and adjournment was again taken to Friday at 11 A. M. Both sides were given a hearing, and it is understood that difficulties in the way of patent litigation were urged against the acceptance of the Westinghouse bid. Vice-president Insull of the General Electric company was in attendance.

An important contract was let by the grounds and buildings committee last week, and by that action the question of the motive power to be used for the intermural railway was settled in favor of electricity. The railway will be carried on an elevated structure of sufficient width to provide for double tracks, and the total length of the line will be about five miles. The Western Dummy Railway company—a new organization formed for the purpose of doing this work—will install the entire plant, having secured the contract referred to. The elevated structure will not differ materially from the ordinary construction of this character, save that the upright supports will be of wood. The transverse girders will be of iron, however. There will be about ten stations, and the general route of the road will be substantially as indicated on the map of the World's Fair grounds published in the WESTERN ELECTRICIAN of November 28th last. Trains will be run on a headway of 90 seconds, and it is expected that a speed of thirty miles an hour will be attained within 300 or 400 feet from the starting point. The company promises that not less than four cars beside the motor car shall constitute each train. To accomplish all this, it is said, more powerful motors and a generating plant of greater capacity than anything yet attempted in the line of electric railway work will be employed. The plan of the electrical equipment has not yet been worked out in detail, but it is surmised that a power station having a capacity of from 25,000 to 30,000 horse power will be required. The company will put up a power house of its own, but the location has not been determined. In size the projected plant will not only exceed any central station or electric railway plant in the country, but it will be larger than the great World's Fair central station for lighting and power. Thomson-Houston apparatus will be used, and the current will be conveyed to the motors by conductors laid between the rails. W. E. Baker, lately connected with the West End Railway company of Boston, is the manager of the company. The size of the motors and the other details of the equipment of the propelling cars have not yet been decided; neither is it determined whether passengers will be carried on the motor cars. It is said that the new company is backed by the Thomson-Houston Electric company.

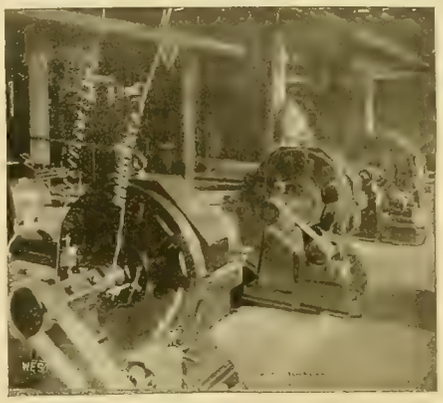


FIG. 2. NEW CENTRAL STATION IN CHICAGO.

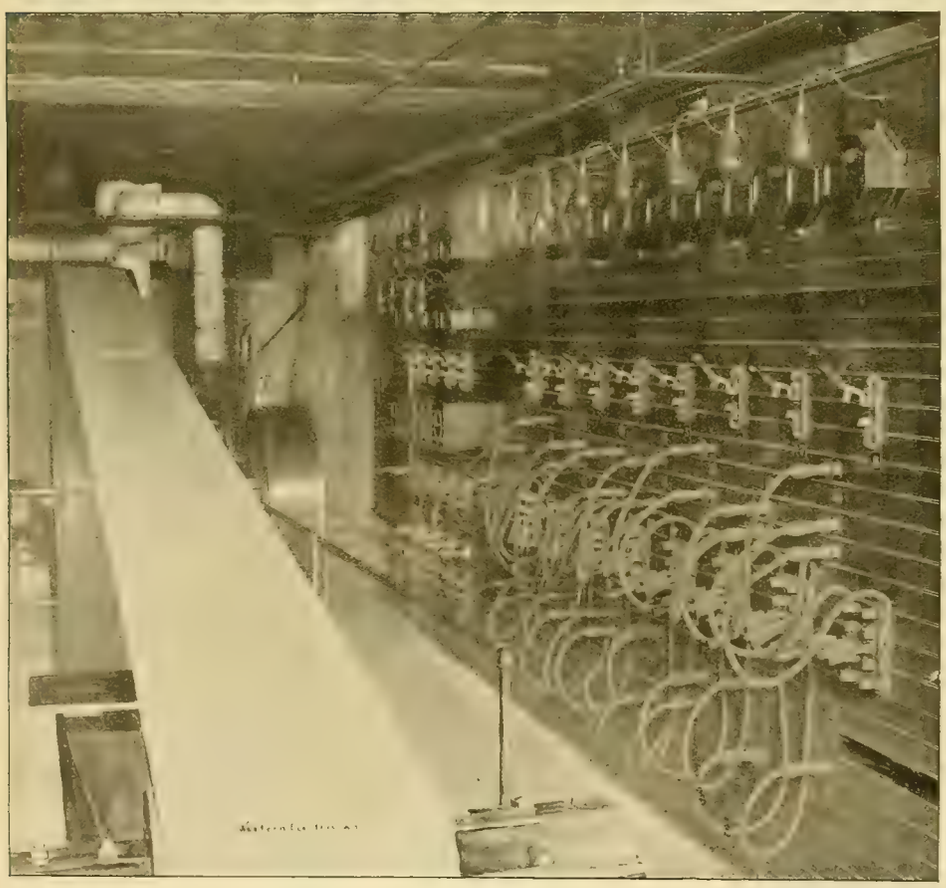


FIG. 3. NEW CENTRAL STATION IN CHICAGO.

Occasionally the tedium of the hard work and sharp criticism that falls so plentifully to the lot of the construction department is relieved by a humorous episode that sets all the "boys" on a broad grin. An incident of this character that occurred a short time ago will be appreciated by the electrical fraternity. It was at the time that Chief Burnham had advertised for bids for the conductors for the arc light circuits at the World's Fair. A letter was received in which the writer proceeded to assert, in due form, that he had an important communication to make to the World's Fair people, and he desired to know whether he should write English or German, as he was equally proficient in both languages. Wondering what momentous proposition was on the tapis, Secretary Pickett replied that, as it seemed to be a matter of indifference to the gentleman inquiring, the department would candidly admit a slight preference for the English language. In answer a formally worded letter was received, setting forth the fact that the writer was a German, thirty-five years old, and of good physique. He had noted by an advertisement in a Chicago German paper that the construction department was in need of conductors, and he desired to make application for a position. He could not say that he had any experience as a conductor, but had no doubt that he could fill the requirements of the place satisfactorily. The letter was a business-like application, and was evidently written in good faith. It is suggested, however, that the tender will probably be thrown out as informal, for the reason that the gentleman failed to state his safe carrying capacity, and was totally silent on the subject of his sectional area in circular mils.

New drawings showing the recent alterations in the interior arrangement of the electrical building have been prepared under the supervision of the department of electricity, and will shortly be issued. By these changes the lavatories are grouped about the east and west entrances to the building and, removed entirely from the ends of the structure. The new arrangement will give a little more space for exhibitors, and is regarded as an improvement. The drawings show the floor and gallery plans on a scale of sixteen feet to an inch. The size and location of the foundations, trusses and gallery supports are clearly indicated.

The rate of progress on the electricity building has been far from satisfactory, and Contractor Johnson has been severely criticised for the delay. The north end of the structure is well advanced toward completion, but much yet remains to be done on the southern end. Mr. Johnson told a representative of the WESTERN ELECTRICIAN on May 12th that he expected to have his work done in about thirty days. His contract includes the iron and woodwork, but not the staff. The contractor lays the blame for the delay partly on the exposition authorities, who, he said, stopped the work to change the plans, and partly on the construction of the building itself, which, he says, was more difficult than that of any other building on the grounds, mainly because of the numerous towers.

Prof. George Forbes of London, who was in Chicago last week, has some very interesting things to say in relation to the attitude of English electrical manufacturers toward the World's Fair. Prof. Forbes is no stranger in the United States, having made many visits to this country. He is well informed on the conditions of electrical practice in the United States, and, although by no means blind to many defects, has found so much to praise that his English contemporaries have frequently dubbed him "a Yankee" after listening to his enthusiastic descriptions of the work accomplished on this side of the Atlantic. The professor takes a patriotic pride in the electrical achievements of his own country, but he is unprejudiced, and is quick to recognize merit in electrical inventions or advancement, wherever found. He is at present engaged in investigating the electric railway systems of the United States, and in Chicago he particularly observed the working of the Love underground conduit system on the North side. He will also inspect the double trolley roads in Cincinnati and the accumulator line in Washington. Prof. Forbes is a member of the electrical committee of the English World's Fair commission, and he has been using his best endeavors to induce the manufacturers of electrical machinery in England to make exhibits at the World's Columbian exposition. At first the committee encountered a decided disinclination to do anything on the part of the large houses. They had much to say about the McKinley tariff law, and could not see how they were to be benefited by displaying their goods at Chicago. The

committee labored incessantly, however, to show the manufacturers that they could not afford to stand idly by and see their American, German and French competitors monopolize the exhibit, and that they could themselves learn something at the World's Fair as well as give hints to others. As the result of the efforts of Prof. Forbes and the gentlemen associated with him, four or five of the largest English companies are on the point of formally declaring their intention of exhibiting at Chicago, and there is little doubt that the English electrical display will be worthy of the nation and industry that it will represent. Prof. Forbes is convinced that the exhibits of English electrical instruments and machinery at the World's Fair will be of mutual advantage, but thinks that his countrymen are entitled to some assistance in the way of contracts for lighting, so that an English central station in practice may be shown.

The headquarters of the electrical engineering department at Jackson Park have been removed into the new construction and maintenance building.

Chief Barrett of the department of electricity will not resign his position as city electrician, it is now said. He announced that intention in a telegram to Mayor Washburne received last week Thursday. The message was in answer to one from the mayor asking the superintendent to reconsider his reported withdrawal. In reply to this Mr. Barrett wired as follows: "Your message received, and for your expression of confidence I thank you sincerely. I am at your command, and shall be with you till the finish."

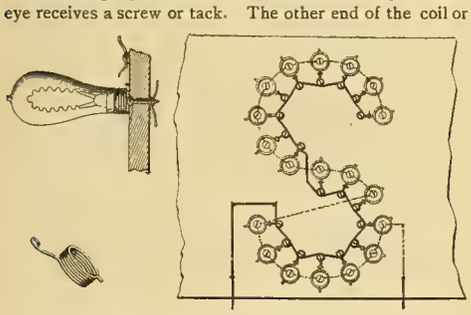
About 160 delegates to the Order of Railway Telegraphers' annual convention at Chattanooga, Tenn., stopped at Chicago on Monday of last week to visit the exposition grounds. The Illinois Central provided a special train to convey the party to and from the grounds.

This Washington dispatch was recently printed in the *Chicago Tribune:* The electric trust is now the subject matter of a resolution of inquiry offered in the House by Mr. Crain of Texas, calling on the attorney-general for information as to whether the Edison Electric company, the Thomson-Houston Electric company, or the General Electric company has violated the provisions of the anti-trust act in submitting proposals for furnishing lighting for the World's Fair at Chicago.

A Simple Lamp Socket.

In the accompanying illustration Figs. 1 and 2 show in detail an exceedingly simple incandescent lamp holder which, is especially adapted for outside decorative illumination and which, it is claimed, will admit of the use of barbe wire and prevent rain from lodging in the holder or socket and short-circuiting the lamp. This holder may be employed when it is desired to facilitate the operation of wiring.

The lamp holder proper is merely a coil of wire of proper size to form a socket to receive the threaded plug of the lamp. One end of the coil or socket is projected to form an arm, which is in the plane of the base-coil and which is slightly curved and terminates in an eye. This eye receives a screw or tack. The other end of the coil or



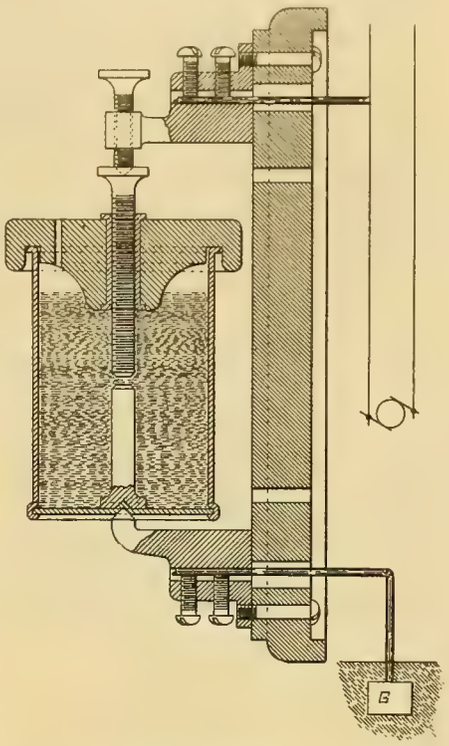
FIGS. 1, 2 AND 3. A SIMPLE LAMP SOCKET.

socket is bent out and forms a projection, which is grasped between the thumb and forefinger to facilitate the detachment of the lamp when it is to be removed.

For ornamental wiring, Fig. 3 the electric contacts, being screws which extend through a base board, are placed in the proper position on the support to present the outline of the desired design, and are electrically connected on the reverse side of the board by a wire, which is coiled about the projecting ends of the contact screws. The sockets are placed on the support so that the contacts occupy a central position relative to each socket and are secured in place by staples as indicated. Two fastenings are provided for each socket. When the lamp is properly inserted in the socket, its terminals are in electrical connection with the socket and the contact. As the socket is a coil of wire it is claimed it will grasp the threaded plug end of the lamp firmly, will yield to vibrations, and being open will prevent the lodgment of water and the short-circuiting of the lamp. By having the positive wire on one side of the support and the negative or neutral wire on the opposite side there is little or no chance of a short circuit. William D. Kurz and Hans Amundson, of La Crosse, Wis., are the joint inventors of this socket.

An Oil Lightning Arrester.

When the ordinary form of comb lightning arrester is used upon electric supply circuits, the escape of a light-



AN OIL LIGHTNING ARRESTER.

ning discharge is apt to establish an arc at the points, and this arc, serving as a conductor, will afford a path of low resistance for the dynamo current to earth, and thus ground the line.

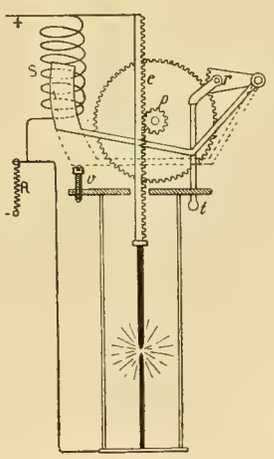
The object of the designer of the arrester shown in the cut, was to prevent the formation or continuance of an arc between the electrodes of the discharging device by interposing between the discharge points a non-conducting liquid, such as oil. The construction of the arrester which is the invention of M. Dickerson of Fort Wayne, Ind., will be understood from the cut. There is an insulating base of porcelain, or glass, upon which are mounted binding posts, by which connection may be made between the earth and the supply circuit. Electrodes or points are mounted between the binding posts, one or both of which may be made adjustable. Surrounding the points is a reservoir, provided with an insulating cap. Within the receptacle is placed an insulating liquid, such as oil. The cap is perforated, to permit the escape of any gases which may be formed.

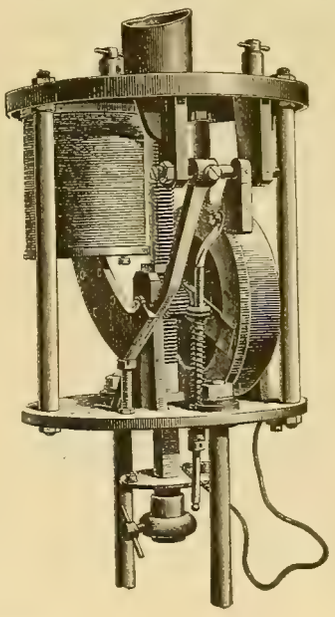
The apparatus is adjusted so that when in action a path of escape between the circuit and the earth plate will be provided, the electrodes being adjusted so that their discharge points will be out of contact. If the line is raised at any time to a potential sufficiently high to cause a disruptive discharge between the electrodes, an escape, of course, will be afforded to earth. If no provisions were made to guard against it, this disruptive discharge would establish an arc, through which the current on the circuit would flow to earth. Mr. Dickerson guards against such a result by the liquid resistance contained in the receptacle. No arc, he claims, can be preserved by reason of the closing in of the liquid after the disruptive discharge. It will be seen, therefore, that the apparatus will always be in condition to afford a path to earth for discharges but will prevent an arc.

Briaune Arc Lamp.

The Briaune arc lamp, shown in the accompanying illustrations, has just been introduced in France. According to the statement of several experts, the operation of the lamp is thoroughly satisfactory. The diagram at the left illustrates very clearly the general arrangement. The lower carbon is fixed, and the upper carbon is held by a clamp at the end of the rack rod *C*, which engages with a pinion *p* on the axis of a toothed wheel. The movement of the wheel, and consequently of the positive carbon, are controlled by the segment *r*, which is mounted in the manner shown in the perspective view at the right, and is connected with the core or plunger of a special design of the solenoid *S*, which is in shunt to the arc. When the plunger rests on the controlling screw *v*, the segment engages with the wheel which stops all movement of the upper carbon, or conversely when it takes a certain position in the solenoid the wheel is free, and the upper carbon falls.

When the lamp is put into service the carbons are separated; as soon as the circuit is closed current of relatively large quantity passes through the solenoid *S*, the upper carbon holder drops and the carbon points come into contact. At this instant the difference of potential at the terminals diminishes suddenly since there is a short circuit. The plunger falls, and by means of the segment *r* and the pinion *p*, it raises the rack rod, and the arc is struck. The construction is such that when the arc is at the proper length, which corresponds to a given current, the plunger is drawn a certain distance within the solenoid, and the segment *r* is on the point of releasing the wheel. When the arc increases by the consumption of the carbons the current falls, but the difference of potential at the terminals, and in consequence the current shunted into the coil, both increase. The plunger is drawn in slightly, the segment releases a tooth on the wheel and the carbon is fed down sufficiently to make the arc normal. The feeding is of course constantly in progress. Tests made at the School of Physics and Chemistry at Paris showed that feeding took place every twenty seconds, when the downward movement of the carbon was .15 millimeters. It is stated that the lamp operates satisfactorily with 55 volts





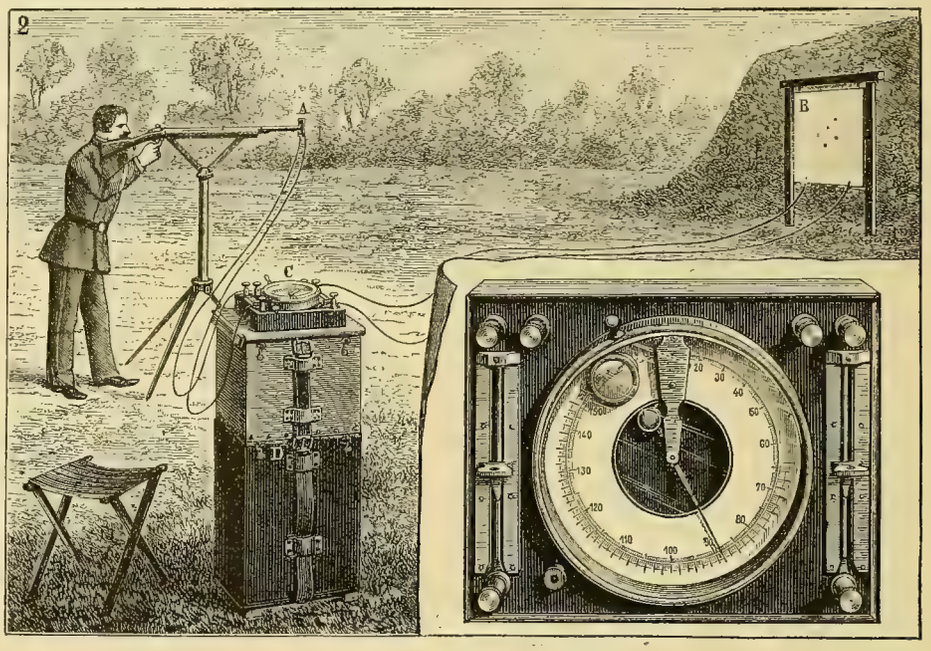
BRIAUNE ARC LAMP.

and from eight to ten amperes, but it is regarded as better to employ a pressure of seventy volts.

Measuring the Speed of a Rifle Ball.

The apparatus shown in the illustration was designed to determine the velocity of projectiles. The most essential feature is the Schmidt chronograph located at *C*; a view of the dial is shown at the right of the engraving. This instrument is designed to measure periods of time, ranging from one-ten-thousandth of a second to a second. It is constructed on the plan of a balance of an escapement.

Where a test is to be made, the gun is mounted in the manner shown in the illustration with the muzzle just back of a small frame, *A*. The balance of the chronograph is held firmly by electro-magnets, the wires leading to which are connected across *A*. When the gun is fired the connection at this point is broken, the balance is released, the hand on the dial is set in motion, and continues till the bullet strikes the target *B*. At this instant a connection is formed in a second circuit and electro-magnets stop the movement of the balance, and consequently the hand. The dial is marked off into spaces indicating ten-thousandths of a second, but the divisions are so minute that reading is only possible with a magnifying glass. The exact means for breaking the circuit in front of the rifle, and for establishing it at the target are not specified in *La Nature*, from which the cut is reproduced, but methods of accomplishing the desired ends are not difficult to imagine.



MEASURING THE SPEED OF A RIFLE BALL.

Thofehrn System of Refining Copper.

In the advance sheets of Hippolyte Fontaine's work on electrolysis, the Thofehrn system for the electrolytic deposition of copper is described at considerable length, and from his description the following synopsis is made: Thofehrn implies the same general plan in point of arrangement as that followed at Hamburg and Biache, but his method in details constitutes what Fontaine asserts to be a new, complete, and efficient system of copper refining. The improvements over ordinary processes may be classified under the heads: arrangement of vats; arrangement of conductors; composition, warming and circulation of the electrolyte; manufacture of the anodes and cathodes; oxidation of the electrolyte.

In the construction of his vats Thofehrn makes the several compartments of concrete or jointed wood. In cases in which the former material is used, and where 120 baths are to be built, he makes 12 series of 10 baths each. Each series is formed by a concrete base, having a central channel, with longitudinal walls from 1 to 1.2 meters in height and 12 centimeters in thickness; the two end walls are of the same height and thickness, and there are nine double partitions. The length of each compartment varies in accordance with the size of the plant from 2 to 3 meters.

The bottom and sides of each compartment are lined with wood which has been boiled for a considerable time in tar. The wood is separated from the concrete by supports resting on the base, and by strips arranged laterally on the concrete walls. A lead lining 1.75 millimeters in thickness completes the vats. This method of construction is considered advantageous inasmuch as it facilitates circulation of the air. All the surfaces of the concrete are coated with a special kind of tar to protect them against the corrosive action of the electrolyte.

When concrete is regarded as too expensive, wood is substituted. The framework is stoutly built, and the boarding and lead lining are provided as in the case of the concrete vats.

Between the several series of baths a little bridge is constructed for the convenience of workmen in charge, Fig. 1.

The dynamos are calculated on the basis of a normal production of one gramme per ampere. Thus if we have a plant with 100 baths, and a total production of 2,400 kilogrammes in 24 hours, each bath must furnish 1,000 grammes per hour, which would necessitate a current of 1,000 amperes. The difference of potential at the binding posts is assumed to be sufficient to overcome the resistance of the circuit.

In plants where several tons of copper are refined daily Thofehrn calculates the potential on a basis of .15 volt for each bath, or for 120 baths 19 volts, assuming a loss of 5 per cent. in the conductors. In small plants where only from 100 to 600 kilogrammes are refined daily, the electrodes have much less surface, and .30 volt is calculated as the fall of potential for each bath.

The conductors are calculated on the basis of allowing an average loss of 5 per cent. In exceptional cases where the baths are located at some little distance from the generating station, a maximum loss of 8 per cent. in the conductors is allowable.

The section of cables leading from the dynamo to the first series of vats should be such that the current will not exceed one ampere per square millimeter. The bars located on the edges of the baths need be only half this section, since two bars are necessary to form one conductor. In the case previously cited the quantity of the current being 1,000 amperes the cables should be 10 square centimeters, and the bars 5 square centimeters in cross-section. The general arrangement of the supporting bars on longitudinal strips, one slightly higher than the other, is shown in Fig. 1.

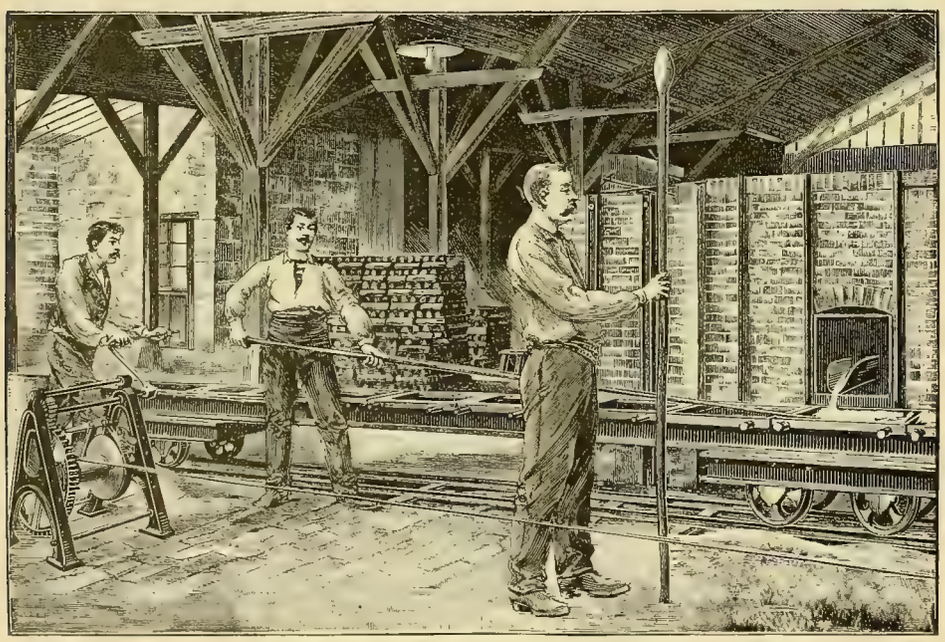


FIG 2 THOFEHRN SYSTEM OF REFINING COPPER.

Circulation is effected by means of injectors, pumps, or apparatus similar to that employed in sugar refineries. The electrolyte is constantly raised from a collecting basin to a higher distributing reservoir, from which it flows into channels leading to the first row in the series of vats. Each bath is provided with two siphons, which draw the liquid at a certain distance from the bottom, and conduct it to the top of the following bath. There is a slight descent in the arrangement of the baths, the difference of level between one bath and that adjoining it being .02 of a meter, or 20 centimeters between the first and last in the series. This difference in level is sufficient to effect a good circulation. After leaving the last bath the electrolytic liquid flows into the collecting basin.

During the process the electrolyte becomes charged with many impurities which may seriously impede the progress of the work, unless means for purifying the liquid are adopted. As the ordinary methods for accomplishing this end require too much skill to be intrusted to the average workman, Thofehrn has endeavored by the oxidation of the electrolyte to secure a simple and effective means of eliminating the impurities. He demonstrated by various experiments that the continuous oxidation of the solution by air would accomplish the desired end, with the simple proviso that the liquid must be heated to 35° C. He has provided special devices for sending a jet of air through the solution, both when it flows into the collecting basin and when it falls into the distributing reservoir. The resulting oxidation is so pronounced that one can see the reddish specks of peroxide of iron, which, like most of the sub-oxides of other metals, is insoluble in the electrolyte, and it is deposited at the bottom of the channel or vessel. It is wise therefore to make the channel of large dimensions, and to permit time to elapse before the liquid is put into circulation again, so that the impurities may fall to the bottom.

The heating of the electrolyte may be effected cheaply, or at no cost, by means of the exhaust steam. The temperature should be kept constantly at 35° C. In some cases Thofehrn has increased the temperature slightly, and has raised it as high as 40° C., but he regards 35° C. as the lowest to which the temperature should be allowed to fall.

Fig. 2 gives a view of the foundry where the anodes are cast. The fused metal flows from the smelter into a series of moulds, arranged on tram cars. As the moulds are filled the train is moved along by means of the windlass.

Each anode is cast with two projections at the top, through which there are holes for suspending the anodes in the baths.

In his first installations Thofehrn believed that a current of 30 amperes per square meter should not be exceeded, but subsequently he adopted the practice of 50 amperes, and in some instances has worked with as high as 60 amperes per square meter.

The solution contained in the vats varies in accordance with the character of the copper and quality of the current. With crude copper 92 to 98 per cent. pure and with a current of 30 amperes per square meter the liquid is as follows:

Sulphate of copper	150 parts by weight.
Sulphuric acid	50 " " "
Water	800 " " "

With crude copper and anodes oxidized, the current being 50 amperes, the proportions of sulphate and acid are slightly increased as follows:

Sulphate of copper	250 parts by weight.
Sulphuric acid	60 " " "
Water	690 " " "

The cost is, after all, the principal thing in refining copper. In making an estimate, Fontaine gives the details of a plant assumed to be situated on the banks of the Seine, in the suburbs of Paris, with a capacity of 120 vats, producing annually from 750 to 1,000 tons of electrolytic copper. The details of anodes are as follows:

Length of one plate,	60 centimeters.
Width " " "	60 "
Thickness " " "	2 "
Maximum weight of one plate,	60 kilogrammes.
Weight " " anode	120 "
Number of anodes in a vat,	13
" " " " 120 vats,	1560
Total weight of anodes,	187.2 tons.
Total surface of one anode,	1.50 sq. meter.
" " " anodes in the bath	19 50 meters.

The details of cathodes are as follows:

Length of one sheet,	60 centimeters.
Width " " "	20 "
Thickness " " "	.2 millimeter.
Weight " " "	184 grammes;
Number of sheets per cathode	6.
" " cathodes in bath	14.
" " sheets in 120 baths	10,086
Total weight of cathodes,	1,855 kilogrammes.
Active surface of each sheet,	.216 sq. meter.
" " " cathodes,	2,180 sq. meters.

Assuming 50 amperes per sq. meter, there will be needed a total of 1,090 amperes, but as this figure is not followed exactly, it will be safe to adopt a total current of 1,000 amperes. This will cause a deposition of copper of 1 kilogramme per hour per bath, or 2,880 kilogrammes for 24 hours with the 120 baths. We will assume a daily average production of 2½ tons, and the expenses attending the installation may be estimated as follows:

Ground	$ 4,500
Building with laboratory	11,400
Engine and boiler (45 h. p.)	6,000
Bath complete	3,800
Dynamos and measuring inst's	2,400
Conductors	2,400
Furnace for anodes	1,200
Electric light installation	600
Elevator, pipes, filters	1,000
Miscellaneous expenses incidental to original installation	4,000
	$37,300

STOCK ON HAND.

Copper in vats (190 tons at $270.00 per ton)	$51,300
Crude copper in stock (100 at $270.00 per ton)	27,000
Coal and Miscellaneous	5,700
	$84,000

OPERATING EXPENSES.

Casting the anodes (coal)	$1,600
Labor (casting)	400
Repairs	300
Making cathodes	1,310
Labor (vats)	1,200
Motive power (coal, oil, repairs)	2,400
General expenses	2,000
	$9,210

RECAPITULATION.

Operating expenses	$9,210
Interest on investment	6,065
Depreciation	2 365
	$17,640

The cost of a ton of electrolytic copper in accordance with the Thofehrn process is ($\frac{17,640}{1000}$) $19 60.

In most copper refinings a quantity of silver can be obtained from the residue, which ranges from 300 to 500 grammes for each ton of refined copper. At $30 per kilogramme the metal will be worth from $9 to $14 80 per ton, and the sum realized from it will reduce considerably the total cost of operation.

The Baltimore Belt Line Tunnel Electrical Equipment.

BY B. C. HOWARD.

With a view of obtaining authentic information in regard to the proposition of the Thomson-Houston company to equip the Belt line tunnel in Baltimore, Md., with electric motors, the writer recently called upon Mr. Judge, the Edison-Thomson-Houston agent in Baltimore, Mr. Randolph, the chief engineer of the Belt line, and Mr. Guild, special Thomson-Houston agent now on the ground. Although the details of the scheme have not entirely been settled, enough has been done to show the lines on which the Thomson-Houston company is working.

The plant is to be erected as a whole, including engines, boilers and all appliances, by the Thomson-Houston company, and is guaranteed by it, and is to be only accepted by the B. & O. R. R. after six months' trial, if it be pronounced satisfactory by two engineers. The entire length of the line is about 15,000 feet. For about 3,000 feet from the main B. & O. tracks there is a down grade of about $\frac{8}{10}$ per cent., at this point the up grade begins and continues uniformly $\frac{8}{10}$ of 1 per cent. for about 7,500 feet and then increases to 1.5 per cent.

The specifications call for a draw-bar pull of 32,000 pounds and a speed of fifteen miles an hour for freight trains, whose weight is not to exceed 1,200 tons, and thirty miles an hour for passenger trains, whose limit of weight is 500 tons, including weight of engines.

The motors will weigh complete about 80 tons. They are to be mounted on four or six driving wheels about 6½ feet in diameter, with an armature mounted directly upon each axle. It is expected that these motors will develop from 1,000 to 1,100 horse power. Current will be supplied to the line at a pressure of about 600 or 700 volts.

Four generators will be used, coupled directly to compound condensing engines, giving about 2,400 horse power.

The power house may be situated about 6,000 feet from the northern end of the tunnel and probably not on the "Bolton lot" as was at first suggested. Perhaps though owing to lack of water for condensing purposes, it may be necessary to locate the power house at the south end of the tunnel at a point near Camden station, and pump water from the river.

Through the open cut of 4,500 feet, where the grade is 1.5 per cent. both the electric and steam engines will be used, but as an extra engine would be required on this portion of the road, the motor will only act as a helper.

Great stress is laid on the use of the braking power of the motors in taking heavy south bound trains through the tunnel. The motor is to be hooked on the rear end of the train, and Westinghouse air brakes applied, and the heavy weight of the motor used as a brake.

It is expected that about 200 trains will pass through the tunnel every twenty-four hours. Two motors will be in use, with a third kept in reserve.

A rear end block system will be used, and with a system of incandescent lamps of a sufficient number to illuminate the interior of the cars, traveling in the tunnel will undoubtedly be much more comfortable than has been the case with the B. & P. tunnel.

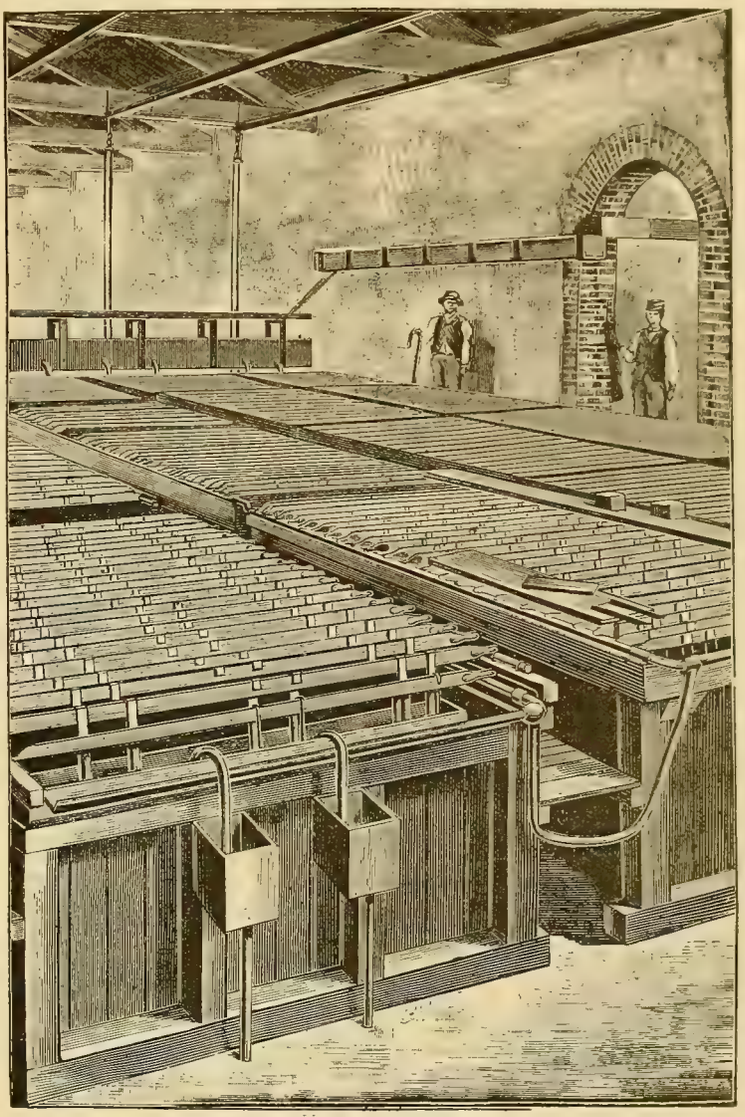


FIG. 1. THOFEHRN SYSTEM OF REFINING COPPER.

New Chicago Telephone Company.

The press dispatches from Springfield announce that a new telephone company has been formed, with a capital stock of $2,500,000, to exploit the D'Unger telephone. This instrument has already been explained in the WESTERN ELECTRICIAN, and Dr. D'Unger's claims presented. Although the "inventor" of the device has repeatedly announced his intention of launching the enterprise now incorporated, he has not heretofore succeeded in interesting sufficient capital to make a start. The Chicago Telephone company, with which he desires to compete, does not feel any anxiety over the outcome of a contest.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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VISITORS to the World's Fair will have an opportunity to ride on an elevated railway on which electrically operated trains will be run at intervals of a minute and a half, at a speed, it is claimed, of thirty miles an hour. Powerful motors and a great power station will be needed of necessity, and the installation will, aside from its practical value, form one of the most interesting exhibits at the fair.

INFORMATION comes from New York that the project of making a new survey of the region surrounding the northern magnetic pole is under discussion by scientists in that city. Such an expedition as the one proposed, if rightly conducted, could hardly fail to add much to the stock of knowledge now available on this subject, and the idea is deserving of hearty commendation. To exactly determine the location of the north magnetic pole would certainly be of more importance to the world than the discovery of the north pole itself, although the hope of accomplishing the latter feat has already cost many lives and large amounts of money. If a portion of the energy and enthusiasm of the Arctic explorers were directed to achieve the end sought by the proposed expedition, science and commerce would be greatly benefited.

EXPONENTS of anarchistic, communistic, socialistic and Bellamistic principles have been so noisy during the last few years that it is truly a relief to learn that the ideas advanced by these several schools of so-called philosophers have been checked by one of the ablest tribunals in the country. The Massachusetts Supreme Court has declared that the municipal coal-yard bill is unconstitutional and that it is not within the province of the state to engage in trade or manufacture. This measure was a pet scheme of the Bellamy crowd, who looked upon it as an opening wedge, hoping if they gained this advantage to proceed with the absorption of the lighting and street railway systems.

THE question of incandescent lighting for the World's Fair, which was reopened on the refusal of Vice-president Higinbotham to make a contract with the Edison company as recommended by the grounds and buildings committee, is still undecided. When the last bids were opened it was found that the Westinghouse company's offer was $80,000 below the Edison company's lowest figure. Chief Burnham and Electrical Engineer Sargent of the construction department recommended the placing of the contract with the Pittsburg company, and the grounds and buildings committee considered this subject at its meeting on Monday. Representatives of both interests were heard and an adjournment was taken to the following day, when another long session was held but without a final settlement of the question.

The controversey over the lighting question has attracted almost as much attention among the general public as in electrical circles, as it was the first notable instance in which a recommendation of the committee on grounds and buildings was disregarded or overruled.

"ELECTRIC motive power is still a dream. That it is a distant dream we may be assured by the amount of money that has been sunk and is even now sinking in the construction of cable roads. If there were any near or certain prospect of the production of a practicable electric motor, we may be quite sure that the shrewd men who control the surface lines would not be making this enormous investment, which the production of such a motor would render entirely useless."

The above remarkable statement is quoted from a recent editorial in the *New York Times* on "Surface Rapid Transit," and we republish it as an example of what must be a willful effort to mislead, or one of woeful ignorance. How it is possible that anyone as well posted on general affairs as an editor of a paper of the standing of the *Times* can pen such utter nonsense in the belief that it is true, is beyond comprehension. It is hardly possible that the *Times* does not know better; and for this reason it is to be regretted that its editor did not explain how it is that the "distant dream" of electric motive power has now become to the cable exploiter even more than a horrible nightmare—a very vivid reality that ere long may find a way to cross the Brooklyn bridge and help New York to rapid transit.

OUR New York correspondent mentions the fact that at a recent meeting of the National Board of Fire Underwriters the committee on lighting, heating and patents made the statement that there had been many mysterious fires during the last two years, and expressed itself as being almost forced into a belief that there was present some unusual social hazard. The committee was inclined to think either that merchants of the highest standing had become incendiaries or that electric lighting currents were chargeable with the loss.

In the pioneer days such reports as these, in which there was a proneness to credit electric wires with all mysterious fires, were as a rule most unjust, and oftentimes did great damage. Now, however, the strict surveillance of the underwriters, although perhaps rather trying to the contractor who has figured close to secure his contract, undoubtedly reverts to the ultimate good of the business. Of course, according to the logic of many underwriters, as electricity is a "mysterious" and a "subtle" agent, all mysterious fires must be caused by electricity. While it is to be deplored, it is but natural that the insurance men should think this way; but in time they will become better educated, and in the interim their watchfulness to prevent careless work will undoubtedly elevate the standard of electric lighting construction.

ADVOCATES of the conduit system of electric street railways will be greatly disappointed with the result of the investigation of the committee of Canadian experts and officials who visited this country recently for the purpose of examining the most approved American practice. Special attention had been called to the visit to Chicago, as it was believed that the conduit system, which is in operation on a small scale in the World's Fair city, had made a favorable impression on the visitors. The committee, however, was not ready to recommend the introduction of this system into the Canadian cities. It could not pass over the fact that the overhead system had proved itself not only economical, but thoroughly reliable as well, and that the conduit system was still without a record extending over any considerable length of time.

Despite this fact it should not be assumed that the underground conduit system is not advancing, although it must be admitted that its progress is not as rapid as its friends could wish. An honest effort is being made to develop the conduit plan, but its promotors are not receiving the enthusiastic encouragement from the powerful companies which marked the early steps of the overhead trolley system. There is yet much work to be done, many improvements in details of construction and, with the assistance of the big companies, whose experience, would be of great valte, these difficulties could be overcome with very little trouble. Yet it is not altogether a one-sided story.

There is a demand for an underground system, and the inventor who can demonstrate the practicability of his system will find many powerful friends in the big street railway corporations that are operating horse and cable cars in large cities. The street railway companies have, however, experimented with electric railways about as much as they care to, and they are satisfied to use the trolley or cable until the underground conduit system has reached a point of perfection that will compare favorably with its established rivals. This is of course a drawback, but the sooner the inventors and exploiters of the underground conduit systems realize the position in which they are placed, the better it will be for themselves. The report of the Canadian officials is but a single instance of many going to show the existence of this condition.

BOMBASTIC advocates of nationalistic schemes will find much to consider in the able article by Samuel Leland Powers in the *Arena* for May. Mr. Powers discusses the "Use of Public Highways by Private Corporations." The fact that there is an increasing demand for compensation from the companies using the streets is acknowledged, and the growing popularity of the theory that all public servants should be taxed for the "privilege" of serving the public, is also admitted. Mr. Powers says: "Street railway, electric light, telegraph and telephone companies have been granted the privileges of doing business in our streets, upon the theory, at least, that such use of public ways was perfectly consistent with the purposes for which they are maintained. While it is true that the companies engaged in these various methods of business are known as private corporations, nevertheless the character of the business conducted by them is of a public nature. They are engaged in serving the general public, and by the express terms of their charters, they are bound to serve the public without discrimination. The location of its tracks, the speed of its cars, the motive power used, and the amount of fare charged, are determined by the public and not by the officers of the company. Electric lighting, telegraph and telephone companies are under public supervision of the same nature, though not to the same extent. * * * The right to use our streets is granted to these companies for the sole purpose of benefiting the public."

It is clearly shown that so far from placing an additional burden, the introduction of street railways, electric lights, the telegraph and the telephone have enhanced valuations and been a boon to the general public. "The decisions of the courts," Mr. Powers says, "in favor of the legal right of permitting corporations engaged in the transportation of passengers and the transmission of intelligence to use and occupy public ways are founded upon the broad principle that such use and occupancy renders the streets of greater value and convenience to the public. None of the new methods adopted for the conveyance of our people and the transmission of information have subjected our streets to uses that were not contemplated when they were originally dedicated to public use. The new methods have simply made the streets of greater service to the public."

Electricity in Mining.

Electrical and mining engineers have considered the application of electricity to mining work one of the most promising fields in which electric power can be introduced. An early experimenter in this field and probably the one who accomplished more than any other in this line was the late Charles J. Van Depoele. One of his latest works was the preparation of an article on this subject, with special reference to the electric reciprocating engine. This article and the accompanying illustrations are reproduced from *Iron Age*. "Through my intimate connnection with the development of electrical transmission of power it occurred to me", says Mr. Van Depoele, "quite early in the state of the art that electricity must sooner or later be employed almost exclusively to the exploitation of mines where any business of importance was transacted."

The first thing, naturally, for the electrical engineer to do was to devise means by which he could drill the hardest rock, as well as apparatus capable of conveying the same from the mine to the place where the ore could be cheaply and economically treated. It was necessary to apply electric power to hoisting apparatus as well as to the locomotive, and the application of electric power to telpherage will play a by no means unimportant part in the future operation of mines. It was further seen that electricity must also be applied to the pumping machinery for relieving the mines of flooded water. Not only has it been shown that this can practically be done by electricity, but further, it has been shown that percussion drills of all sizes can be more successfully and economically driven by electric power, especially under conditions unfavorable to either steam or compressed air.

A good many attempts have been made from quite an early date to apply the current of the dynamo electric machine to the operation of reciprocating engines for the driving of rock drills, or similar purposes, but in all the devices thus made there were either commutators or make and break of circuits, or some means for shifting the current from coil to coil to produce reciprocating motion, which, although it might appear successful experimentally, would certainly not be so in practice, especially in the operation of rock drills, where skilled labor could not be expected. It was therefore evident that simpler means were necessary in order to produce a commercially successful electro-magnetic reciprocating engine.

From a very early date in the art I experimented in that direction, and produced, as far back as 1883 and 1884, some very efficient reciprocating engines. It was not, however, until I applied the principle of slowly rising and falling currents in closed circuits, thereby eliminating the impracticable make and break devices, that I became satisfied that such machines could be made to operate percussion drills of the type used in all mines where hard stone is to be extracted. Without entering into the details of the progress of the reciprocating engine, I will briefly state that I have devised several methods of producing the desired quality of rising and falling current impulses. The first which may here be cited, and which is applicable to plants operating a very large number of drills, is to have a generator of sufficient capacity to furnish motive power to all the drills or apparatus. Such generator would comprise an armature of large dimensions, capable of giving the necessary electromotive force and current under a slow speed, a speed, in fact, corresponding absolutely to the number of strokes to be made by the drills. Such armature would be provided with a sectional commutator, from which the fields of the machine would be supplied, and, further, furnish current of continuous direction to operate other electrical apparatus requiring a continuous current. A portion of this current can also be used to energize part of the coils of the reciprocating engine.

In addition to the commutator two continuous contact rings are carried upon the armature shaft, these rings being connected respectively to the main conductor of the armature at diametrically opposite points. From these two rings currents of rising and falling character and of alternating polarity can be collected and led to part of the coils of the reciprocating engine. The coils of the reciprocating engine consist, in some instances, of a polarizing coil or coils energized by a continuous current derived from the sectional commutator of the armature, or the polarizing coil can be excited by a current pulsating in character but continuous in direction, and this is obtained in the present instance by connecting the coil to one of the brushes upon the sectional commutator and the other terminal of the coil upon one of the continuous rings, giving the alternating current. The polarizing coil is intended to magnetize in a continuous direction a mass of iron consisting of the envelope of the machine and the plunger of the same. To this is added the action of one or more coils, which are energized by currents of rising and falling character and of alternating polarity, having a defined speed corresponding to that of the speed at which the reciprocating drills are to be driven.

Such an arrangement is illustrated in diagram, Fig 1, where a sectional commutator is shown, upon which press the brushes plus and minus. These brushes collect currents of continuous direction which, as here shown, are sent to the main line, while the brushes d^1 d^2 press upon their respective rings A and A^1, which are connected respectively to opposite sections of the commutator or the winding of the armature. From the brushes d^1 d^2 are collected by suitable conductors currents of alternating polarity, giving a defined rise and fall. As shown in the diagram, these conductors are respectively connected to the middle binding posts of the distributing board and are indicated by the alternating sign. As shown in the diagram, from this arrangement of currents a great many combinations can be made, all of which can be applied to the operation of rotary motors and other machinery, as well as for lighting purposes, as will appear. A represents an electro magnetic reciprocating engine being energized by a continuous current, the two coils I and M being connected respectively to the positive and negative leads of the system, while at the center of these two coils, K, is connected a suitable conductor, which is connected to one of the conductors carrying the alternating current. It will be seen that, as the armature revolves, the ring from which the current is collected passes continually from the positive brush to the negative, and [illegible] thus sending the current to the section which is not short circuited by the rotating ring, while the other section, being connected to the ring, presents a short circuit to the coil which is temporarily cut out, so that on the rotation of the commutator and the armature currents continuous in character will be sent alternately from coil I to M, so that the plunger placed under the influence of these two coils will naturally be reciprocated within the same with a speed corresponding to the defined rise and fall of current produced by the generator. B represents a continuous current motor which is driven by connecting the same to the two continuous current leads of the system. In the same way and from the same leads current can be distributed for lighting purposes, it being contin-

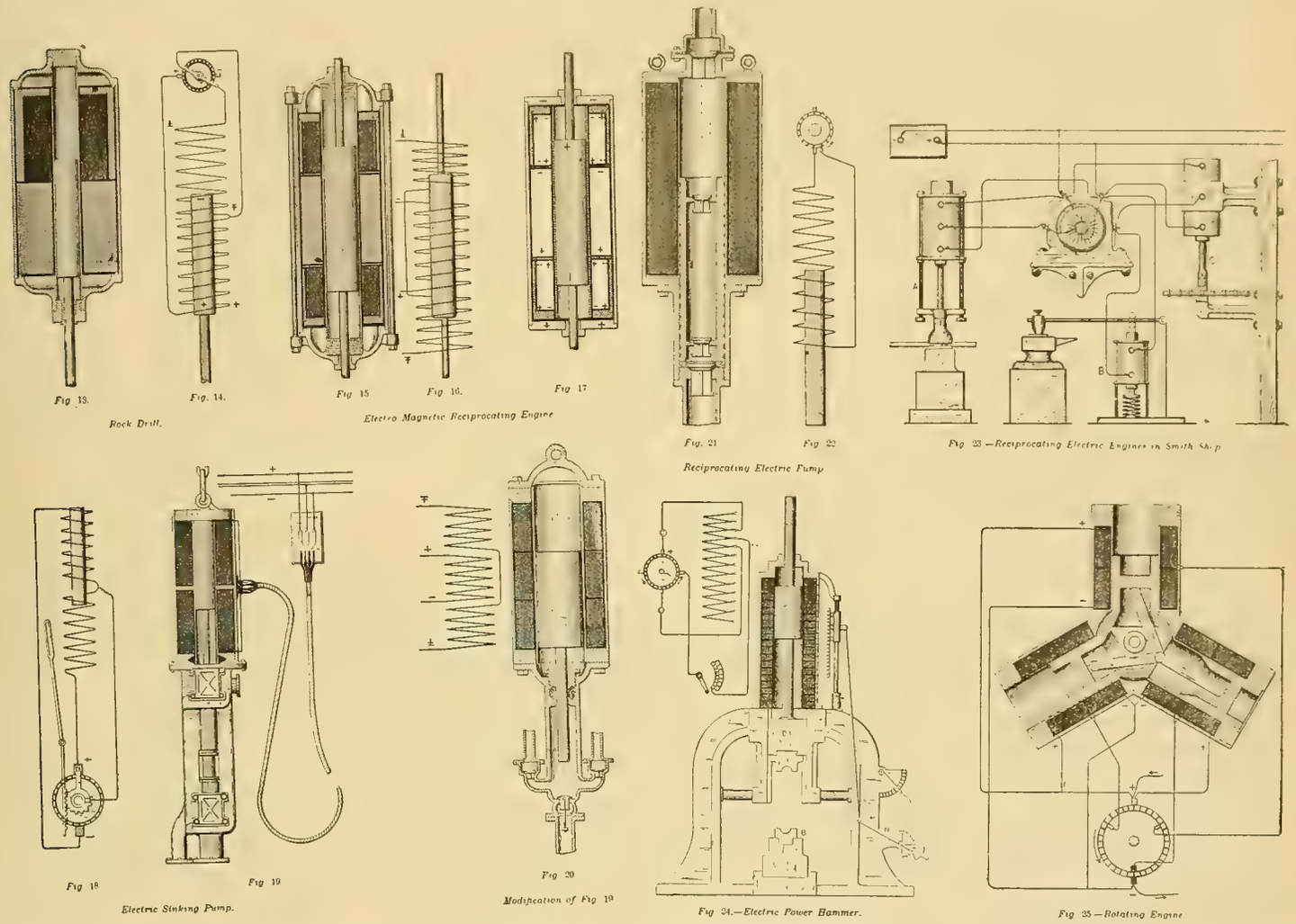


Fig 13. Rock Drill. Fig. 14. Fig 15 Fig 16. Electro Magnetic Reciprocating Engine Fig 17 Fig. 21 Fig 22 Reciprocating Electric Pump Fig 23.—Reciprocating Electric Engines in Smith Ship

Fig 18 Fig 19 Electric Sinking Pump. Fig 20 Modification of Fig 19 Fig 24.—Electric Power Hammer. Fig 25.—Rotating Engine

FIGS. 13 TO 25. ELECTRICITY IN MINING.

tinuous in character. C represents a coil, one terminal of which is connected to one of the continuous current leads, while the other extremity is connected to one of the pulsating or alternating leads. At each revolution of the armature one impulse will be sent through the coil. At D is represented a circuit of the reciprocating engine comprising a central coil, which is energized from the two continuous current leads, while the two extreme coils R R^1 are energized by currents of alternating polarity and defined rise and fall, this combination necessitating four wires. E is another combination of the same disposition of coils with the exception that the central coil S^2 is energized by currents having a defined rise and fall, but continuous in direction. The central coil is connected to one of the alternating leads, while the other terminal of the central coil is connected to a continuous current lead. The two extreme coils S and S^1 are placed in series with each other and are connected with their respective terminals directly upon the two alternating leads. F represents an alternating current motor which is energized directly from the two alternating leads. G is a combination of two coils, one energized by a pulsating current continuous in direction, while the top coil U is energized by a current of defined rise and fall, but alternating in polarity.

It often happens, however, that some of the apparatus in a mine is required to run faster or slower than the rest, and for this purpose I have devised a means which will give any number of current pulsations it is desirable to run the engine with. This simple means consists in the rotating of a brush upon the commutator of any contin-

uous current machine. This is illustrated in Fig. 2, where there are two reciprocating engines showing the maximum and minimum current respectively. Fig. 3 illustrates a means for rotating the brushes upon the commutator, while Figs. 4, 5 and 6 represent the different positions of the rotating brush, and illustrate clearly the action of the current between the generator and the coils of the engine. Fig. 7 represents an arrangement by means of which currents of different speeds of defined rise and fall can be collected, so that it becomes possible to run engines of different speeds from one single continuous current machine, the speed of which may be entirely neglected in our present question, since the speed of the current phases depends entirely upon the speed of rotation of the different traveling brushes. As shown, there are three traveling brushes, each one rotating at a different speed, thus operating the engines at three different rates of current impulses. Figs. 8 and 9 represent two diagrams, where the two stationary brushes *a* and *b* respectively bear upon the commutator of the continuous current armature, while two rotating brushes, *B* and *C* respectively, travel around the commutator, passing consecutively in front of the stationary positive and negative brushes, thus sending defined currents of alternating polarity over the lines connected to the rotating brushes,

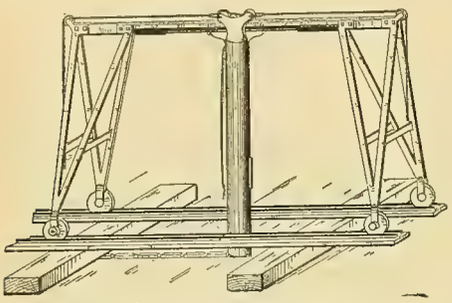


FIG. 26. ELECTRICITY IN MINING.

while current continuous in direction can be collected between the stationary brushes plus and minus, or a pulsating current can be collected between one of the stationary brushes and one of the rotating brushes As shown in Fig. 8, the center coil is energized by a pulsating current continuous in direction, while the two end coils are energized by currents of defined rise and fall, but alternating in polarity so that these coils react upon the polarized plunger, causing the same to reciprocate in accordance with the speed of the rotating brushes. Fig. 9 shows a method of connecting the polarizing coil by means of which the preponderance of the stroke may be given either forward or backward by closing the circuit between the central coil and the conductors. Thus it will be seen that I am enabled to furnish currents of defined rise and fall operating the reciprocating engines, either corresponding to the speed of the prime generator or independent of that speed, by simply causing collecting brushes to rotate over the rotating sectional commutator of the generator, and that currents of defined character can be obtained from the same machine, either continuous, pulsating, or alternating, and of such defined speed as is required to operate the respective machinery to be driven, each one at its proper speed.

Up to the present I have shown apparatus in which the current is simply transformed from continuous into currents of rising and falling quality, but of the same nominal potential as that of the machine itself or the supply to the motor generator or converter. There will be many cases, however, where power can be cheaply obtained at a considerable distance from the mines to be operated. In such case it will be advantageous to drive the prime generator by water power or other cheap and available means, and then to transmit this current, which can be of high potential, and then convert the same at the point of operation into currents of low potential, which can be easily handled without danger to the insulation of the machines or to the workmen having the same in charge. A great many different machines might be constructed that would answer the purpose of converting the high potential current into low potential energy. Fig. 11 shows such an apparatus, Fig. 10 being a side view of the machine. Fig. 11 shows that end of the machine from which transformed currents are to be transmitted, while Fig. 12 represents the end of the machine where the high potential current enters to be transformed. As shown in Figs. 10 and 12, the leads plus and minus from the distant source are brought up to the binding posts of the machine, from there connected to the brushes bearing upon the sectional commutator of what may be termed the high potential or motor part of the machine, by which power is transmitted to the shaft, which carries a second armature which is wound with a suitable size conductor, according to the potential desired, and, as here shown, the two independent armatures revolve within one common field, although this disposition is unimportant, and may be changed in a variety of ways.

It will be seen in Figs. 10 and 11 that the shaft bearing the armatures is provided with a small pinion engaging the large gear g^2, this gear transmitting, by means of a second gear g^3, motion to the rotating brushes, from which current is collected and transmitted by suitable means to the main line, as before explained. The continuous current for the system is obtained from the stationary brushes *I* and *J* pressing upon the sectional rotating commutator of the low potential armature, so that we have here a means of changing the high potential current to one of suitable potential, giving us an opportunity to take advantage of distant sources of power, making the same available for operating mines where it would be impossible to obtain either coal or wood or any other means for producing power. I have now shown the principles upon which the system is based for producing and distributing currents having the required rise and fall, and the generation of such currents either directly or indirectly, and have explained the different machines by which I accomplish my purpose. Having thus described my system of generating and distributing such currents, I shall now proceed to illustrate and explain a few of the reciprocating engines, such as are used in the operation of mines.

First in order comes the percussion or rock drill. Figs. 13 and 14 illustrate a reciprocating engine having two motor coils, one energized by a current of continuous polarity, while the top coil is energized by currents rising and falling and changing polarity. Fig. 13 represents the energizing circuits of the machine, while Fig. 14 illustrates its mechanical construction, the coil, as here shown, being the coil receiving the pulsating current phases of the supply circuit, the phases being, however, constant in direction, although rising and falling in character. The top coil is intended for the rising and falling currents of alternating polarity, and, as will be seen, is surrounded by a laminated iron shield, which may be continued on the bottom of the top coil, if desired. With this arrangement the plunger will be magnetized in a continuous direction by the action of the coil, but as the polarity in the top coil changes continually, the plunger will be reciprocated to and fro within the two superposed coils at a speed corresponding to the frequency of the current phases.

Figs. 15, 16 and 17 represent an electro-magnetic reciprocating engine, having a coil in the center energized by either a continuous or a pulsating current, while two coils are placed one at each end of the central coil respectively. These end coils are the seat of defined rising and falling currents of alternating polarity and cause the plunger to move in accordance with the defined currents. Fig. 17 shows the fixed and variable polarities of the engine under the action of the energizing currents. Fig. 15 shows the construction of such an engine, which can be applied either to pumping or the perforation of rocks, or, in fact, any purpose where a reciprocating motion can be used to advantage. Fig. 16 shows the energizing circuits, the connections of which can be made according to any of the different ways shown in Fig. 1. It will be noticed that in the construction of the reciprocating engines the exterior iron casing of the machine forms in each case part of the magnetic system of the machine.

The percussion drill can further be applied to channeling bars such as are used in the extraction of marble, slate and the like where blasting cannot be done, so that in this case a longitudinal slit can be cut of any length, width and depth desired; in fact, similar to the quarrying machines now in use, but which are driven either by steam or compressed air.

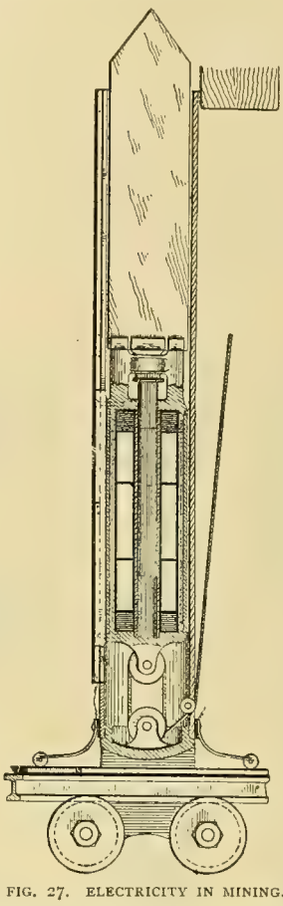


FIG. 27. ELECTRICITY IN MINING.

In the operation of mines pumps are kept running almost constantly to keep them clear of water, and up to the present time in almost every instance the work has been done by the ordinary steam or compressed air pump. In some cases ordinary pumps have been driven by rotary electric motors, while at the present time very promising experiments are being made with the application of my electro-magnetic reciprocating engine to the driving of all kinds of reciprocating pumps.

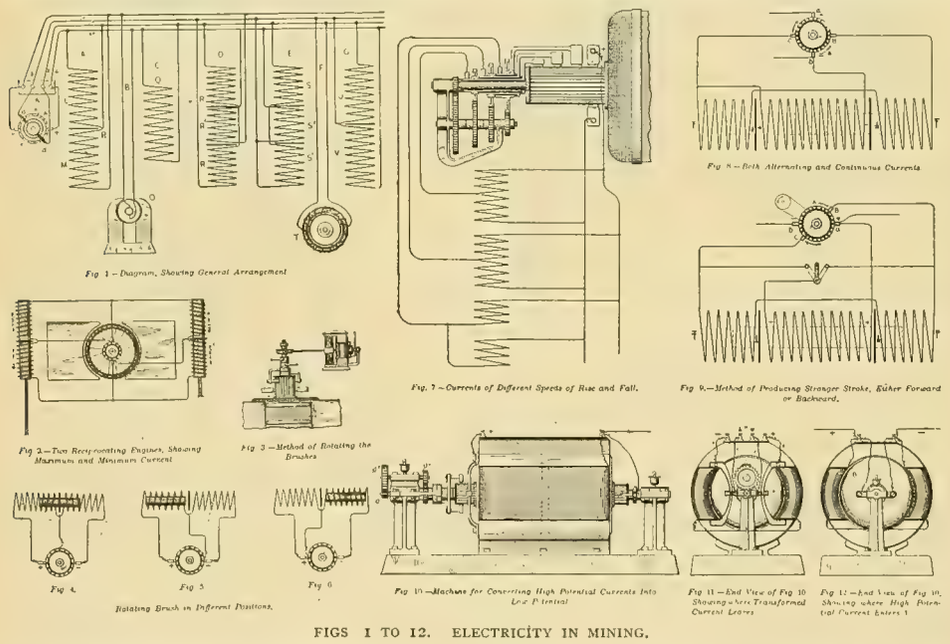
Figs. 18 and 19 illustrate a sinking pump such as used in mines where the pump is to be lowered down by block and tackle or other and suitable means, and intended to work while thus suspended. The cable connection between the power leads and the pump can be made of any length to accommodate the descent of the pump to its proper level, so that here certainly a ready means is obtained for pumping out a mine as effectively as any steam pump would do it, and with much less trouble of erection and attendant repairs. The pump shown is of the double acting type. The circuits are shown in Fig. 18, as well as a simple method of reciprocating the movable brush upon the commutator of the generator.

Fig. 20 shows a modification of such a pump, being single acting and intended to raise the water to great heights. The different figures show the circuits from the generator to the pump, as well as the mechanical construction of the same, and need no further description.

Fig. 21 is still another modification of an electric reciprocating pump, being of the single acting type and direct acting, inasmuch as the magnetic plunger plays the part of the pump's piston, being provided with valves and working in a diamagnetic tube, water packed or otherwise made tight within the cylinder or tube, thus producing a pump which will find many applications where water is not to be raised to great heights. Fig. 21 shows the construction of the pump; Fig. 22 shows the energizing circuits of the same.

Fig. 23 represents the application of the reciprocating system as applied in a smith shop, where the reciprocating action is applied to run hammers either for forging, riveting or other purposes.

Fig. 24 represents the system as applied to heavy forging. It represents a power hammer of the ordinary construction, having, however, electric instead of steam power to actuate it. It will be noticed that the power cylinder is composed of a large number of superposed solenoids of short length and large diameter surrounding an iron plunger *G* which is connected to the block or hammer *D* below the rod. The sectional coils are connected to a corresponding number of stationary and well insulated segments, and upon these segments bear three brushes or contact plates, so that by placing the three contact plates and keeping them stationary upon any part of the sectional commutator the current pulsations will take place between the respec-



FIGS 1 TO 12. ELECTRICITY IN MINING.

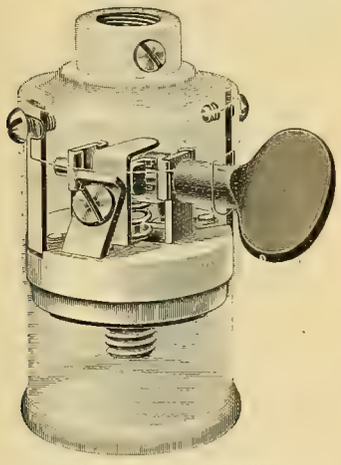
tive contact blocks and will reciprocate the plunger within the field created by the energized coils, so that by simply moving the handle *N* the contact blocks will be displaced upon the sectional commutator, thus displacing the magnetic field of the coils, and by so doing the same will be made to ply within a certain region, and can also be made to strike a light or heavy blow according to the distance between the hammer and the work. The handle *N* further regulates the power of the blow by placing more or less resistance in the return circuit, as illustrated in the diagram. With this disposition it becomes at once practical to construct the largest hammers used in heavy forging. No valve mechanism or other delicate parts being present in such a machine, the same will lend itself readily to all purposes where steam or compressed air is being employed at present.

Not only can reciprocating motion be produced by the system of rising and falling currents, but the same can be converted very readily into rotating motion, such a machine being represented in Fig. 25, where a tri-cylinder reciprocating engine is shown, the circuits of which are illustrated in diagram between the generator and the circuits of the engine.

In fact, space is too short to enumerate all the applications to which the reciprocating system lends itself, and last but not least, I show in Figs. 26 and 27 the application of the reciprocating engine to the driving of piles, the illustrations showing such an engine as applied to sheet pilings, as used in the digging of sewers or other trenches where quicksand or other loose material has to be dealt with. Fig. 26 shows the apparatus as in operation, being carried by a transferable carriage, which can be moved along on suitable rails as the work progresses. Fig. 27 shows the support of the reciprocating engine guided within an iron tube, the same being slitted on the side for the introduction of the board or plank to be driven in the ground. As here shown, the full weight of the reciprocating engine is at once placed upon the board, the rope raising the engine being entirely free when the engine is to be started to work. It will be noticed that the board is placed between the downwardly projecting lips on the lower end of the engine, and that between these lips is placed a driver also embracing the top of the board. The engine itself is driven by means of any of the methods already explained, reciprocating a heavy iron plunger, which strikes forcibly upon the driver, at the same time partly lifting up the whole body of the engine, so that on the up-stroke of the plunger the weight of the whole engine comes down upon the board and continues to drive the same downward, when the next blow will repeat the same action, thus affording an apparatus which causes a double action, one blow being struck directly by the plunger and the other by the falling of the machine itself upon the pile.

The New Perkins Socket.

The cut shows a new socket made by the Perkins Electric Switch company of Hartford, Conn. Differing from most other sockets, there is only one porcelain, which is guided into the shell by two upright brass legs. These legs are thoroughly insulated from the contact pieces, the screws in the end of which hold the mechanism in the proper position in the shell. The cap is fitted with a bayonet lock for the screw heads.



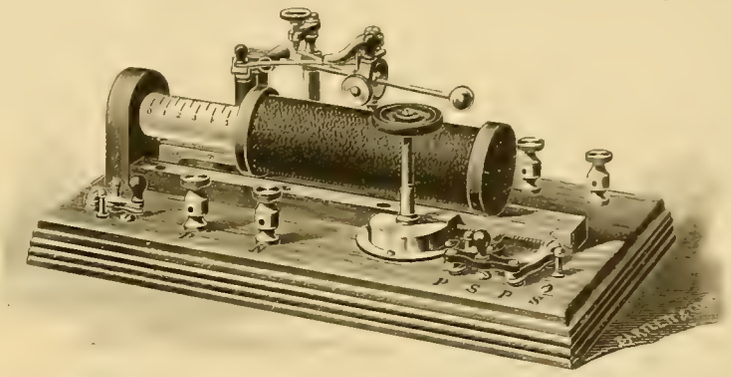
THE NEW PERKINS SOCKET.

As will be seen the contact is made in a novel manner, by means of a parallel brass slide upon two upright pieces of sheet brass, which form part of the one pole of the socket. This slide is always kept pressing up against the tumbler by means of a small phosphor bronze spring, so that there is good contact at all times, the connection being made by means of the tumbler, when in a vertical position, between the slide and the L-shaped piece of brass shown in the illustration. It is claimed that this socket possesses all the best features of the existing sockets, and is the result of careful development. The binding screws are well back from the shell. It is extremely easy to wire, and owing to there being only one porcelain, admits of a large knot being made in the wire, for the purpose of hanging the socket, so that the strain is taken off the binding screws.

The Law-Dubois-Reymond Faradic Coil.

The manufacturers claim for this coil that the soft iron wire in the core and the length of the wire in the primary coil are exactly proportioned to the electromotive force of the two cells used to operate the coil, and also that the secondary coil is wound to the length and number of convolutions necessary to secure the highest efficiency from the primary and the core.

In the Law-Dubois-Reymond coil the circuit breaker is operated by a separate set of magnets. This disposition of the vibrator, it is claimed, adds to the efficiency of the coil. The movement of this portion of the coil is even and constant, and the vibrations can be raised from 80 to 200 per second by means of the adjusting screw.



THE LAW DUBOIS-REYMOND FARADIC COIL.

The slow interrupter, calculated to break the circuit from 40 to 600 times per minute, is mounted on a standard, and is so arranged that the removal of the fast vibrator from over the magnets allows the interrupter to rise to its place.

The rack and pinion, by which the secondary coil is removed from over the primary, allows of a gradual increase and decrease in the currents not possible where the steadiness of the hand alone is depended upon.

The two binding posts marked *P* and *N* are for the electrode cords, and when the double switch rests on buttons marked *P P* the primary current is obtained, and when the switch is thrown on buttons marked *S S* the secondary current is obtained. The small one button switch is for throwing on or off the battery. The coil is mounted on an oak base 10 inches wide by 13 inches in length. This coil is intended for physicians' offices, sanitariums, hospitals, etc.

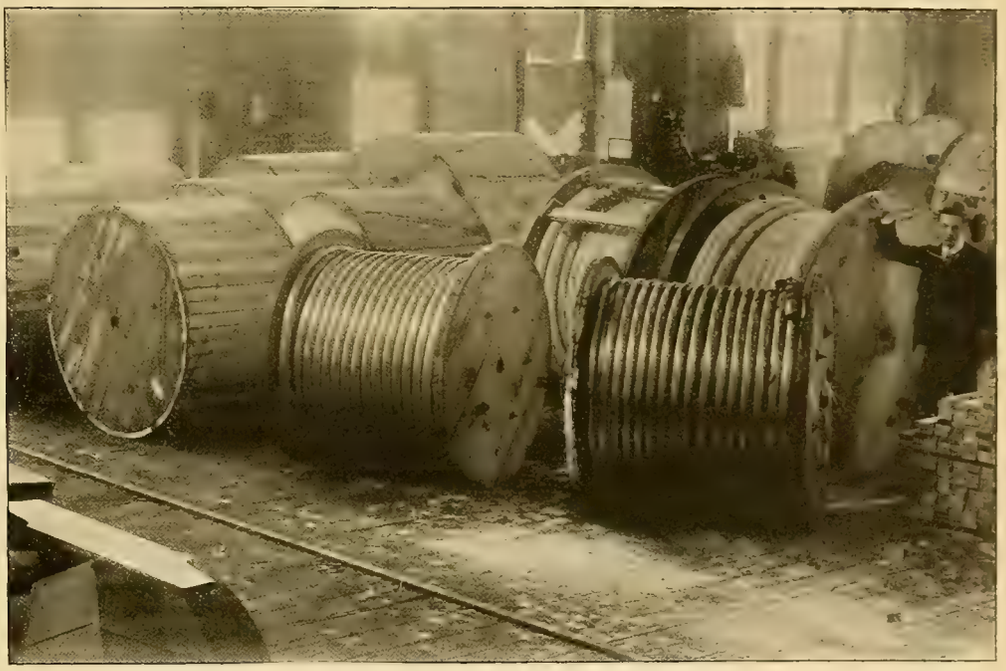
The new hotel Waldorf in New York is to be fitted with telephone communication between the office and every room in the house. This is a system stated to be in use in the Adelphi, Liverpool, and as a feature of hotel service is an important one, especially in the saving of time. Instead of pushing a button and waiting for a hall boy to answer the ring guests can communicate their order to the office at once and have it filled in one-half the time.

Manufacturing Telephone Cables.

Recent advancement in electrical engineering has been noticeable in many allied industries, especially in the manufacture of wire and cable. Considerable difficulty has been experienced in lowering the static capacity to meet the requirements of the specifications of the telephone and other electric companies. A short time ago .20 or .21 micro-farad were considered satisfactory, but this has been decreased until now .080 micro-farad is required.

Although the Edison General Electric company has for sometime been manufacturing telephone cable, it has only recently put in the immense lead presses which now enable it to turn out complete lead covered cable. With these new facilities, the difficulties just mentioned have been overcome, and several cables lately shipped have, it is claimed, shown a static capacity of not more than .075 micro-farads. In striving to lower the static capacity, the matter of insulation has not been neglected and a remarkably high insulation has been obtained.

While these points are excellent in themselves, they do not alone constitute superiority when compared with the best cables of other manufacturers. It has been customary to press the lead over the core in a semi-viscous state, the molten lead being poured into the press. Lead in this condition, it is said, may carry on its surface a thick scum consisting of impurities, oxides, etc. This can be partially removed by ladle, and when pouring the lead into the press, considerable oxidation may take place. The Edison company has determined to adopt the process of Siemens & Halske, and use absolutely cold lead. It is claimed for this method that every particle of oxide is removed before insertion in the press, and as the atmospheric pressure is increased the lead is pressed out over the cable, inclosing it in an armor impermeable either to air or water



MANUFACTURING TELEPHONE CABLES.

Cable recently supplied to the Metropolitan Telephone company of New York has received unqualified approval, and although dry core was used, the cable could be handled as well as one made with the saturated core. The uniform gauge of the cable and its smoothness were also matters of appreciative comment.

The Pacific Telephone & Telegraph Company of San Francisco recently placed a large order for this cable, the lead sheathing inclosing no less than 100 pairs of wires.

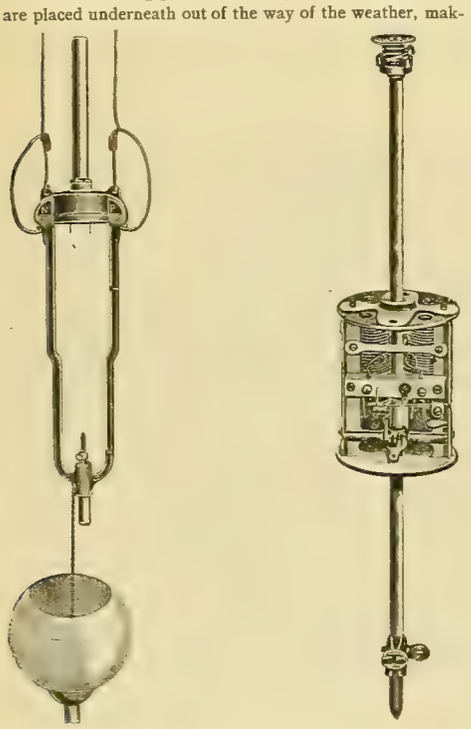
In the cut a corner of one of the cable shops at Schenectady is shown with several drums of this cable awaiting shipment. The larger drums are 5 feet 16 inches in diameter by 3 feet 6 inches wide, the smaller ones 4 feet 8 inches in diameter and 3 feet 6 inches wide.

Waterhouse Arc Lamp for Arc or Incandescent Circuits.

With the numerous arc lamps now before the public, it seems almost impossible to improve on some of the present styles. But the lamp recently placed upon the market by Waterhouse Bros. of Hartford, Conn., has several new features worthy the attention of those interested in arc lighting. It is believed by the makers that this lamp fulfills all the requirements found by long experience to be necessary. Following is a detailed description of the lamp:

Fig. 1 shows the frame with works removed. Fig. 2 represents the works with carbon rod attached, and Fig. 3 the works without the rod.

The lamp is very neat in design, light and compact in construction, and it is both dust and weather-proof, requiring, when placed out of doors, no protecting hood or canopy. Its length over all is 45 inches and weight 23 pounds. In Fig. 1 is shown the attachment for holding the globe during the trimming or cleaning of the lamp. The globe holder is dust-proof, and is made in cup shape, so as to form a recepticle for carbon dust, and thus avoid the necessity of taking off the globe every time the lamp is trimmed. With this style of holder, the dust can be brushed down and remain for two or three weeks, as it sets far enough below the lower carbon holder and terminal to overcome all danger of a short circuit or a ground. To empty the globe it is only necessary to unhook the chain from the frame and tip the globe. The globe is intended to be at all times fastened to the holder, so as to lessen the danger of breaking. The holder is fastened to the frame by a snap spring which engages with a hole in the side of the frame. Fig. 1 shows how the outside connections are brought to the lamp; also how connection is made with working parts of the lamp. The binding posts are placed underneath out of the way of the weather, making much neater and safer terminals than those usually attached to top of frame.



FIGS. 1 AND 2. WATERHOUSE ARC LAMP FOR ARC OR INCANDESCENT CIRCUITS.

Fig. 3 shows the works in detail. From the form of magnet used, great strength and wide range are obtained.

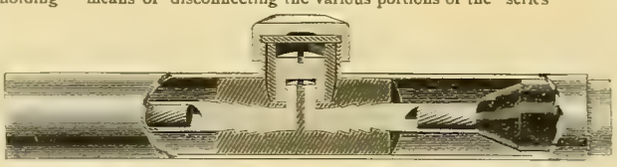
There are no springs, and there is but one piece of insulation in the whole lamp outside of the insulating cement which attaches the binding posts. The clutch feed is used, as Waterhouse Bros.' long experience has proved it to be the most practical as well as the most reliable style of lamp for both inside and outside lighting. An objection heretofore has been the tendency to overfeed when the rod becomes a little worn. This objection, it is claimed, is entirely overcome in the new lamp by the employment of the peculiar device noticed on top of the carbon rod. This device is an air plunger working a peculiar clamping device inside of the chimney of the lamp. The quick and positive feed in the lamp for incandescent circuits, it is stated, entirely overcomes the tendency of one lamp to rob another of current where they are run in series across mains above 75 volts.

The same works are employed for arc circuit lamps as those for incandescent circuits, the only change being in the cut-out. A lamp can be changed from one-half to full arc, or *vice versa*, by simply changing the magnets. Having works and frame separate, it is not necessary to carry the whole lamp to the station when it is in trouble. The frame may be left hanging and a new feeding mechanism, which, it is asserted, can be carried in the coat pocket, may be attached in a very short time.

These lamps are made to run on any circuit, arc or incandescent, at any voltage, and from 5 amperes up. Carbon holders for 7-16, ½ and ⅝ inch pencils are provided.

Cutter's Conduit Connector.

On account of the spread of underground arc lighting systems, it has become the more necessary to have means of testing every section of the lines in order to keep them in proper order. The conveniently placed manhole gives ready access to the cables, so all that is needed is a means of disconnecting the various portions of the series circuit. George Cutter, Chicago, has designed a conduit connector which is illustrated herewith. The cut shows how the ends of the two lead-covered cables are soldered into metal terminals imbedded in hard rubber. A metal screw-cap, when in place, makes the connection between these two terminals, and opens the circuit when it is removed. This screw is covered by an insulated and water-proof cap which seals the device, the brass shell being soldered to the lead covering on the cable. The construction of this form of connector allows it to be wired very quickly, and many months of experience with it have shown its effectiveness. Hundreds of these conduit connectors are used in Chicago alone, and George Cutter, who is the sole manufacturer, is busy making more of them.



CUTTER CONDUIT CONNECTOR.

Prize Essay on the Transmission of Power by Electricity with Special Reference to Its Application to Mining.

An alumnus of the School of Mines of Columbia College has offered a prize of $100 for the best essay on the subject of transmission of power by electricity, with special reference to its application to mining, that may be presented by a graduate of the school. The essay must be sent to Prof. W. P. Trowbridge on or before November 1st. President Seth Low will appoint a committee to examine the essays and award the prize.

Wisconsin Electric Club.

A very enjoyable lecture by Prof. F. E. Davies, of the Madison University, on "The Energy Relations of Voltaic Cells", was listened to by the Wisconsin Electric club at its club rooms in the Loan & Trust building, Milwaukee, Friday evening, May 13th.

Dr. Davies said in conclusion that in these days of dynamic electricity, the powerful forces at work in the galvanic cell in the production of electricity, were liable to be lost sight of, and that it would be well for the electrical student of to-day to give more time to the study of the primary battery. "In years to come," he added, "when a method shall have been discovered for utilizing more completely the immense forces let loose in the chemical action of a voltaic cell in the production of an electrical current, electricians will look back on the practice of to-day with wonder at the crude and wasteful methods employed."

The common council of Salem, O., has ordered the city clerk to advertise for new bids for city lighting. The council had secured a report from Rob. Mackie of Cincinnati, on the candle power of the lights furnished under the old contract, which showed that the company was not living up to its contract. The report showed that the fault was in the operation of the plant, and not in the system. The company denied the accuracy of the test and questioned its fairness, but the council passed a resolution expressing approval of Mr. Mackie's work and its confidence in his ability and integrity.

Electrical Power Transmission.[1]

There is no longer any question as to the superiority of electricity for the transmission of energy to a considerable distance. In fact, this has been the great advantage of electricity since it was first applied to a useful purpose for instantaneous communication between distant points. The only difference is that in one case we have the mere transmission of signals and in the other the transfer of a sufficient amount of energy to come within the definition of "power." Knowing what can be done theoretically, however, the question of practical application becomes of importance, and before this is fairly solved it must be known that a demand exists for the transmission of power over long distances. Under ordinary conditions this demand is not strikingly apparent, for the reason that we are now so well served, through the mining, transportation and consumption of fuel, that power is developed at so small a cost as to become a matter of minor consideration. When distributed as it is amongst the mass of consumers, the tax for power is practically imperceptible, and when compared with the cost of production before the general introduction of the steam engine, it disappears altogether. In practice we have gained so much by labor saving machinery that the prime cost of moving it, to use a slang expression, is "cut of sight." It is for this reason that the earlier and more important installations of electric power transmission, have been due to exceptional circumstances, where the cost of fuel is comparatively high, as in some of the mountainous districts of the mining regions or upon the never failing streams in Switzerland, a country where power distribution is probably of greater importance than in any other part of the world. Under stress of competion, however, the tendency is ever toward the cheapest possible production of power, and any advantage gained by the location of a certain manufactory, must be met elsewhere, or the business that is carried on at a greater cost in one branch must economize in some other direction in order to establish the equilibrium. What may be saved in one location by cheaper power, may be offset in another by lower freights. All advantages and disadvantages of this character must be calculated upon before it can be determined whether a demand exists for long distance transmission of power, and when we consider the doubts which arise even in the minds of those electrical engineers who have devoted most attention to the subject, it must be admitted that there are at present comparatively few opportunities where the advantage to be gained is sufficient to warrant incurring the risk of failure—not an absolute failure, but a failure in an economic sense. That is to say, the power might be transmitted at reasonable efficiency, but at a cost exceeding that of producing power by well-known methods. In work of this kind sentiment must be eliminated. It might be a grand thing, and a great object lesson to transmit power from Niagara Falls to the World's Fair, and yet as a matter of business it would be far cheaper to transport coal by rail to Chicago and burn it on the spot. The utilization of water power at Niagara is a different proposition. There is to be located a great manufacturing city. The transmission of this power economically to Buffalo, for instance, is a separate question, and will be solved by the relative cost and convenience of the different systems, viewed from a strictly economic standpoint. In fact the question of long distance power transmission by electricity, like that of the electric motor for the operation of steam railways, is one of the future rather than the present. There is an intermediate field for the electric motor which may well occupy attention for some time to come, and while experimenting is always in order it is most profitable to investigate within reasonable limits, where the advantages to be gained are readily apparent.

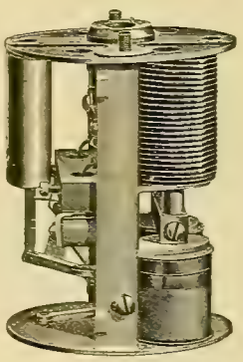


FIG. 3. WATERHOUSE ARC LAMPS FOR ARC OR INCANDESCENT CIRCUITS.

Underground Wires in Europe.

In obedience to instructions issued last June the United States consuls in several of the principal cities of Europe have forwarded reports in regard to the use of underground conduits for telephone, telegraph and electric light and power service. The conduits are generally used for the telegraph and telephone wires. Marseilles being the principal point at which they are still carried overhead on poles across the housetops or attached to the sides of the houses along the streets. In Antwerp, however, the conduit built eight years ago has never given satisfaction, and is to be replaced by an air line. Cables for the transmission of power and for lighting are carried above the ground in Copenhagen and Cologne, in cement conduits at Nantes, and overhead to Rouen. In Germany the change from overhead to underground is still a matter of experi-

1. From *Electric Power*.

ment, but may be said to be in progress. In some of the cities, as Bremen, for instance, electric light wires run in a cemented brick tunnel and iron case, and the government has recently adopted a standard form which is now in use by the Imperial Telegraph Bureau. The cost is $290 per mile, but the insulation is imperfect, for which reason the cables require more delicate instruments than overhead wires for successful and rapid working. Rome has no underground conduits, and a few in Florence are unsatisfactory.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 14.—The metropolis is still wrestling with the rapid transit problem, and as might be expected, the proposed underground plan continues unpopular. A detailed report of all the "talk" that has been reeled off during the last few weeks would fill a dozen books, and to the electrical man waiting his chance to bid for the introduction of the motive power equipment, an account of the "hearings" would be as uninteresting as voluminous. In reading the newspaper reports on the rapid transit question one's curosity is excited as to what might be the cause of the animosity displayed by some of the dailies. In the long editorial on "Surface Rapid Transit" in to-day's *Times* the learned scribe, that I might almost venture to say has never ridden in an electric car, calmly makes the somewhat amusing assertion that "Electric motive power is still a dream. That it is a distant dream we may be assured by the amount of money that has been sunk and is even now sinking in the construction of cable roads. If there were any near or certain prospect of the production of a practicable electric motor we may be quite sure that the shrewd men who control the surface lines would not be making this enormous investment, which the production of such a motor would render entirely useless."

While on the subject of the New York city railways it should be stated that recent agreements among the various lines of surface roads in the city point toward such practical consolidation and extension upon the west side that the existing congestion of travel upon elevated trains will be perceptibly relieved.

The Houston, West Street and Pavonia Ferry Railroad company, more frequently called the "Broadway Syndicate," because it controls the Broadway and Seventh avenue line, has recently taken a lease of the Ninth Avenue Railroad company's property, and now proposes to run cars, either by cable traction or electrical power, in connection with the Broadway system, along Columbus avenue to One Hundred and Tenth street. It is also proposed to revive the old scheme of running cars through Lenox avenue from the upper extremity of central park to the Harlem river, with such connections and cross-town branches as shall revolutionize existing transit facilities.

John D. Crimmins, president of the Houston, West Street and Pavonia Ferry Railroad company has made the following statement in reference to the project:

"The extension of the Broadway system in Columbus avenue will begin at Sixty-fourth street and run up to Morningside, under the tracks of the elevated railroad. We shall make a connection with the Broadway system somewhere between Fifty-ninth and Fifty-third streets, wherever the consent of property holders can be most readily obtained, and where the convenience of the greatest number of passengers will be served.

"We shall run two tracks up to Columbus avenue. The road is to be constructed so as to be independent of horses. I take it that horse cars have had their day for long lines of travel. The power will be either a cable or electricity."

In reply to the question "Does 'electricity' mean the trolley system?" President Crimmens said:

"Very likely. The accumulator and Julien people have been fighting each other until there is practically no electrical motor in sight that I know of except the trolley system. However, no system has yet been decided upon. If the trolley should be adopted we would rig it up under the tracks of the elevated structure, provided the Manhattan company would consent. If they would not consent, we should make our own structure just underneath."

At the annual meeting of the National Board of Fire Underwriters held on Thursday last, the Committee on Lightning, Heating and Patents pointed out in its report that there had been many mysterious fires in the last two years' and that it was almost forced to conclude that there was at present some unusual social hazard, that merchants of the highest standing had become incendiaries, or that electric lighting currents were chargeable with the loss. According to the committee, losses from electricity arose in three ways, from sparks from arc lights, from grounding of wires, and from imperfect joints or splices or imperfect insulation, and all these would seem to be preventable by the exercise of proper care.

In consequence of a belief that the frequency of fires has been due to unprotected electric wires, the insurance companies of Newark, N. J., have raised their rates. To prevent injury to their business, though, the Newark electric lighting companies have agreed with fire underwriters, that wires are to be strung in accordance with the rules adopted by the National Insurance Bureau and National Electric Light Association in 1891.

The New York state electrical executioner will probably do a brisk business next week. On Tuesday last it looked as though there would be three electrocutions in the State prisons during the week commencing May 16th. The condemned are John S. Tice, at Auburn prison, Charles Wright at Dannemora and Henry C. Fanning at Sing Sing. The judgments against Tice and Fanning have been affirmed by the Court of Appeals, but the case of Wright has not been passed upon by that Court. To-day, however, Governor Flower commuted Fanning's sentence to imprisonment for life.

Things move with deliberation in the East, so the installation of the electric system in Jersey City has not come on with such rapidity as was hoped for. But there is good reason for the delay. The idea is that with the completion of the new road across the Newark meadows, from West Side avenue to Newark, the electric poles and wires will go up in the city as part of the same contract. It is expected that the whole system will be in operation this summer.

The Orange Crosstown and Bloomfield railroad is to be equipped with the overhead system.

W. F. O.

Milwaukee, Wis.

MILWAUKEE, May 14.—The blanket street railway ordinance has been signed by the mayor and published. It is by all odds the most important supplementary railway ordinance ever granted by the common council. Besides the Fond du Lac avenue franchise, which is embraced in a separate ordinance, the company has secured permission to extend its system on the following streets: Humboldt avenue, from Lee street north to the city limits; Park place, from Murray avenue to Oakland avenue, and on Oakland avenue north to the city limits; Winnebago street, from Chestnut street to Eighth street; Clybourn street, from Sixth street to Eleventh street, and on Sixth street from Clybourn street to Sycamore street, and on Sycamore street from Sixth to Third street; State street, from Eleventh to Sixth street; First avenue, from Maple street to Lincoln avenue; Lake street, from Clinton to Barclay street; Howell avenue, from Kinnickinnic avenue south to the city limits; Ellen street, from Nock street to Kinnickinnic avenue, and on Kinnickinnic avenue south to the city limits; on Delaware avenue, from Ellen street to the city limits; Forest Home avenue, from Lincoln avenue to the city limits. Most of the lines, except those which will run to the city limits, are intended to connect different branches of the present system and afford practically new lines between the outlying portions of the city and the business district, thus rendering unnecessary the excessive use of one track. The ordinance provides that work on the new lines must be commenced before June 1st, and finished before Dec. 1st, 1893. The charter will expire July, 1924, unless it is renewed. The company must repair the street between its tracks and one foot on each side.

A proposition to extend the Milwaukee and Wauwatosa Rapid Transit line south to the state fair grounds is being talked over by the stockholders. If it is extended to the fair grounds it will be built to North Greenfield as well, and place a great deal of residence property on the market. Much of the property needed for a right-of-way is owned by the stockholders. The Wauwatosa line will probably be opened in a few days.

Among the cars which were destroyed by fire in the Northern Car company's works at Minneapolis were a number, including four that were ready to ship, that had been ordered by the Milwaukee Street Railway company.

The demands of the operatives on the Milwaukee Street railway, as has been expected, were settled without any serious trouble. The men held a meeting and resolved to demand 20 cents an hour, eleven hours to constitute a day's work, but made no threats to strike in case of the demand being refused. A committee of the employes held a conference with Vice president Payne of the company, and finally decided to accept 17 cents an hour; 10 hours and 48 minutes to constitute a day's work, and overtime to be paid at the same rate—17 cents per hour. These terms proved generally satisfactory to the men. Mr. Payne announced that as a result of the arrangement cars would run later than before on the Third, Walnut and Chestnut street lines.

Last week several scores of laborers engaged in building the new electric line on Clinton street went on a strike and tried to prevail upon laborers employed on other lines to follow their example. They were not successful. They struck in order to enforce a demand for $1.50 a day. They were receiving $1.35, the amount fixed last fall when the days became short. Not being successful, some of the men returned to work, and the places of the others were filled without any trouble.

A car was run over the new North avenue electric line a few days ago, and every thing was found to work satisfactorily.

Frank Ziegler, superintendent of the George Ziegler Candy company, kept employes of the Milwaukee Street Railway company from piling rails in front of the company's plant on East Water street, by turning the hose on them. A policeman appeared on the scene and ordered Ziegler to stop. His refusal was followed by his arrest. On the trial the prosecution showed that the work of laying new track was being conducted with as little annoyance as possible to business men. Ziegler on the other hand, claimed that the men were leaving rails so that the company's wagons could not back up on the sidewalk. Judge Walker held that Ziegler had not taken the law into his own hands, but had simply protected his property in the easiest way possible. An injunction would have resulted in long and tedious litigation. Ziegler was formally acquitted.

Several accidents have happened on the Villard lines within the past two weeks and prevented cars from running for a time. On one occasion high winds threw the draught machinery at the power house out of order.

The Milwaukee Board of Fire Underwriters has issued pamphlets containing specifications for the installation of electric plants and the putting in of electric wires. It is stated in the pamphlet that the fire at the West bookstore in February, 1891, was caused by an electric lighting apparatus. L. A. Carr has published a communication denying this statement. The electric light plant, he avers, had been shut down thirty minutes when the fire broke out. The cut-out cabinet in which the fire started, according to those who claim that it was caused by electricity, was burned from the outside, and the bottom was burned very little. Mr. Carr says that the cabinet would have been burned on the back side had it been caused by electricity. He adds that the plant in the New Insurance building, where the fire occurred, was installed by experts, and has always been cared for by careful men. He states that he does not deny that a fire by electricity is impossible, but says that statements like the one in the pamphlet are unjust, and injure the electrical industry. Too much, he concludes, cannot be said in praise of the insurance men for what they have done to secure better electrical installations, but even they make mistakes, as is evidenced by their statements regarding the West fire.

In the Superior Court Miss Mary Hardy has secured a verdict against the Milwaukee Street Railway company for $5,000. On Sept. 7, 1891, she was injured while alighting from a Farwell avenue electric car. The car, she alleged, started up before she got off. She claimed that her injuries were worse than they would have been otherwise because the height of the step had been increased by putting in motor car trucks, the car being one of the old ones.

The Board of Public Works has ordered three bridge motors from the Thomson-Houston company. The contract amounts to about $4,500, and the motors are for State, East Water and West Water street bridges.

Wauwatosa is not lighted by electricity any longer. The lights had been maintained at the expense of the more generous citizens, and they became tired of the burden. The Wauwatosa Electric Light company did not find the contract very profitable. The residents may decide to incorporate as a village and then electric lights will be supported by taxation.

In the Circuit Court ex-Alderman Thomas Ramsey sued the Holmes Electric Protective company, which sells and keeps in repair burglar alarms, to recover $5,000 for breach of contract. After he had made an agreement with the company, he alleged, it turned its business here over to the Milwaukee District Telegraph company. The jury gave him a verdict for $1,425.50.

C.

Cincinnati, O.

CINCINNATI, May 14.—The question of the contract for the city lighting has been disposed of as far as lies in the power of the Board of Legislation. An ordinance awarding the contract to the Cincinnati Edison Electric company has been adopted. Mayor Moody has approved the ordinance and it now remains for the company to begin operations.

The contract for the plant for the new city buildings has been awarded to the Western Electric company of Chi-

cago. This gives the company the entire honors on this plant, as it had already secured and practically completed the contract for the wiring of the buildings.

George F. Card has completed drawings for a novel coal mining machine. Mr. Card has been working an experimental machine in one of the largest coal mines in the state, where he has personally watched its operation in service. He has also recently designed an electric drill for underground work. Mr. Card is now devoting his entire time to designing electrical wiring machinery, and will soon have a full line of special electrical tools, including a locomotive and a slow speed motor for fan and pump work.

On Saturday, the 7th inst., the Board of Administration removed Luke Lilley who, for a number of years, has been employed in various electrical capacities by the city, first as inspector and afterward as electrician.

Those interested in the postoffice and telephone service will be surprised to learn that Supt. Alonzo D. Burt of the fifth division of the railway mail service, has resigned that position to accept a more lucrative one under C. Jay French of the National Bell Telephone company.

It is reported that the C. H. & D. R. R. company will build a large station in the heart of the city, and that passengers will be carried from the present station to the new one "by means of electricity." Whether this feat is to be accomplished by wires, or on cars underground or overhead, the local reporter thinks entirely unnecessary to state, considering it, no doubt, a "mere detail."

Thursday afternoon an attempt was made to run the first electric car over the new Cincinnati and Newport bridge, but it was found the truck was too wide and struck the curb of the footwalk.

Friday morning, however, the trip was successfully made with another car, and a number of leading citizens and electrical men rode back and forth a number of times to test the current required to operate the road. Among those on the car were Mayors Berry of Newport, Harms of Bellevue, and McLain of Dayton, the three cities to be reached by the new extensions of this road. Messrs. Bullock, Williamson, and Superintendent Jenkins of the Street Railway company; Vice-President Hesser and Superintendent Weissleder of the Cincinnati Electric Light company and Robert Mackie, who made the tests of current used. The current for this section of the road is furnished from station A of the Cincinnati Electric Light company on a meter basis.

Excitement ran high on Madison avenue, Covington, on the morning of the 12th inst., caused by the falling of a large maple tree across the street, carrying with it the numerous electric light and street car wires. Several horses standing near by received shocks and were knocked down, and a man who tried to release one of them was entangled in the wires, and another man driving past was knocked from his cart, without serious injury. The cause of the accident was the cutting away of the roots of a large tree to make street improvements.

C. E. E.

Detroit, Mich.

DETROIT, May 14.—The directors of the Citizens Street Railway company recently took the first practical step toward furnishing rapid transit to this city, and although the people had been shouting for improved street railway service and the company had been abused for not meeting the demand, this first step was met with opposition. In order to secure the best available apparatus the company ordered its general manager to have a public test of the several systems made on Jefferson avenue. Both overhead construction and storage batteries were to be given a fair trial, but the people kicked, and kicked vigorously. The Board of Public Works was asked to prevent the erection of overhead wires. The railway company has gone ahead, however, and it is now announced that a contract has been awarded to the Detroit Electric company to equip the Jefferson avenue line from the Michigan Central depot to the old city limits, with the trolley system. The contract provides that the electrical company shall have the line equipped and ready for cars to run by July 22d, but if unforeseen delays do not occur, the work will be finished by July 6th. The figures for the work have not been made public, but are said to be close to $100,000.

Supt. Cottrell of the railroad company says: "Iron trussed poles will be used. They will be set just inside the curb, 125 feet apart. The shops of the company on Antoine and Woodbridgestreets will be used as a power house. The electrical company guarantee to furnish sufficient power to run a train of five cars at any rate of speed desired, and besides this plant the railway company will have an emergency plant to prevent delay in case the main plant breaks down. The Jefferson avenue line was rebuilt last year with special reference to running electric cars on it."

The work of setting poles will commence next week. The poles will be set in concrete, and will be twenty-two feet high. Some of the new cars now running on the Woodward and Jefferson avenue lines, were built for electric roads, having been wired and arranged so that motors can be put in at any time.

It is expected that Jefferson avenue citizens may apply for a temporary injunction, but no fears for the result are anticipated by the company.

It is reported that the directors of the Fort Wayne & Elmwood Street Railway company, having for some time had under consideration a proposition to introduce the overhead system, have voted to issue bonds for the purpose of making the improvement, and a meeting of the stockholders has been called to vote on the bonding question. If the stockholders approve the bonds all that portion of the line west of Woodward avenue will probably be equipped before next January. Under date of May 10th, one of the Detroit papers says: "Yesterday was a great day for this town. Yesterday three things happened. The Citizens Railway company signed contracts for a rapid transit system on Jefferson avenue. The courts refused to uphold those suburban property owners who tried to enjoin the building of an electric railroad that will connect Detroit with the suburban settlement of Delray, Amman, Ecorse, Wyandotte and Trenton; and the same courts refused to uphold the contention that no railroad shall be built out Gratiot avenue to Leedsville and beyond."

H. Leonard Wilton has resigned his position as secretary and general manager of the Peninsular Electric Light company, to take part in a private enterprise. He leaves at an early day for Europe and on his return will take up his new duties. He will retain his connection with the Brush Electric company, of which he is secretary.

The bellows of the pipe organ in the First Congregational church of this city is operated by an electric motor, and the connection between the keyboard and the action of the organ is effected by an electrical system, the current being supplied by a storage battery. So far the electrical system has worked satisfactorily. G.

Spokane, Wash.

SPOKANE, Wash., May 11.—Articles of incorporation of the Spokane & Cœur d'Alene Railway & Navigation company were filed to-day in the auditor's office. The amount of the capital stock is $500,000, divided into 5,000 shares of $100 each. The incorporators are A. A. Newbery, W. S. Norman, James Monaghan, L. C. Dillman, and D. M. Drumheller. It is the purpose of the company to construct an electric raliway from Spokane to Cœur d'Alene Lake, thirty miles distant. It is connected at present with Spokane by the Northern Pacific railroad. Engineers are now at work surveying for the most feasible route, and seeking for the lowest possible grades. It is the idea of the directors to procure a line with a maximum grade of one per cent. and to build it with heavy rails, so that the high speed proposed can be easily attained. The distance between Spokane and Cœur d'Alene will be made in one hour. Gearless motors will probably be used, and the passenger cars will be so arranged that they can traverse any part of the city of Spokane system, and they would, of course, come into town on the regular speeds allowed by city ordinances. It will be necessary, in order to make the distance in one hour, to build the motor and equipments to make forty miles an hour on the open prairie. Auxiliary power will probably be obtained at Post Falls, a small town on the route with a large water power. The cost is estimated by Mr. Norman to be about $700,000. Service will be given every hour; and the articles of incorporation specify the hauling of freight, parcels, United States mail and express matter, the hauling of ores from the mines, the use of steamboats, ferries, etc., on the lake.

The Spokane Street Railway company has received its new equipment of Thomson-Houston apparatus. This consists of twelve Thomson-Houston single reduction "W. P." motors and eight complete car equipments, four for double and four for single equipments. This apparatus is now being equipped on Brill trucks and cable dummies, which the company took off their cable road when they turned it into an electric road. The company is now extending its road from the center of its system to the southeast end of town, in Liberty Park. This extension proceeds from the corner of Howard and Second streets, up Howard to Fourth, along Fourth to Arthur avenue, thence up Washington avenue to Eighth street, in all about two and a half miles. The cars will be running on this extension in about a week. They are also building another extension of half a mile from the end of the Boone street line to Twickenham Park, where a large pleasure resort and zoological gardens are just opening.

J. M.

Seattle, Wash.

SEATTLE, May 11.—This city will have a new electric street railroad. D. T. Denny, president of the Rainier Power & Railway company has signed a contract, which covers the construction and equipment of the new Third street railway and an extensive electric lighting system. The power station is at the Western mills, on Lake Union.

The Short system has been selected and the St. Louis Car company will build the cars. There will be six handsome vestibuled cars. The present lighting plant will be increased by 2,000 incandescents and 100 arc lamps. The National alternating and the Western Electric arc systems have been adopted. This will be the first appearance of these electric systems in this state, except at Spokane where the Short railway is in operation,

A 300 horse power Ideal engine will also be put in at the power station, as well as two eighty horse power railway generators. This contract, including five miles of street construction, was awarded to the local contracting firm of Charles H. Baker & Co., who have placed their order for the steam plant with Power & Collins, also of this city.

About $100,000 will be expended under this initial contract. It is expected that cars will be running on Third street about August 1st, and construction will begin without delay. S. P. I.

Indianapolis, Ind.

INDIANAPOLIS, May 14.—There is considerable work in progress in this city, principally in the electric lighting plant. President Caven says that the Brush company has been at work on the dynamos and lamps for more than thirty days, and the putting down of the conduits is going on as rapidly as possible. "Some one has said that the cost of putting down these conduits should not be more than $65,000," said Mr. Caven, "but the system will cost a great deal more than that. Why, the expense of laying them on Kentucky avenue to Washington street alone is about $12,000. We are keeping ahead of the permanent improvements all over the city and expect to have the plant, building and all in operation by November 1st. Should we be delayed, however, the Board of Public Works has a right to extend the time if it is so desired." K.

PERSONAL.

T. Ahearn, of Ahearn & Soper, Ottawa, Can., was in Chicago last week.

J. H. McGraw, of the *Street Railway Journal*, New York, is in Chicago.

Frank Rae of Detroit visited Chicago last week and renewed his acquaintances.

D. B. Dean of New York, eastern manager of the McGuire Manufacturing company, was in Chicago Sunday and Monday.

Col. L. G. Burnham, vice-president and manager of the Electric Gas Lighting company of Boston, was a recent visitor in Chicago.

W. H. McKinlock of the Central Electric company, Chicago, returned from a trip to the Pacific coast on Saturday of last week.

E. E. Keller, of the firm of Keller & Degenhardt, Chicago, returned last week from a business trip to Kansas City, Mo., and Pueblo, Colo.

Jas. G. Biddle, of the firm of Jas. W. Queen & Co. of Philadelphia, has been making a tour of the Northwest, and spent several days in Chicago.

Henry B. Cutter, president and general manager of the Cutter Electrical & Manufacturing company of Philadelphia, spent a day or two in Chicago last week.

Chas. E. Bibber, general manager of the Consolidated Electric Manufacturing company of Boston, was in Chicago last week. Mr. Bibber is visiting several of the largest cities in the West.

NEW INCORPORATIONS.

Boulder Electric Power company, Creighton, Neb.; capital stock, $500,000; to operate mines in Park county, Mont.

Standard Electric Heat, Light & Power company, Portland, Me.; capital stock, $500,000; to manufacture and deal in electricity in all forms; N. & H. B. Cleaves, Portland, Me.

Gate City Electric Street Railway company, Keokuk, Iowa; capital stock, $130,000; operation of electric street railway and power at Keokuk; W. J. Roberts, Keokuk, Iowa.

Physicians' Electrical Supply company, Lafayette, Ind., capital stock, $50,000; the manufacture and sale of electro-medical batteries and special appliances for electro-medical and surgical purposes, and also the carrying on of a general

novelty manufacturing and electro-plating business; C. G. Longyear, Lafayette, Ind.

Susquehanna Railway company, Susquehanna, Pa; capital stock, $75,000; constructing and operating an electric railway in Cumberland county; Jno. F. Finney, Harrisburg, Pa.

Bloomfield Street Railway company, Pittsburg, Pa.; capital stock, $12,000; constructing and operating an electric street railway in the city of Pittsburg; Wm. D. Evans, Pittsburg, Pa.

Electric Cutter company, East Orange, N. J.; capital stock, $25,000; to manufacture, sell and deal in electric cloth cutters, etc.; Smith & White, 280 Broadway, New York City, N. Y.

Neftel & Marsh company, Jersey City, N. J.; capital stock, $50,000; to purchase, sell, furnish and equip electrical and other machinery apparatus, etc.; W. Brinkerhoff, Jersey City, N. J.

Tamaqua & Pottsville Electric Railroad company, Tamaqua, Pa.; capital stock, $120,000; constructing and operating an electric railway in Schuylkill county, Pa.; J. O. Ulrich, Tamaqua, Pa.

Delaware County & Philadelphia Electric Railway company, Chester, Pa.; capital stock, $120,000; constructing and operating an electric railway in Delaware county; Wm. I. Schaffer, Chester, Pa.

Lewistown & Bellefonte Electric Railway company, Lewistown, Pa.; capital stock, $400,000; constructing and operating an electric railway in Bellefonte, Center county, Pa.; W. W. Trout, Lewistown, Pa.

Liberty Avenue Street Railway company, Pittsburg, Pa.; capital stock, $50,000; operating an electric street railway from Liberty avenue and Main street to Garrison Alley and return; W. A. Lewis, Pittsburg, Pa.

Canton Electric Light, Heat & Power company, Canton, Pa.; capital stock, $10,000; supplying light, heat and power by means of electricity to the public at the Borough of Canton, Pa.; Delos Rockwell, Troy, Pa.

Thomas Day & Co , San Francisco, Cal.; capital stock, $300,000; to manufacture and deal in gas and electric fixtures, brass goods, plumbers' supplies, real and personal property; Olney, Chickering & Thomas, San Francisco, Cal.

Brookwood Traction company, Harrisburg, Pa.; capital stock, $10,000; construction and operation of motors and cables and other machinery for supplying motor power to passenger railways; Jno. E. Fox, Harrisburg, Pa.

Nicaragua Water Irrigation & Electric company, San Francisco, Cal.; capital stock $250,000; to deal in water, electric lights and power in the Republic of Nicaragua, and deal in real and personal property; W. C. Quinby, San Francisco, Cal.

Negaunee & Ishpeming Street Railway & Electric company, Negaunee, Mich.; capital stock, $120 000; consolidation of the Negaunee & Ishpeming Street Railway company and Negaunee & Ishpeming Electric Light company; J. B. Mass, Negaunee, Mich.

Lynden Electric Motor Railway company, Lynden, Wash.; capital stock, $250,000; to build and operate railroads and steamboats, docks, warehouses, etc.; do a general railroad and navigation business; loan and borrow money; B. W. Loring, Lynden, Wash.

West India & Columbia Electric company, Chicago, Ill.; capital stock, $500,000; general telegraph and telephone business; to furnish electricity for light, heat and power purposes, street railways, water works, etc.; Knight & Brown, 87 Washington street, Chicago, Ill.

Galesburg Electric Motor & Power company, Galesburg, Ill; capital stock, $210,000; to construct and operate an electric plant for furnishing power, light, heat, and system of street cars in Galesburg, Ill., and adjacent territory; Williams, Lawrence & Bancroft, 20 Main street, Galesburg, Ill.

ELECTRIC LIGHTING.

Oakland City, Ind., is to be lighted by electricity.

Hudson, Mich., is to have an incandescent plant to cos from $8,000 to $10,000.

The Erie County Light company and the city of Erie. Pa., are negotiating over an electric lighting contract.

The capital stock of the Western Electric Light company of Toledo is to be increased from $20,000 to $200,000.

A member of an Episcopalian church at Waukegan, Ill., made an Easter offering to his church of an electric light outfit.

The Citizens' electric light plant at Van Wert, O., has been sold to Robert E. Drake of Boston, Mass., for $12,150. The plant was appraised at $14,000.

The new passenger cars now being built for the Chicago, Burlington & Quincy are wired for electric lights, and the makers estimate the cost to be about $7 a car.

A stockholders' meeting of the Edison Electric Light & Power company of Kansas City will be held on June 28th, to vote on the proposition to increase the capital stock of the company from $150,000 to $225,000.

At a meetimg of the city council of Kansas City, Kan., an ordinance was passed granting a franchise to the Electric Construction company of Chicago, to construct and operate a private electric light and power plant in Kansas City. The company will be compelled to commence work on the plant within 90 days after the acceptance of the ordinance, and have it completed and ready for operation within one year.

The Eufaula, Ala , gas and electric plant has been leased to W. P. Monroe of Missouri, who will at once make extensive improvements and enlarge the system.

Fireworks and music were utilized to express the joy of the citizens of Constantine, Mich., when the streets of the town were recently lighted by electricity for the first time.

A dispatch from Massillon, O., says: Employes of the electric light company dug a hole in front of the residence of Mrs. W. D. Bruny, on Grant street, and would have put in a pole had not Mrs. Bruny objected by planting her body in the opening in the earth and refusing to come forth. The force of workmen dug a hole about eight feet distant and put the pole there. Mrs. Bruny declares that she will çut down the pole.

A recent dispatch from Middletown, Del., says: "Had it not been for the moon this town last night would have been in total darkness, as the electric light plant has suspended operations indefinitely. About noon notice was served upon the merchants to the effect that there would be no lights last evening, and further inquiries elicited the fact that the company, which became insolvent several weeks ago, had decided to suspend. It is believed that an attempt will be made by the town to purchase the plant, which is in a very dilapidated condition, and will require a considerable sum of money spent on it before it can be successfully operated."

ELECTRIC RAILWAYS.

Galesburg, Ill., expects to have an electric railroad in operation by August 1st.

Electric cars have been put on the Bunker Hill street railway line at Charlestown, Mass.

Estimates are being made for an electric railroad connecting Kent, Brady Lake, Ravenna and Sandy Lake, all in Ohio.

Traffic has so increased between Vancouver and Westminster, B. C., that the Electric Tramway company has decided to double its track.

Youngstown, O., and Girard will be connected by an electric street car line, an extension of the Youngstown Street Railway company's line, which will mean a continual tion of three miles from the present terminus at Brier Hill.

An electric railway is to be built from Alexandria, Va , to Mt. Vernon. It is said that the fare from Washington to Mt. Vernon will be but 35 cents, with 25 cents additional for entering the grounds and mansion. The fare is now $1 by the boats.

A Baltimore inventor claims to have perfected a remarkable electric railway system. By its use neither overhead wires, storage batteries, surface conduits nor underground conduits are employed, the motive current being conveyed to the car by induction from buried conductors extending along the line of travel.

A great sensation was caused in Buda Pesth on May 12th by an explosion that occurred in Andrassey street, one of the fashionable thoroughfares. As one of the cars on the electric railroad was rapidly moving along there was a sudden jar by a bomb exploding, followed almost instantaneously by a terrific roar. The shock was very great, and the people on the car, which was crowded to its fullest capacity, were terribly frightened. A search along the line showed that seven other cartridges had been placed alongside the rails, but that they had in some manner become displaced so the car wheels could not touch them. It was by this fortunate accident that a terrible disaster was averted. The car wheel that struck the cartridge was blown off the axle, and the bottom of the car was badly shattered. Nearly all the passengers were more or less severely bruised, but none of their injuries are fatal.

TELEGRAPH.

The sixth annual convention of the Order of Railway Telegraghers is being held in Chattanooga, Tenn., this week. It is said that the organization has 30,000 members.

Sir J. Ferguson, the British postmaster-general, in rep'y to the resolution of Sir Edward Birkbeck in the House of Commons, made the definite announcement that the government was prepared to take in hand the improvement of coast communications. Sir E. Birkbeck's resolution was to the effect that it was desirable that all coastguard stations on the coast and signal stations should be telephonically and telegraphically connected, and where such stations do not exist the postoffices should be connected, and that a royal commission be appointed to inquire into the desirability of connecting certain light vessels and lighthouses by cable with the mainland. In this matter, he said, the English were far behind Denmark, the United States and Holland. He also stated that the government recognized the necessity for extension of the telegraph communication on the coast, and had framed an estimate of the working cost necessary to connect telephonically the coastguard stations from the Isle of Wight to Lynmouth in North Devon. Exact calculations showed that the cost would be something over £16,000. The matter had now got beyond the stage of contemplation, and the engineers of the postoffice were taking active steps to give effect to the scheme. A rough estimate had also been made of the cost of establishing communication between all lighthouses and lightships and the shore, and it was calculated that nearly £300,000 would be required for the purpose. It was the intention of the government to appoint a royal commission to investigate.

TRADE NEWS.

On May 1st the New York office of the Fort Wayne Electric company was removed to 42 and 44 Broad street, with H. C. Adams as agent.

A 400-light incandescent dynamo has been installed in the Hotel Brunswick, Kansas City, by the Mather Electric company. The wiring was done by the Kansas City Electrical Works.

On May 1st the Chicago offices of the Brush Electric company were removed from No. 225 Dearborn street to the Monadnock building, corner Dearborn and Jackson streets. The company has secured a suite of seven rooms extending along the entire front of the building facing the postoffice.

The Citizens' Street Railway company of Detroit, Mich., has awarded the entire contract for the equipment of its Jefferson avenue line with the electric system to the Detroit Electric Works of Detroit. As this will be the first electric line running through the center of the city the plant is to be made a model one in every respect. The steam plant will consist of three horizontal return tubular boilers, 60 inches in diameter, 16 feet long, each to have sixty 4 inch flues; three 14x24x14 Westinghouse automatic compound engines, with feed water heaters, pump, injectors, piping, smoke stack, etc. The electric plant will consist of three 100 kilowatt multipolar railway generators of the Detroit Electrical Works' latest type. There will also be furnished a slate switch-board of the most improved design, with all instruments and attachments necessary to make a complete electric plant. The overhead construction will consist of two No. o B. &. S. gauge hard drawn copper trolley wires, with necessary feeders and guard wires, supported on Milliken iron poles. The car outfit will consist of twelve 40 horse power motor equipments of the Detroit Electrical Works' standard type. If the work is not delayed by injunctions or measures of that character, it is expected that the plant will be in operation in about 75 days.

BUSINESS.

The Boston Braid Manufacturing company, of Boston, reports a good demand for its silk braid, and new customers are booked every month.

George Cutter, Chicago, has just received a large consignment of the Germania shadeholders, which, like the improved Schaefer lamps made by the same firm, are becoming favorably known in the West.

C. R. Field, of the India Rubber & Gutta Percha company, of New York, is away from the city on an extended business trip. It is Mr. Field's intention to visit most all of the large cities in the West.

The Emerson Electric Manufacturing company, St. Louis, is having an active demand for its new Meston alternating current fan motor. The new device for regulating the speed of this fan motor has been introduced and it adds greatly to its desirability.

Thos. G. Grier, western manager of the Bryant Electric company of Bridgeport, Conn., has just received at his offices, 1522 Monadnock building, a new invoice of switches, and is now prepared to meet promptly all orders for the well known Bryant goods.

Owing to lack of room in their old quarters, Kohler Bros , 341 Rookery building, Chicago, western branch of the Eddy Electric Manufacturing company, have removed to another suite of offices, 1417-1418 Monadnock building, corner of Jackson and Dearborn streets.

The Hill Clutch Works, of Cleveland, O., through their Chicago manager Chas. B. Coon, of 347 Rookery building, have recently closed contracts for furnishing the power transmission for the German Opera House company's building on Randolph street and the Produce Cold Storage exchange, Chicago.

R. J. Randolph, manufacturer of the "Little Daisy" fan and motor, has moved his office from the Rookery to room 1325 Monadnock building. Mr. Randolph has secured the general western agency for the Duplex Electric company of Corry, Pa., and reports an active demand for the motors and other apparatus made by that company.

Houliston, Hubbard & Co., who opened a supply house in Cincinnati on March 1st, find that their business has increased to such an extent that they have removed from their present location to larger and more commodious quarters at 164 Plumb street. This firm represents the Jenney Electric Motor company of Indianapolis and other manufacturers.

Robb MacKie, 208 Neave building, Cincinnati, is giving considerable attention to the inspection of station work and subsequent supervision of its reconstruction. Mr. MacKie has held responsible positions with some of the leading electric companies of this country and should have acquired an experience of value to local lighting and street railway companies.

S. A. Day, of New York, well known as the manufacturer of the Kerite insulated wires and cables, has moved from his Dey street office to new quarters in the Mail and Express building, Broadway. It may be mentioned also in this connection that W. H. Eckert, formerly general manager for S. A. Day, has severed his connection with this concern and has been succeeded by Supt. W. R. Brixey.

Louis Blatz, 107 West Monroe street, Chicago, has drifted into the manufacture of several specialties that are more or less closely related to electrical interests. These articles include trolley wheels, graphite bushings, strain clamps, electric railway switches, etc. Mr. Blatz has a finely fitted up brass foundry in connection with his busi-

ness and is making a specialty of brass castings for electrical work.

The Jacksonville Railway company, Jacksonville, Ill., on January 6th decided to divide its order for motor equipments between the Detroit Electrical Works and the Thomson-Houston company and gave each an order for three 30 horse power equipments. The road was equipped and put into operation about March 1st. On May 2d the Detroit Electrical Works received another order for three additional 30 horse power motor equipments.

The Lunkenheimer Brass Manufacturing company of Cincinnati has just issued an illustrated catalogue and price list of brass and iron goods and specialties, that for typographical beauty and completeness of detail leaves nothing to be desired. In compiling the catalogue it is stated that an effort has been made to show only the best and latest improved designs, making it brief and practical. The object aimed at has been fully reached, and the result is a "thing of beauty."

Kerite wire is being vigorously pushed to the front rank of high grade insulated wires. Mr. F. W. Cushing, the general western agent, announces that he has established agencies for Kerite goods in San Francisco, Milwaukee and Cincinnati. The local Chicago trade has been turned over to the Enterprise Electric company at 313 and 315 Dearborn street, and negotiations are pending for the establishment of agencies in several other western cities all of which will be under the direction of the general western agency in Chicago.

Charles E. Sharp has been appointed manager of the Southern Electrical Supply company, St. Louis. Mr. Sharp is a conscientious, pains taking business man, and since his appointment, May 1st, has secured again many of the old customers of the Southern, besides a number of new ones. William H. McKinlock, the founder and president of the Southern Electrical Supply company, has just returned from St. Louis, and reports the Southern company as doing a very brisk business. Mr. McKinlock considers that under the new management, the prospect for an extended trade is very encouraging.

Wm. Hazelton, 3d, has been appointed assistant general manager of the Short Electric Railway company. Mr. Hazelton has been in the employ of the company for about a year, having his headquarters at Philadelphia, managing a large and very important eastern territory for the company. His promotion is well deserved, and he is receiving congratulations from the electrical fraternity generally. Mr. Hazelton will move to Cleveland, Ohio, immediately, and pending the growth and training of Mr. Hazelton, 4th, the Philadelphia office will be placed under the management of C. C. Curtiss of the New York office.

The Central Electric company, Chicago, reports that it has secured through the Brush Electric company the order for 32 miles of Acme lead Okonite cable for the South Park Commissioners of Chicago. This wire is to be used to carry current for lighting the boulevards to the World's Fair grounds, and Okonite was selected because of its high quality. The Central Electric company reports also a very active business in the Interior Conduit & Insulation company specialties. A great many of the large buildings in Chicago and elsewhere are being equipped with this conduit.

The Rockford Electric Manufacturing company of Rockford, Ill., has received the following letter from a prominent house at Scranton, Pa.: "We have had one of your five horse power Mayo motors, 220 volts, in use about three years. Have it attached to one half medium printing press, one wire power stitcher, one number 2 Bougarters eccentric mill, which requires full five horse power to run, and to the elevator loaded with 3,600 pounds of merchandise, and your motor has run through it all. We use the motor about six to eight hours daily at a cost of from $3 to $9 a month. The repairs have been nothing, with one exception, which was caused by rank carelessness. We thoroughly appreciate your motor, and wish for none better."

From the list of recent sales just received from the Page Belting company of Concord, N. H., one would be led to believe that the directly connected engine and dynamo and "rope transmission" had, to put it mildly, by no means taken entire possession of the field. Following is a partial list of recent orders for the "Eureka dynamo" belt: Two to Galveston, Tex.; one to Chattanooga, Tenn; two to Roanoke, Va.; one to Seymour, Conn.; one to Boston; nine belts to the Brooklyn City Railway company, Brooklyn, N. Y.; four to the United States Electric Light company, Washington, D. C.; two to the Staten Island Light, Heat & Power company, Port Richmond, N. Y; three to the Prudential Insurance company, Newark, N. J. Of the company's regular "dynamo double" belting sales have been made to the Pennsylvania Railroad company, Camden, N. J.; to the Red Star Line repair shops, Jersey City, N. J., and to the People's Electric Light company, Trenton, N. J.

The Great Western Electric Supply company, after an annoying delay, has acquired possession of nearly the entire second floor of the Springer building, 195to 207 South Canal street, Chicago, over 30,000 square feet of floor space, and is now fairly ready for business. The offices of the company have been transferred to very desirable rooms in the new building, which have been elegantly fitted up with every convenience possible to secure. Directly in the rear of the offices and separated only by a glass partition is a salesroom, which, for size, variety and beauty of stock displayed, is unequaled by any similar establishment in Chicago. This company has recently taken up the manufacture of electrolier and electric light fixtures and the display made is unsurpassed. The different lines of electric supplies is also well represented, nearly every article of which is made by the Great Western company in a factory, the capacity of which has recently been largely increased. The Sun arc lamp for incandescent circuits is also manufactured, and W. H. Gilman, president of the company, announced recently that the orders in this department were over 200 lamps behind, with a constantly increasing demand. This company has unexcelled facilities for the transaction of business, and the outlook is reported as being very bright.

The Automatic Switch company of Baltimore, Md., has received a most flattering testimonial relating to the Whittingham automatic motor starter from Hershberg, Hollander & Co., importers; jobbers and manufacturers of paint, Baltimore. This device it will be remembered, was described in the last issue of the WESTERN ELECTRICIAN. The Hershberg, Hollander & Co., motor is a 10 kilowatt with 110 volts Wenstrom machine and it is used for running a large paint mill, frequently drawing 90 amperes for 14 hours at a time. The current upon which it is operated is subject to many stoppages during the day, and formerly the returning current after each stoppage would blow the fuse before the resistance could be turned in by hand. With the automatic motor starter now in use, the return current starts the motor automatically, without damage, and with no attention whatever. Hershberg, Hollander & Co, write to the Automatic Switch company as follows: "We take great pleasure in stating that after a trial of six months with your automatic motor starter attached to our 12 horse power Wenstrom electric motor, we are very much pleased. Having tried other switches, we find that the device we are using at present is decidedly the best, and consider it a perfect piece of mechanism."

Since the establishment of a western department by Col. L. G. Burnham, vice-president and manager of the Electric Gas Lighting company of Boston, Western Manager Chas. E. Lee has had phenomenal success with the company's goods, particularly with the Samson battery, which has been introduced into a number of lines in which an open circuit battery never before had been considered practicable. The sales of Samson battery to concerns somewhat outside of the regular line of electrical trade have, according to Mr. Lee, amounted to thousands of cells more than have been sold through the ordinary channels. For instance, the Samson battery is being used on railway signal work where bells are to be rung at crossings and semaphores are to be worked for block signal systems. The Hall Signal company, for example, is making extensive use of the Samson battery. The O'Neill Signal company of Cleveland, too, has recently equipped the Belt railway in Chicago with its crossing bells in which the Samson battery is used exclusively. An idea may be had of the requirements for this sort of work when it is stated that the battery service is required at one railway crossing in Chicago where the bell is rung on an average of 350 times daily for a space of one minute for each train. This is very severe work. Thos. Kane & Co., a large manufacturer of gas engines, have found that the Samson battery is a most reliable source from which may be obtained the spark to light the gas in the engine. This firm's experience is that there may be obtained a life of from six to nine months from one charging of the Samson battery. The battery is called on in this work to give 175 sparks per minute for ten hours a day. This is probably one of the severest tests to which any open circuit battery has been put. The DuLaney Clock company, Chicago, a new corporation manufacturing self-winding clocks, is also using the Samson battery in its clocks and is enthusiastic in praise of the cell's electromotive force and lasting qualities. From the above and a knowledge of the fact that the Samson cell is meeting with marked success where it is applied in medical work it would seem that Col. Burnham has every reason to be encouraged with the prospects in the West.

ELECTRICAL STOCK MARKET

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, May 14, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	110½	111
Edison Illuminating company of New York	80	80½
" " " Brooklyn	83	
" " " Boston	115	120
" " " Chicago	130	140
Edison Ore Milling company	15	20
United States Electric company of New York	15	25
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomson-Houston Electric company	60½	67
" " " Preferred	29	30
North American Phonograph company	5	7
New York " "	2½	5
Automatic Exhibition company	4	6
Westinghouse Com	28	29
" Pfd	45	46

ELECTRICAL PATENTS.

Issued May 10th, 1892.

474,355. Electric Railway. Charles H. Baker, Lake Geneva, Wis.

Consists of an elevated railway trestle carrying a conduit the trolley wheels being supported upon a bar adjustable by the operator.

474,375. Trolley Wire Support. Owen F. Evans, Columbus, O.

Between the opposite poles is stretched a wire; to the centers of these transverse wires is secured an electrical conductor which is allowed to sag slightly. This wire is broken at center of span and a turn buckle is interposed. The trolley wire is suspended horizontally from this wire by short vertical conducting wires of proper length to bring the trolley wire into horizontal position.

474,388. Dynamo Electric Machine or Motor. Charles D. Jenney, Indianapolis, Ind.

474,398. Electrically Heated Vessel. Willis Mitchell, Malden, Mass.

A vessel wound with wire for carrying a current to heat the contents of the vessel.

474,403. Truck for Electrically Propelled Vehicles. Louis Pfingst, Boston, Mass.

A truck one axle of which carries the motor, the other axle carrying a counterbalancing weight.

474,447. Electric Speed Regulator. John W. Gibboney, Lynn, Mass.

A regulator for a motor mechanism comprising a Foucault disk and a pivoted field magnet, the position of whose axis is changed by a change in the speed of the disk, thus actuating the controlling device.

474,454. Exciting Fluid for Galvanic Batteries. Carl Lutcke, Jr., Berlin, Germany.

The exciting fluid consists of a concentrated solution of one or several chlorides, such as copper, iron, zinc, etc., in combination with from two to three parts by weight of nitrate of mercury.

474,468. Electric Conduit. Augustus Bruner, Indianapolis, Ind.

This invention consists of sections of clay pipes, their ends abutting, and a flexible metallic band slit on one side, sprung around the joint, such pipes being surrounded by cement.

474,469 Lightning Arrester. Malcolm Dickerson, Fort Wayne, Ind.

The invention consists of discharging device having separated points between which is interposed insulating liquid, whereby the high potential discharge may escape by disruptive discharge, and an arc prevented by the closing in of the liquid.

474,472. Cleaning Brush for Electric Railways. Rudolph M. Hunter, Philadelphia, Pa,

A brush attached to the car adapted to fit the conduit and sweep all foreign matter into wells provided along the conduit.

474,473. Electric Snap Switch. George K. Hutchins, Baltimore, Md.

474,523. Electrical Indicator. John W. Gibboney, Lynn, Mass.

474,528 Locking Device for Switch and Signal Operating Mechanism. Thomas H. Patenall, Rahway, N. J.

474,541. Electric Switch. Carl A P. Willing and Richard J. G. Violet, Berlin, Germany.

474,542. Thermostat. Archibald H. Brintnell, Toronto, Canada.

The design is to produce either a trouble alarm or a trouble alarm and fire alarm according to the space the diaphragms are caused to recede from each other by the heat.

474,552 Trolley for Electric Railways. Charles E. Friel, Boston, Mass.

474,569. Insulating Coupling. Albert Anderson, Boston, Mass.

474,584. Connection for Electric Conductors. Charles W. Tobey, New Bedford, Mass.

A metallic clip adapted to be bent about the conductors, and having its face provided with a coating of solder and a flux therefor.

474,592. Ore Conveying Apparatus. Thomas A. Edison, Llewellyn Park, N. J.

474,600. Commutator Brush. Robert Hirsch and Herman Meminger, Milwaukee, Wis.

This is a mixture of refined clay, graphite, carbonized oil or sugar and wax, covered with a metallic coat.

474,623. Circuit Controller for Electric Motors. William S. Andrews, New York, N. Y.

474,624. Dynamo Electric Machine or Motor. Joseph D. F. Andrews, London, England.

A multipole machine in which the armature coils are so connected that all coils in approximately the same phase act together in series.

474,631. Low Water Alarm. Thomas A. Delaney and Robert E. Hills, Chicago, Ill.

474,632 Electrical Switch-Board. Louis A. Fehr, New York, N. Y.

The lamp circuit terminals are arranged in a circle around each generator circuit and a switch on the generator circuit is adapted to engage with any set of lamp circuit terminals.

474,667. Electric Lamp Socket. William D. Kurz and Hans Amundson, LaCrosse, Wis.

This improvement is especially adapted for outside decorative illumination.

474,670. Automatic Fire Alarm. Morris Martin, Malden, Mass.

This improvement produces a signal different from the fire alarm signal when the circuit is broken by other means than by the thermostat.

474,673. Electric Heat Alarm. Joseph Meyer, Jersey City, N. J.

A column of mercury by its expansion above a certain point completes an electrical circuit and sounds alarm.

474,706. Automatic Repeater. Richard Watkins, Sacramento, Cal.

474,735. Electric Wind Vane Indicator. Henry J. Haight, New York, N. Y.

474,771. Telethermometer. Fernando J. Dibble, Peabody, Mass.

474,787. Electric Machine. Herbert A. Wagner and Ferdinand Schwedtmann, St. Louis, Mo.

A combination of a cylindrical field magnet surrounding the armature of longitudinal brushes held by springs against the commutator, which consists of a plate, provided with coil terminals upon its face, placed on the end of the armature.

474,797. Electrical Heater. Willis Mitchell, Malden, Mass.

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STANDARD SCREW GLASS INSULATORS,

Glass Break Knobs, Floor Insulators, Battery Jars.

ARC LIGHT GLOBES FOR ALL SYSTEMS.

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A GOOD LIVE MAN, with small capital, to take active interest in a growing and well established electrical concern, doing a specialty manufacturing, general jobbing and construction business. Must be experienced in general business management, also possessed of sound practical knowledge. Address, "A. B."
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WANTED!

An Agent to sell our

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in every city in the U. S. where we are not already represented. Liberal inducements and exclusive territory to the right party. Address,

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THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

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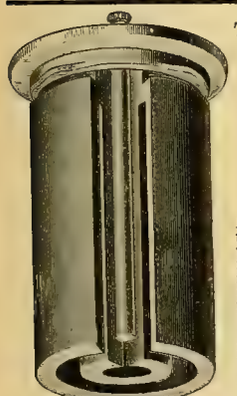

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Well adapted for use in electrical machine shops.

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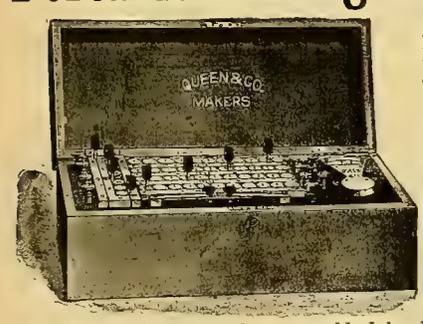

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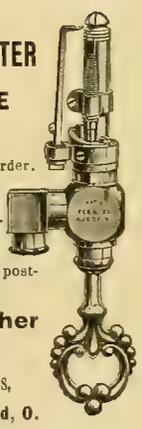

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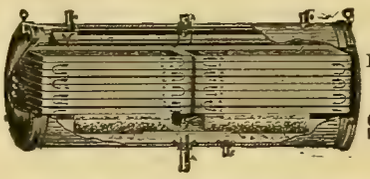

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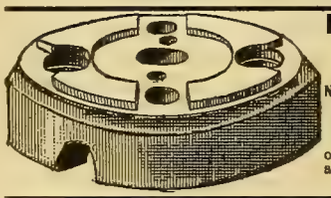

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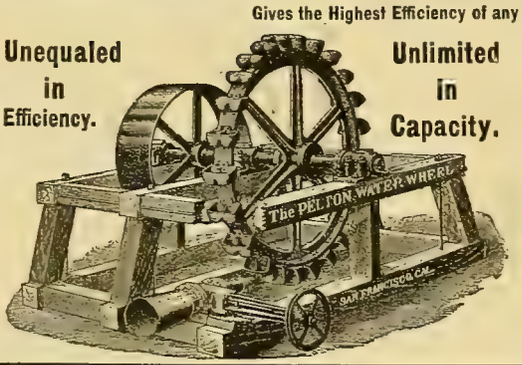

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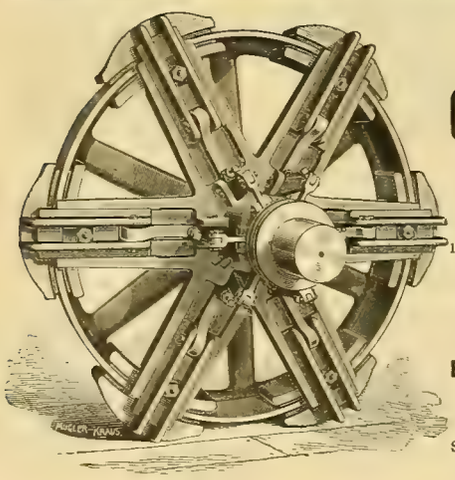

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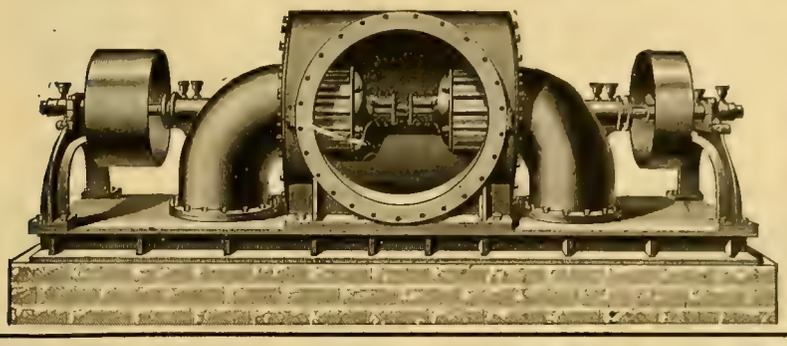

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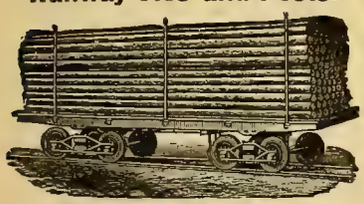

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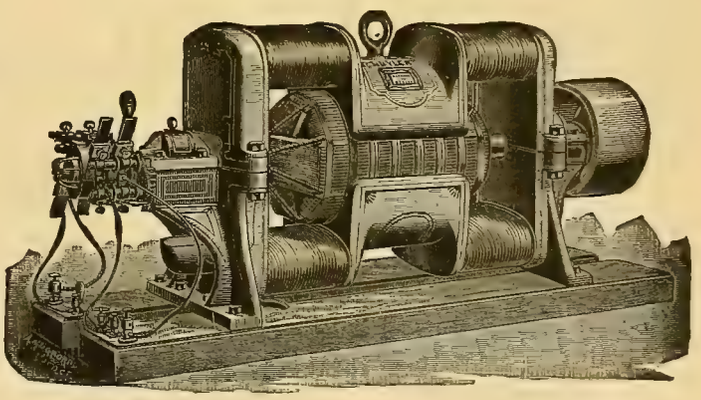

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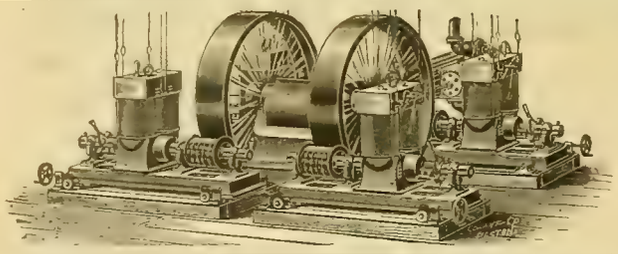

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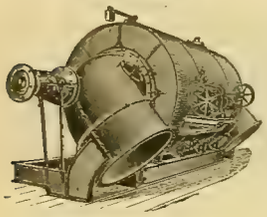

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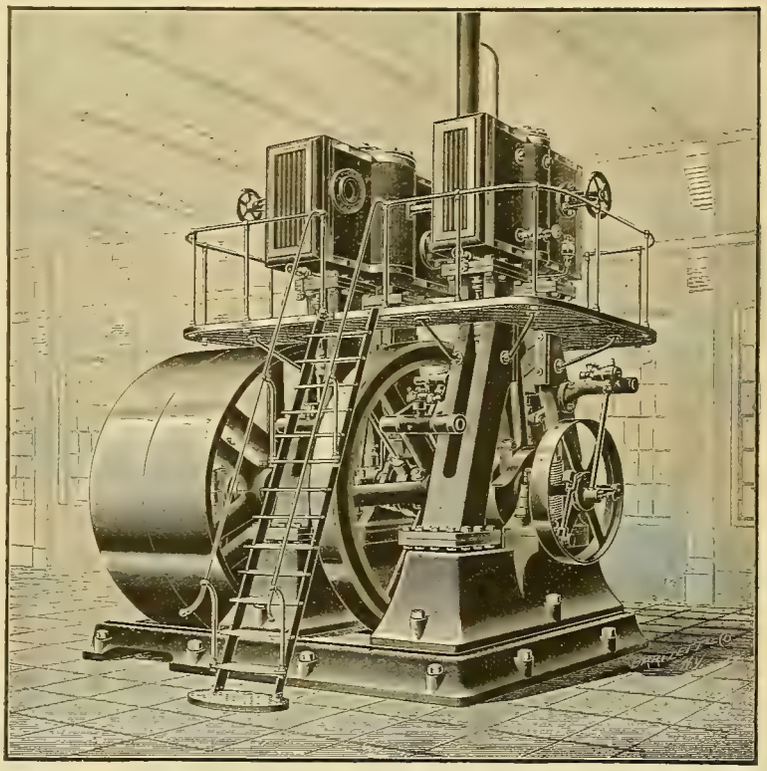

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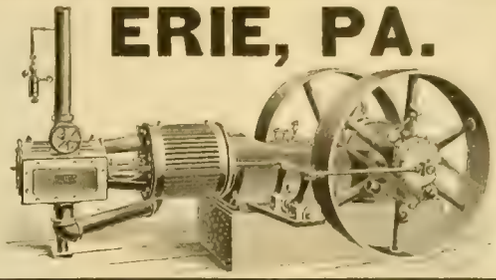

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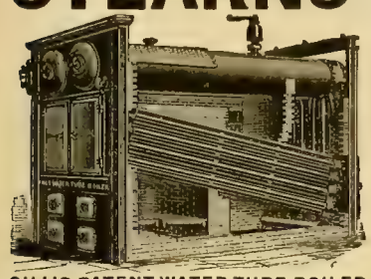

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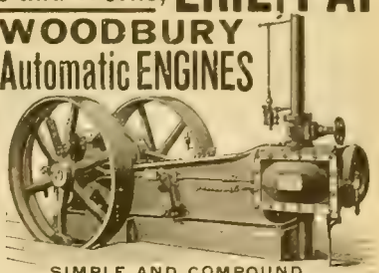

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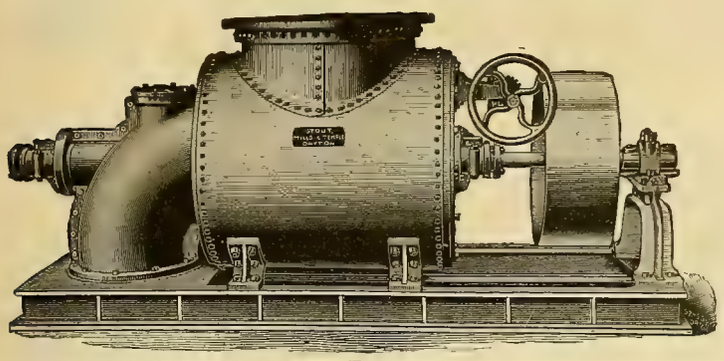

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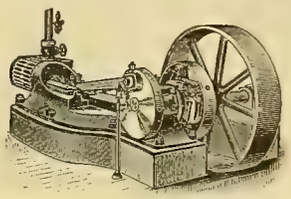

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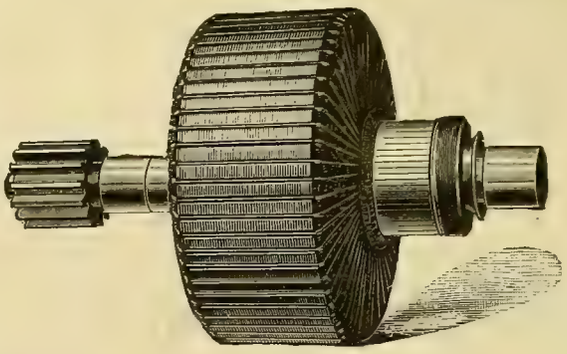

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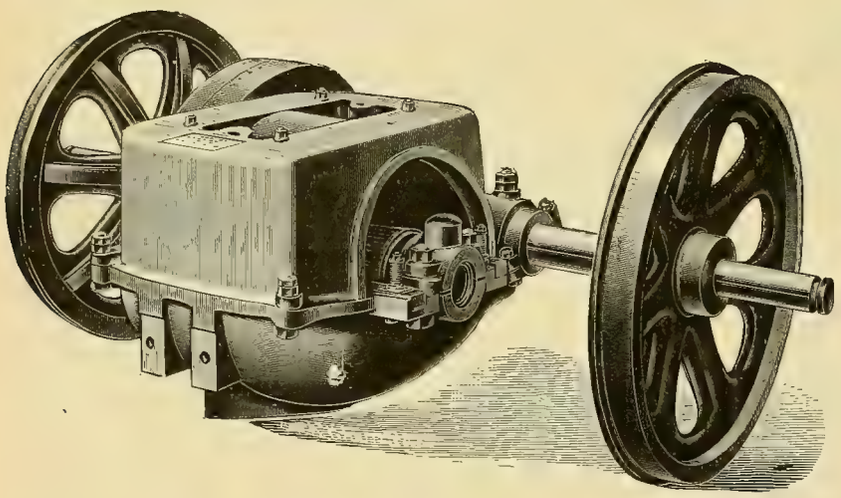

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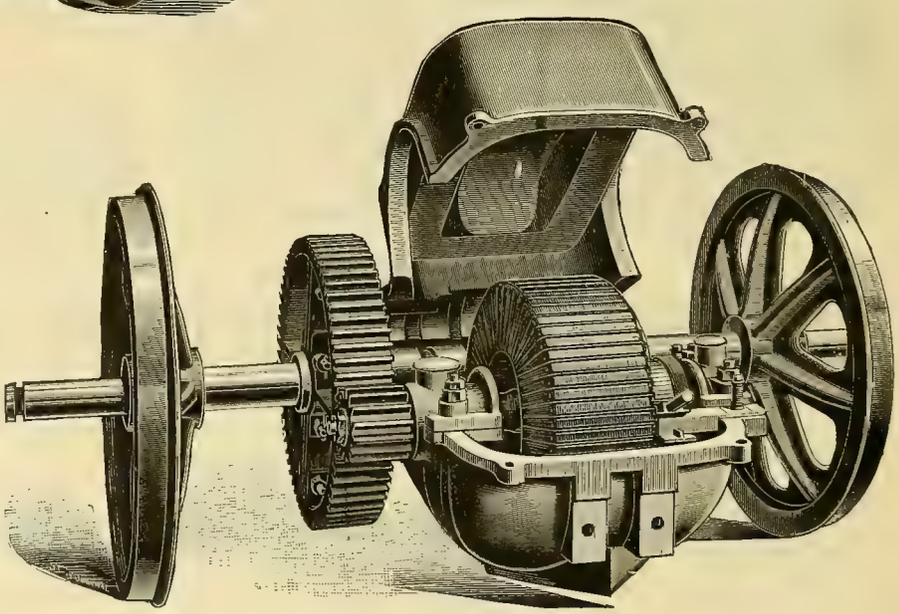

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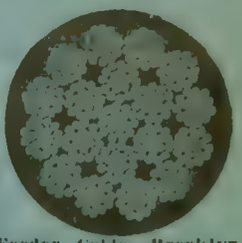
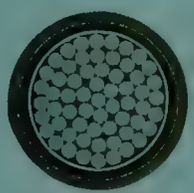
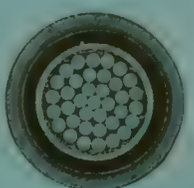

Feeder Cable, Brooklyn Edison Electric Light Co.

Underground Core, N. J. Central R. R.


Feeder Core, Broadway Theater.

Submarine Work, Edison Electric Light Co., Easton, Pa.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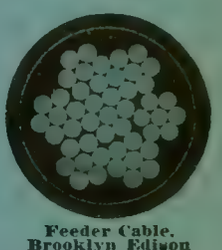
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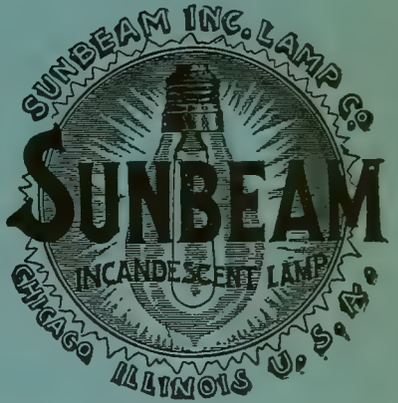

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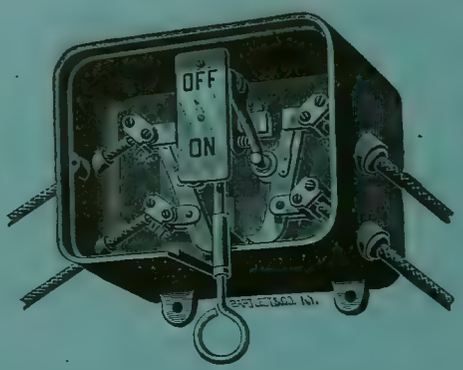

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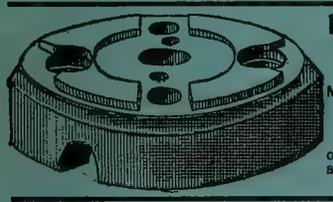

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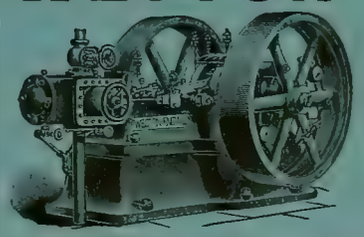

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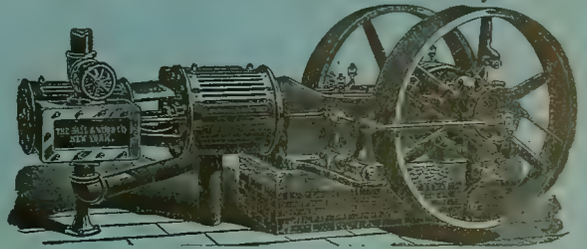

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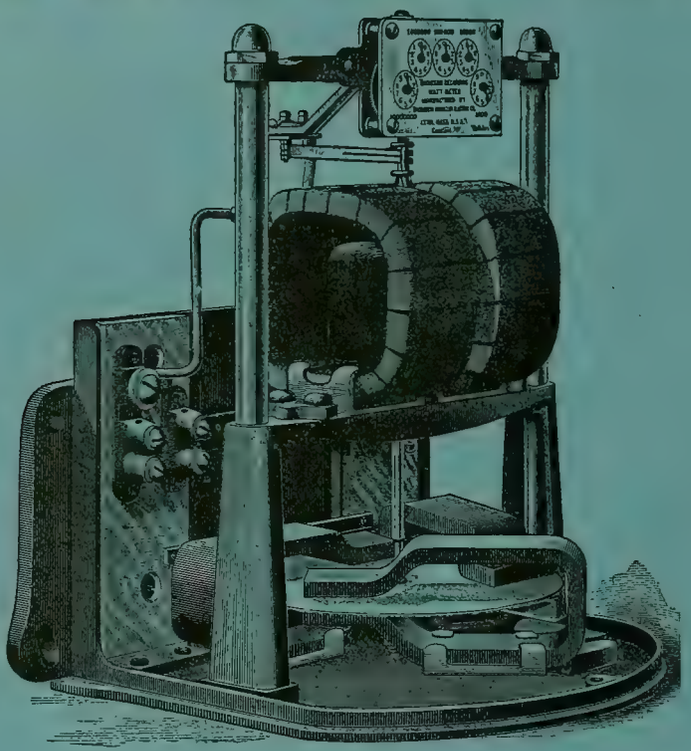

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GERMANTOWN, PA., April 29, 1892.

Thomson-Houston Electric Co.

GENTLEMEN:—Replying to your inquiry of the 21st I am pleased to say the THOMSON RECORDING WATT METERS in use by us are giving us no trouble in any way. Repairs are so insignificant as not to need mentioning. We are using a great many, both on Direct and Alternating Currents, to our great satisfaction. Yours truly,

GERMANTOWN ELECTRIC LIGHT CO.,
(Signed) Chas. M. Allen, Supt.

LANSING, MICH., April 6, 1892.

Thomson-Houston Electric Co.,
BOSTON, MASS.

GENTLEMEN:—Answering yours of the 31st regarding the THOMSON-HOUSTON RECORDING WATT METERS, would say that we are well pleased with them so far, and consider them better than anything else we have tried. Yours truly,

LANSING ELECTRIC LIGHT & POWER CO.,
(Signed) E. F. Cooley, Supt.

Thomson-Houston Electric Co.,

PRINCIPAL OFFICE,
620 Atlantic Ave., Boston, Mass.

WESTERN OFFICE,
148 Michigan Ave., Chicago, Ill.

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Lane & Bodley Co., The.
Stearns Mfg. Co.
Weston Engine Co.

Books, Electrical.
Electrician Publishing Co.

Brass Goods.
Powell Co., The Wm.

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Detroit Electrical Works.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.

Cables.
(See Insulated Wire.)

Cables, Electric. (See Insulated Wire), **Copper, Sheet and Bar.**
Roeblings Sons Co., J. A.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Washington Carbon Co.
Western Electric Co.

Clutches, Friction.
Falls Rivet & Machine Co.
Hill Clutch Works.
Lake, J. H. & D.

Cordage.
Samson Cordage Works.

Construction and Repairs.
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Electric Cons. & Supply Co.
Electrical Construction Co., The.
Knapp Electrical Works.
Rae, Frank B.
Smith, Thos. G. Jr.
Western Electric Co.

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American Engine Co.
Ball Engine Co.
Ball & Wood Co., The.
Brush Electric Co.
Detroit Electrical Works.
Diamond Electric Mfg. Co.
Edison General Electric Co.
Electric Cons. & Supply Co.
Electrical Eng. & Supply Co.
Falls Rivet & Machine Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Keller & Degenhardt.
Lake Erie Engineering Works.
Lane & Bodley Co., The.
La Roche Electric Works.
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Pearson & Co., W. B.
Racine Hardware Mfg Co.
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Royal Electric Co.
Short Electric Railway Co.
Sioux City Engine Works.
Smith, Thos. G. Jr.
Taylor Engine Co.
Thomson Houston Electric Co.
Waddell-Entz Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Weston Engine Co.
Williams Engine Works.

Copper Wires and Tapes.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cutter, Geo.
Detroit Electrical Works.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Roebling's Son's Co., J. A.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
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Schindel & Schindel.

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Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Electric Engineering & Supply Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Hart & Hegeman Mfg. Co.
Knapp Electrical Works.
Perkins Elec. Switch Mfg. Co.
Star Electrix Co.
Van Nuis, C. S.

Dynamos.
Brush Electric Co.
Detroit Electrical Works.
Diamond Electric Mfg. Co.
Duplex Electric Co., Ltd.
Easton Electric Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Gregory, Chas. E.
Heisler Electric Co.
La Roche Electric Works.
Lovell Mfg. Co., Ltd.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Rose Electric Light Supply Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Waddell-Entz Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Lava Gas Tips.
Smith, A. T.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Rae, Frank B.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

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Pierce, Josiah Jr.
Rae, Frank B.

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Electrical Supply Co., The.
Greeley & Co., The E. S.
La Roche Electric Works.
Queen & Co.
Western Electric Co.

Electrical Intelligence.
Keller & Degenhardt.
Rae, Frank B.

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Andrae, Julius.
Bryant Electric Co.
Crown Electric Mfg. Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Electric Engineering & Supply Co.
Fletcher & Fletcher Electric Co.
Hussey & Co.
Ries Electric Specialty Co., The.

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Electrical Supply Co., The.
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Brush Electric Co.
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Edison General Electric Co.
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Link Belt Machinery Co.

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American Engine Co.
Ball Engine Co.
Ball & Wood Co., The.
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Lane & Bodley Co., The.
Morse & Co., A. M.
Pearson & Co., W. B.
Racine Hardware Mfg. Co.
Smith, Thos. G. Jr.
Sioux City Engine Works.
Stearns Mfg. Co.
Taylor Engine Co.
Weston Engine Co.
Williams Engine Co.

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Emerson Electric Mfg. Co.
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Stanley Electric Mfg. Co.

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Electrical Supply Co., The.
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Sperry Elec. Mining Machine Co.

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Detroit Electrical Works.
Electric Gas Lighting Co.
Fletcher & Fletcher Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.

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Bryant Electric Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Cons. & Supply Co.
Electric Engineering & Supply Co.
Electric Gas Lighting Co.
Electrical Eng. & Supply Co.
Electrical Supply Co., The.
Fletcher & Fletcher Electric Co.
Hart & Hegeman Mfg. Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Queen & Co.
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Phœnix Glass Co.

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Electrical Supply Co., The.
Great Western Elec. Supply Co.
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Cutter, Geo.
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Holmes, Booth & Haydens.
International Okonite Co., The.
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Western Electric Co.

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Central Electric Co.
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Sperry Elec. Mining Machine Co.
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Crocker Wheeler Electric Co.
Chicago Electric Motor Co.
Detroit Electrical Works.
Diamond Electric Mfg. Co.
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Edison General Electric Co.
Electrical Eng. & Supply Co.
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Railway Equipment Co.
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Electrician Publishing Co.

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Railway Equipment Co.
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Andrae, Julius.
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Cushing, F. W.
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International Okonite Co., The.
New York Insulated Wire Co.
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Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

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Western Electric Co.

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Greeley & Co., The E. S.
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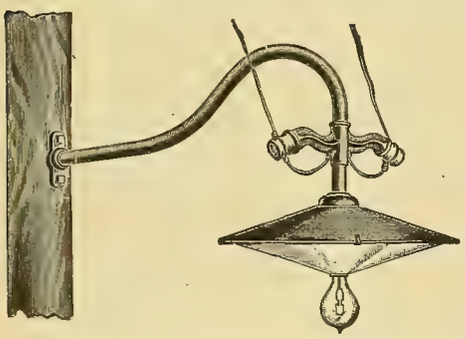

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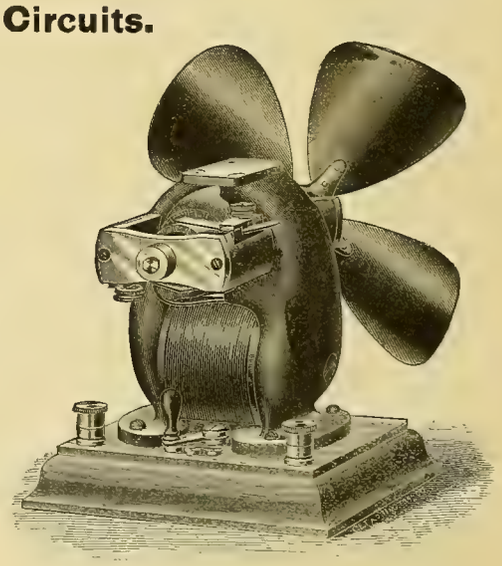

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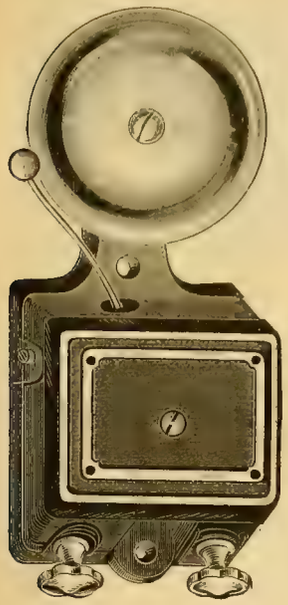

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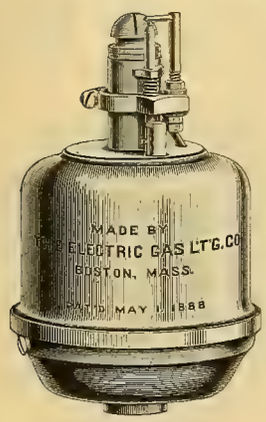

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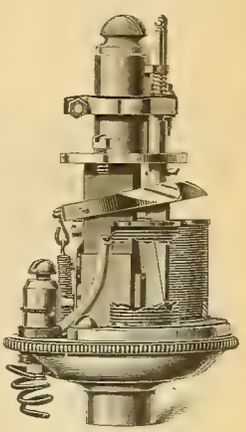

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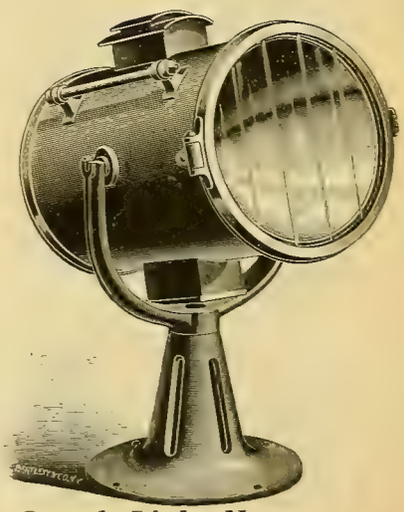

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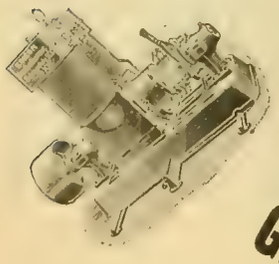

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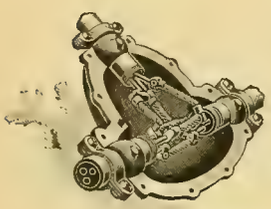

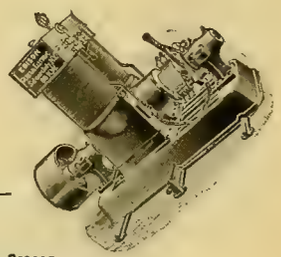

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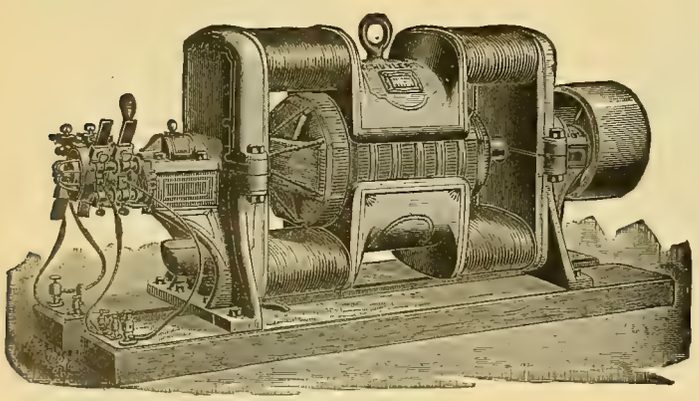

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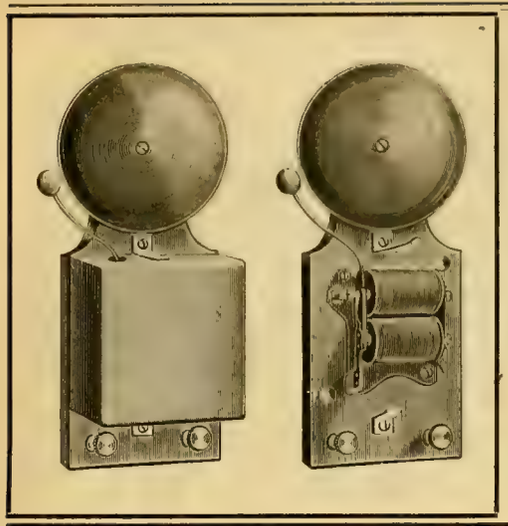

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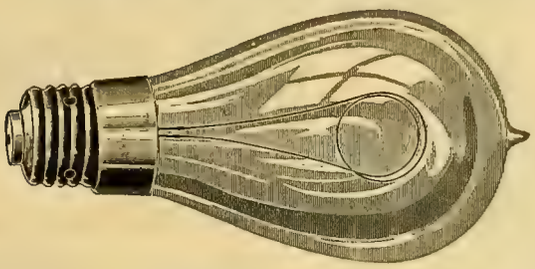

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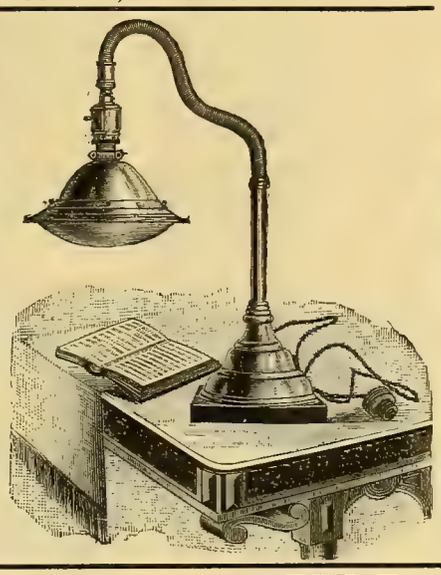

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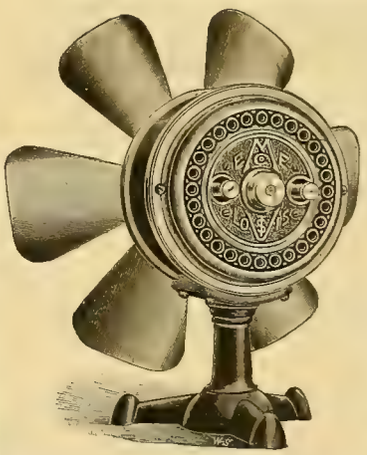

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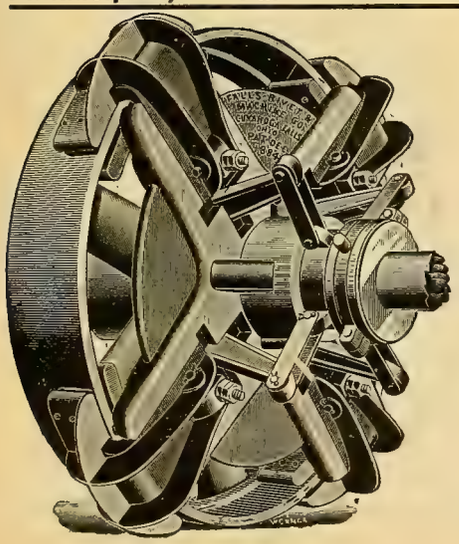

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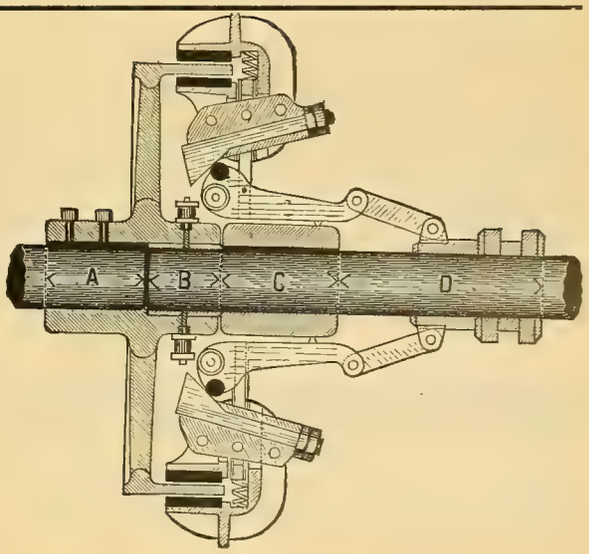

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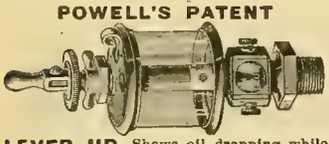

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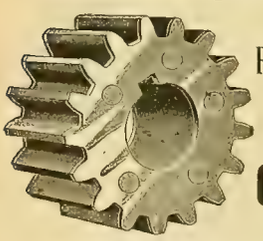

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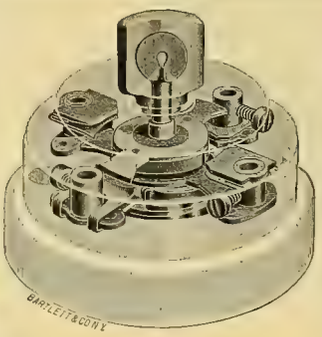

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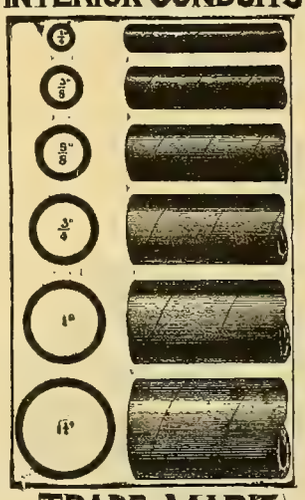

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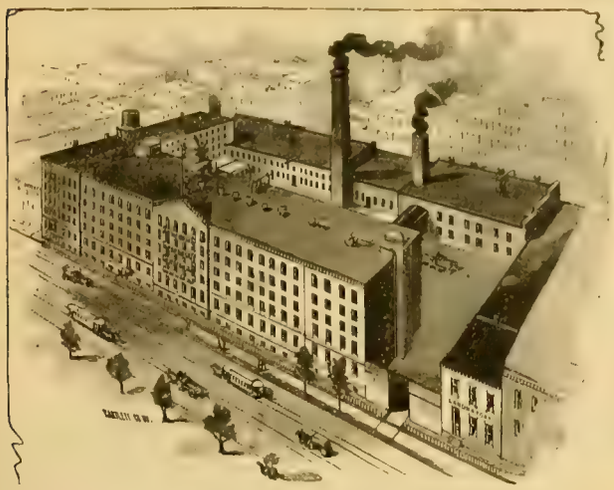

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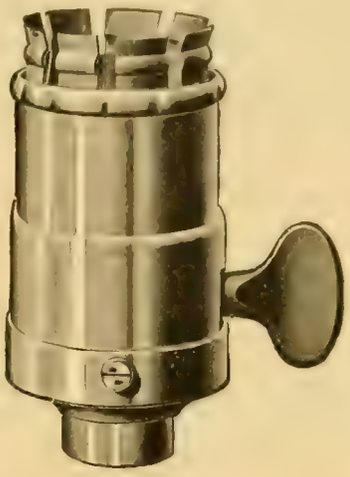

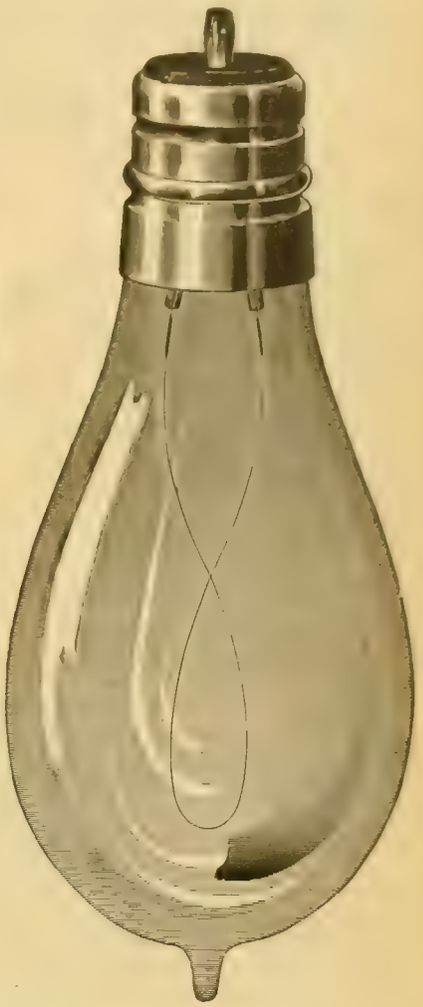

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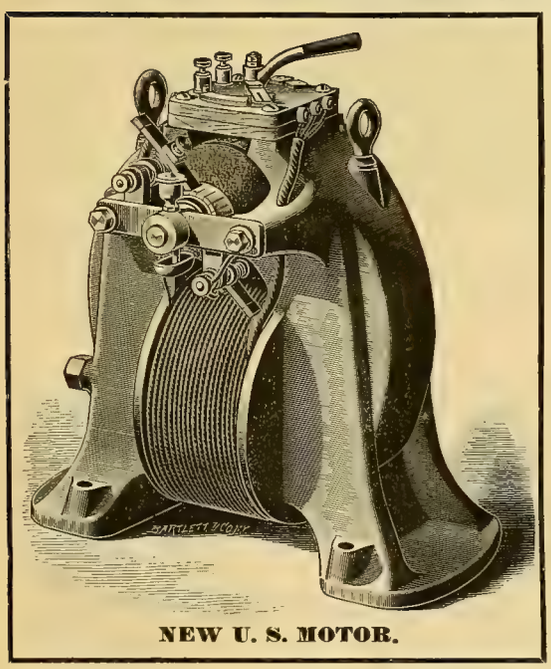

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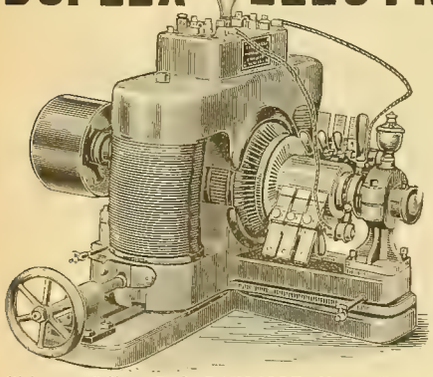

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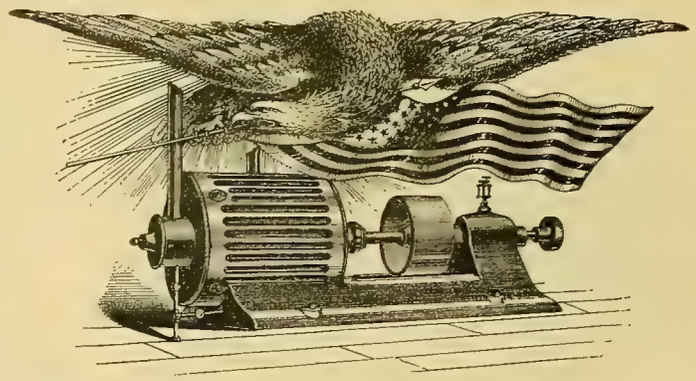

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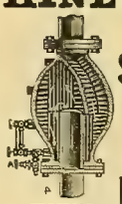

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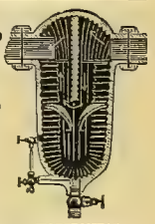

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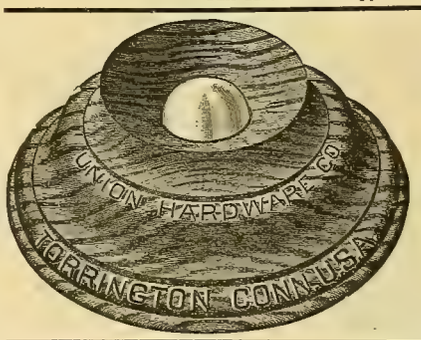

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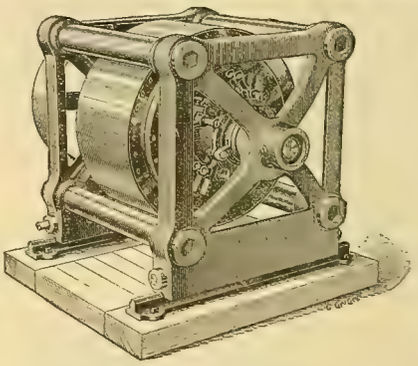

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Vol. X. CHICAGO, MAY 28, 1892. No. 22

The Lighting by Electricity of the Buoys in Gedney's Channel, New York Harbor.

From the deck of one of the ocean racers steaming into New York harbor of a dark night, a close observer could hardly fail to notice six lighted buoys which mark the course of the vessel as she approaches Sandy Hook. Some distance apart, but plainly discernible to any one on the lookout for them, the six lights three white on one side and three red on the other, mark the ship's way through what is known to the mariner as Gedney's channel.

Under ordinary circumstances, one might pass up the harbor without so much as a thought of the six little spots of red and white light. But in stormy weather, with the seas running high and the waves dashing the buoys about and oftentimes breaking over and submerging them, perhaps curiosity would be aroused and an inquiry made as to how the lamps were always kept at the same steady and brilliant glow. Was a close inspection possible, there would be no mystery, since a glance would reveal a 100 candle power Edison incandescent lamp snugly ensconced in a stout iron cage on the upper end of a spar extending from the water.

The Gedney's channel buoys are lighted by electricity fed from the shore to the lamps through cables, and from the following description the readers of the WESTERN ELECTRICIAN may obtain a knowledge of the details of this somewhat unique installation.

It will not be amiss before going into particulars relative to the apparatus employed to illuminate the buoys, to have a clear understanding of the conditions which led to the introduction of an electric system, and also to give a few particulars relative to the work of installation.

Seagoing vessels sailing to New York have a choice of two courses from the ocean. One of these passages is by way of Long Island Sound, through Hell gate and the East River. The other course is through the Narrows, between Staten Island and the shores of Long Island. The entrance through the Narrows is the more direct and accessible from the ocean, and from the fact that it is the only one practicable for vessels of the larger class, it is the most important. The Narrows is approached by way of channels, which cross a bar extending from Sandy Hook on the south to Coney Island on the north. From the map, Fig. 12, which shows the location of the buoys, cables, dynamo house, etc., there may also be obtained a clear idea of these channels.

It will be sufficient to say relative to the channels, that there are several across the Sandy Hook bar, but only two of them, Gedney's and the Main, are used by deep draught vessels. The different courses through these two channels before the electric buoy service was adopted, were marked at night by range lights on shore. The entrance to Gedney's channel was, however, practically unmarked, except by unlighted buoys. There was, to be sure one range light, that at Princess Bay, but, as it was thirteen miles away, pilots found some difficulty in steering by it with the compass.

By so marking Gedney's channel that it would be safe and easily navigable at night, the harbor would be opened to vessels of the largest size at all times, except when the weather was such as to render navigation anywhere within the harbor unsafe. The Lighthouse Board fully appreciated this situation, and a number of plans were considered with the view of indicating the channel at night in some efficient manner.

When a number of schemes had been tested and found to be wanting in one way or another, it was finally decided to experiment with an electrical method of lighting the buoys.

From experience it had been learned that a buoy in the form of a long spar fixed in place by its lower end being shackled to a heavy anchor or sinker resting on the bottom, was best adapted to withstand the effects of heavy seas and floating ice. Besides this, the spar buoy possesses the advantage of being the form least liable to be displaced or set adrift when run down by passing vessels.

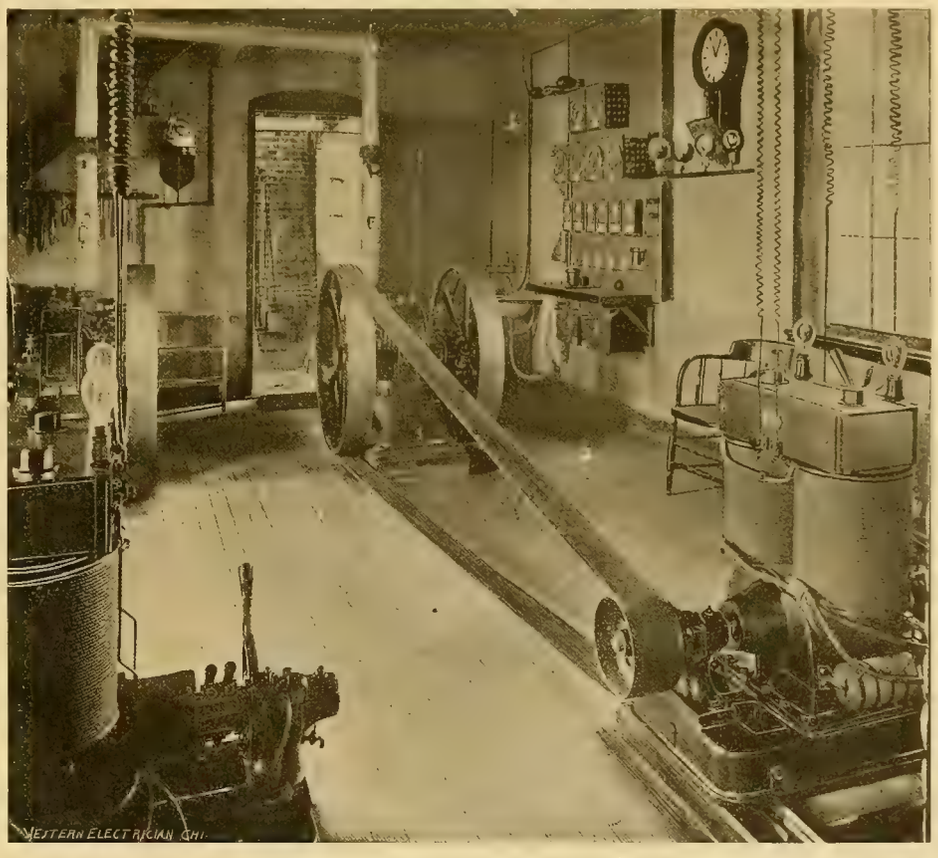


FIG 14 THE LIGHTING BY ELECTRICITY OF THE BUOYS IN GEDNEY'S CHANNEL, NEW YORK HARBOR.

It was decided, therefore, to adopt this form of buoy as a support for the proposed lights, and experiments were instituted to put the electrical system to a practical test.

An armored cable containing two copper conductors insulated with gutta percha was procured and laid from the lighthouse depot at Thompkinsville, Staten Island, to a spar buoy planted near Robbin's Reef lighthouse. The distance was about 6,000 feet. The location of the experimental buoy and cable is shown on the map, Fig. 13 The buoy was fitted at the top with an iron cage, which enclosed a heavy glass jar containing the lamp. The cable was laid in a groove cut in the side of the buoy and connected at the top with the lamp. The shore end of the cable was connected with the dynamo by short lengths of wire strung overhead.

With this outfit a number of different lamps were tried under various conditions, and the experiments resulted in the development of the present Gedney channel system.

In laying the cables for the Gedney lights, one with three conductors was run out in two nearly equal lengths from the channel to the beach near the East Beacon light house. In the neighborhood of the buoys, these two cables run into cast iron junction boxes and from thence each conductor of the larger cables makes connection, through a single conductor cable, with a buoy.

The two main, or triple conductor cables were laid by the Bishop Gutta Percha company, and the setting of the buoys in the channel, laying the single conductor cables, making the splices and placing the junction boxes, was done under the direction of Lieutenant Commander Mackenzie, with the aid of the vessels and crews of the lighthouse service and with some assistance from the cable manufacturers.

The buoys were first set with the tender *John Rogers* on October 21, 1888. Each buoy was provided with about 250 feet of single conductor cable. The upper end of the cable was placed in a groove in the buoy and was secured by staples and a covering strip fastened on top as shown in Fig, 20. The free end of the cable was then brought up and the extra length coiled and securely lashed to the cage on top. The setting of the buoy was accomplished without difficulty. The cable was laid from the hold of a barge. Everything being in readiness, a small boat containing one of the junction boxes and the men and material for making splices, was anchored near buoy "G 5," Fig. 18. The barge, having on board one of the triple conductor cables, was brought near and a cable end passed and made fast to the small boat. The barge was then propelled toward the beach and the cable was slowly paid out. On arriving at the beach the end was taken ashore in a small boat and made fast temporarily to the first pole of the land line. The cable was afterwards buried in the sand as far out as the low water mark. Meanwhile, the single cables running from the junction boxes to the buoys were being laid by the tender *Gardenia*. From the boat at the junction box the single cable to buoy "G 3" was fed out from a reel mounted on the forward deck of the *Gardenia*. After this cable was spliced at the buoy, and brass tags attached just outside the junction box, to facilitate future identification, the box and cable were lowered to the bottom. The laying of the cables connecting the buoys, Nos. 1, 3 and 5, on the south side of the channel, was completed in one day, October 31, 1888. On November 2d, cables for the buoys on the north side of the channel were laid. The lamps and lanterns were put in place, and the final tests having been made and everything found to be in good working order at the station, the lights were started at 5 P. M. November 7, 1888. The system has been in regular operation since that date.

Starting with Figs. 14 and 15, a good idea of the generating plant on Sandy Hook can be had. Fig. 14 is a reproduction of a photograph showing the interior of the little square brick building, which, though miniature in its way, is still deserving of the name of "station." Fig. 15 is a plan and sectional view of the building.

The connections in the station to the cables will be understood by reference to Fig. 16.

The manner in which the cables are laid to the buoys is

clearly shown on the map, Fig. 12. In the view of the East Beacon light-house, Fig. 17, there may be seen the last pole and the box in which the land lines from the station join the cables.

A view of the buoy "G 5," which shows a white light at night, is given in Fig. 18. It may interest some to know that the photograph for this cut was taken by a

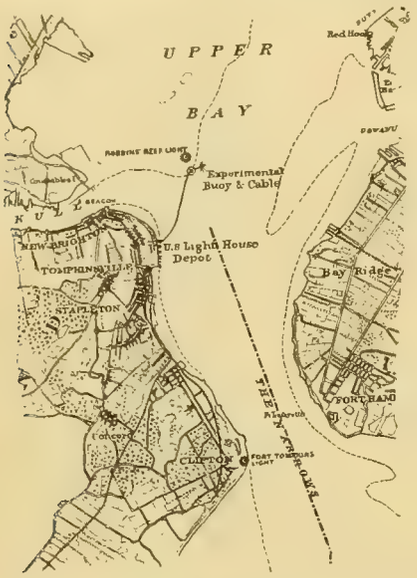


FIG. 13. THE LIGHTING BY ELECTRICITY OF THE BUOYS IN GEDNEY'S CHANNEL, NEW YORK HARBOR.

representative of the WESTERN ELECTRICIAN last August with an ordinary tripod camera from a small steam launch. The little vessel was tossing about on the waves when the picture was taken.

From the map it will be noted that "G 5" is the last of the three white lights, which may be seen to the left as one sails up to New York.

The details of one of the electric buoys with the lamp lantern, protecting cage, etc., are clearly shown by Figs. 1 to 11 inclusive. The method of shackling a buoy to its sinker, and also of running the cable up to the lamp on the buoy-spar, will be understood by reference to Figs. 19 and 20.

The steam plant in the little Sandy Hook station was furnished and erected by E. P. Hampson & Co. of New York. There are in all two upright tubular boilers, having not less than 180 square feet of heating surface and 5 square feet of grate surface. These are made of ½ inch steel of 60,000 pounds tensile strength, and carry 80 pounds pressure.

The two boilers supply steam for two small Armington & Sims engines of 12 horse power each. The engines belt directly to the dynamos.

The dynamos, of the Edison type, are two in number. Each machine was built to deliver a maximun current of 40 amperes at an electromotive force of 180 volts at the terminals. These dynamos are compound wound. In Fig. 16 are given the connections of the windings. They have each two separate coils for the field magnets, one being connected as a shunt to, and the other in series with, the main circuit. The shunt field coil has an adjustable resistance in series, and the series field coil has a separate external coil connected in shunt with it. The resistance of this latter can also be varied for adjustment. The switch board is arranged for six independent circuits with switches for throwing on either dynamo. There are six 16 candle power indicator lamps in the station in addition to an ammeter for each of the six buoy circuits. Each lamp is on an independent circuit in which is placed, besides the lamp, an ammeter, a safety plug and a controlling resistance for regulating the potential of each lamp separately. This adjustment is necessary on account of the inequalities of the line resistance due to the unequal lengths of cables to the different buoys. There is also an ammeter for the entire current, and a voltmeter. Wires are led from each circuit to a test board where connections are provided through which it is possible to make tests as to the condition of the circuits. The 100 candle power lamps at the buoys are fed at a constant potential of 110 volts. From the generator to the lamps there is a drop of potential of from 160 to 110 volts, a loss of about 30 per cent. The lamps have what might be described as a solenoid filament. The system is operated with an earth return, that is, one side grounded on the armor. For lighting the building, six 16 candle power lamps are connected to the mains in multiple series with a controlling resistance.

The boilers, engines and dynamos are in duplicate, arranged to provide against accident to this part of the system. From the switch-board the wires pass out and are supported on poles until they reach the box at the East Beacon light house, Fig. 17. The six circuits to the cables are of No. 10 B. & S. copper wire. Each of the eleven poles of the land line is provided with a lightning arrester of No. 8 copper wire. This wire is stapled to the poles and projects 6 inches at the top. The E. S. Greely & Co. of New York, constructed the land line.

Cable to the amount of 32,000 feet of three-conductor and 15,000 feet of single conductor, was required. The map, Fig. 12, shows very clearly how these cables were disposed of. The conductor in both kinds of cable consists of a strand of seven wires, having a cross section of a solid wire $\frac{1}{16}$ inch in diameter. The conductors were insulated with not less than three coatings of gutta percha, and Chatterton's compound was used to fill the interstices between the wires. The same compound was applied under each layer of gutta percha. The insulation resistance of this covering was required to be not less than 300

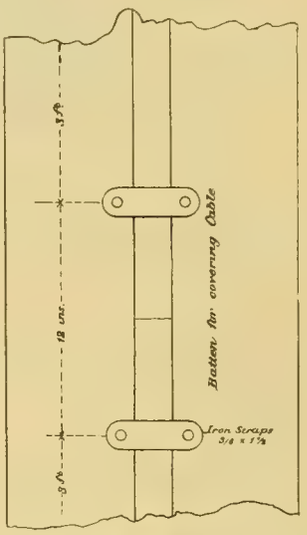
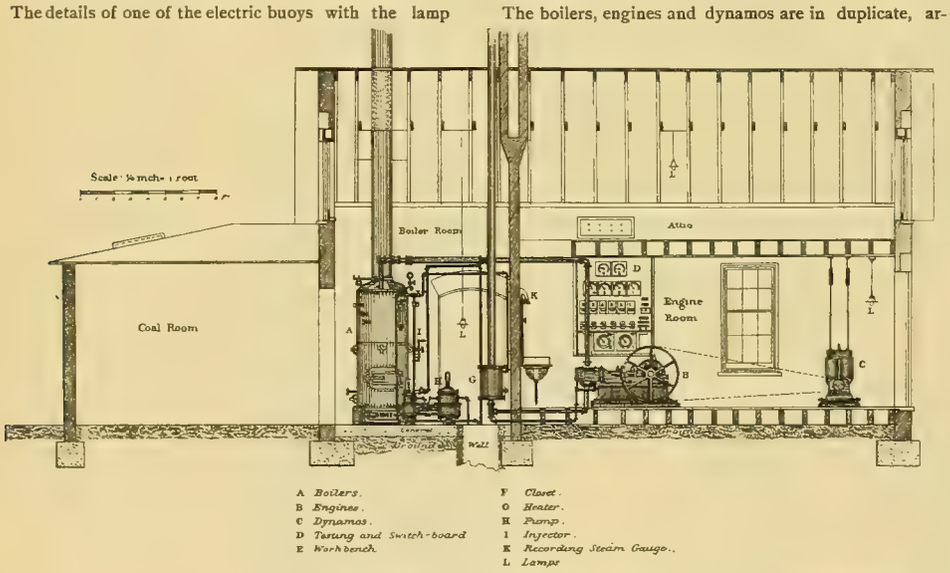
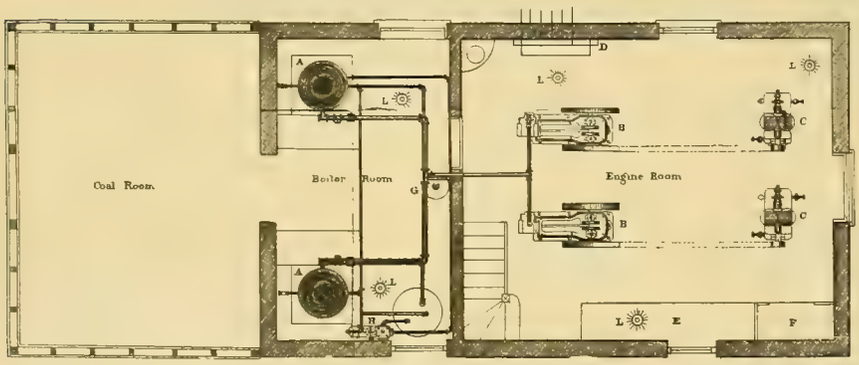
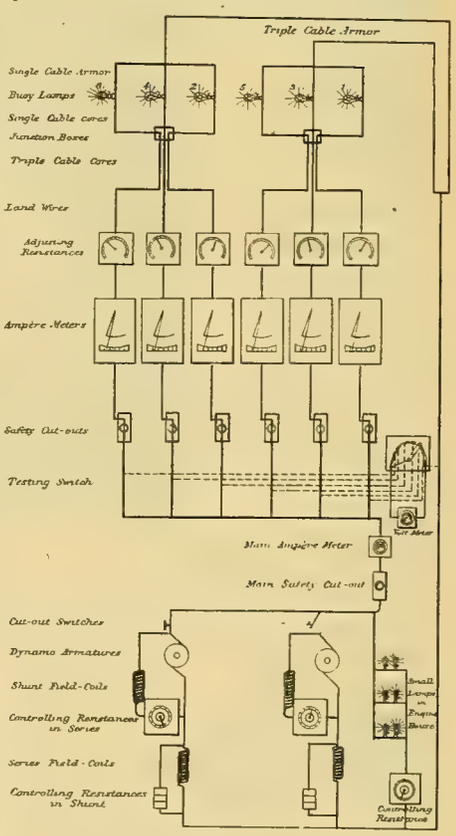


FIG. 20. THE LIGHTING BY ELECTRICITY OF THE BUOYS IN GEDNEY'S CHANNEL, NEW YORK HARBOR.







FIGS. 15 AND 16. THE LIGHTING BY ELECTRICITY OF THE BUOYS IN GEDNEY'S CHNNNEL, NEW YORK HARBOR.

megohms per nautical mile after forty-eight hours' immersion in water at 75 degrees Fahrenheit, with one minute's electrification. The cores were served with the best jute or hemp yarn saturated with tar. The armor was annealed and galvanized iron wire. On the three conductor cable sixteen No. 6 B. W. G. wires were used, while the armor for the single cable was formed of twelve No. 9 B. W. G. wires. By the specifications for these cables it was agreed also that the current in the cables was not to exceed 6 amperes with an electro motive force of 350 volts. A bonded five year guarantee was also required.

The buoys are each a spruce spar about 50 feet long, 10½ inches diameter at the butt, 20 inches at the largest section and 10½ inches at the top. They are shackled at the bottom to a hemispherical cast iron sinker weighing 4,500 pounds, Fig 19. To the top of the spar is firmly screwed the protecting cage for the lantern. This cage is made of flat iron ribs rivited to two iron bands which encircled the spar, with a third ring at the top of the cage. The upper portions of the ribs and the top ring are turned, as shown in Fig. 1, so as to present their edges to the lamp. This construction was adopted to secure strength and to obscure the light as little as possible. The curved shape was given to the ribs in order to allow ice and driftwood to run over the buoy without injuring it.

It may be mentioned as an instance of how the buoys stand rough usage, that on one occasion one of the buoys was unintentionally run down by the tender, *Gardenia*. The cage and lamp were completely submerged, passing under the vessel's keel, but no injury whatever resulted.

The details of the lantern are shown in Figs. 3 to 11 inclusive. The lamp is shown mounted in its frame ready to be placed in the lantern. It is inserted through the top and secured by three thumb-nuts. The cable core passes through the central support under the handle to the connectors, Fig. 10. The lamp is mounted in the frame at the station, so that when out at the buoy, the old lamp may be removed and the new one substituted without requiring any tools or material, except the rubber tape for covering the connector. There are no loose parts to be dropped into the water, the thumb-nuts being secured to the lamp frame by the brass strips shown in Fig. 8. The lantern is not taken from the cage, except for repairs. The weight of the part handled is only five pounds. Incandescent lamps with red globes were employed at first, but these were abandoned, and as a substitute the lanterns were fitted with red glass.

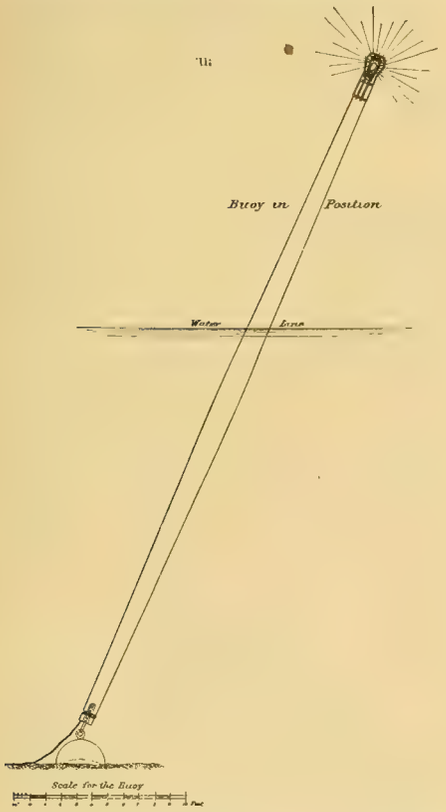


FIG. 19. THE LIGHTING BY ELECTRICITY OF THE BUOYS IN GEDNEY'S CHANNEL, NEW YORK HARBOR.

In addition to supplying the lamps at the buoys, the Sandy Hook station lights the Hook Beacon, Fig. 17. An incandescent lamp of the same pattern as those in the buoys was first placed in the lens on August 16, 1889, and connected to the station by means of wires on the pole line for the buoys. On September 28, 1889, a lamp especially designed for the purpose by the Edison company was substituted for the buoy lamp. The new lamp has a normal intensity of 150 candles, and when placed in the lens it gives 3,000 candles. This beacon has been operated in this manner since the date mentioned. So far as is known, this is the first regular light-house in which this method of illumination has been employed.

FIG. 17. THE LIGHTING BY ELECTRICITY OF THE BUOYS IN GEDNEY'S CHANNEL, NEW YORK HARBOR.

The buoy station at Sandy Hook is in charge of Superintendent W. L. Brown, who has been complimented by the light-house board for his intelligent management of the plant. It was through Superintendent Brown that the accompanying illustrations were secured. For information relative to the details of the installation, the WESTERN ELECTRICIAN is indebted to Captain Henry F. Picking, U. S. N., United States light-house inspector.

Utilization of the Waste Forces of Nature.[1]

By W. H. PREECE, F.R.S.

I am anxious to attract your attention especially to the facility which the electric current gives to bring power to our doors and to enable us to facilitate home industries. The congregation of large bodies of males and females in magnificent buildings is a modern consequence of great industries dependent on the presence of great power and great steam engines. A system of centralization has followed, which is not always beneficial to healthy mental and corporeal growth. The electric current steps in to check this system. It enables us to apply in our own dwellings power from the smallest fraction of a horse power to many hundred horse powers.

Moving water as a source of power is already utilized to a very large extent. At Bushmills near the Giant's Causeway in Ireland, there is a fall of 26 feet, which, actuating turbines, produces currents of electricity that drive a railway from Portrush, a distance of six miles. This line has been at work since 1883. Between Newry and Bessbrook, also in Ireland, there is another railway worked electrically, in the same way, and of the same length. At Lynton, in Devonshire, and at Keswick, in Westmoreland, the fall of water is used for electrically lighting the two places; while at Tivoli, near Rome, 2,000 horse power is going to be converted into electrical energy which will be transported 18 miles to Rome to light up 40,000 lamps. At Geneva the lake which merges there into the river Rhone flows through the town with considerable velocity, and more than 3,000 horse power is there obtained, not only for electric lighting purposes, but to raise water to a height of over 400 feet, so as to distribute its energy over the whole town for the innumerable watch, musical box and other industrial purposes for which that town is so famous. At Schaffhausen (the famous falls of the Rhine) about 600 horse power is converted into electrical energy, and is applied to the production of aluminum, and 700 horse power for the transmission of power, to a woolen spinning mill about half a mile away, the wires crossing the river. At the Skippers Creek Mountains, near Otago, in New Zealand, two 50 horse power turbines generate electrical energy, which is transmitted three miles to work quartz stampers. At the Virginius mines in Colorado some unprofitable mines at a height of 12,700 feet have been made profitable by the utilization of water at the foot of the mountain. Labor has also been reduced. Two pumps, a hoist, a blower, and two mills are worked by electric motors, 1,200 horse power being available for transmission four miles up the mountain by current.

The tides of the ocean, surging backward and forward with unerring accuracy, produce in our estuaries and straits, movements of great masses of water which if utilized as power, could be turned to useful account. Take the case of the Menai Straits, whose breadth at Belan, the entrance from Carnarvon Bay, is 1,188 feet, and mean depth 60 feet. This gives a sectional area of water of approximately 71,000 square feet, flowing either in or out four times a day at a mean speed of three feet per hour, which gives a velocity of five feet per second. The effective energy of such a stream would give 6,000 horse power if it could be utilized. At the present moment not one fraction of this wasted power is employed other than for the motion of ships and boats. The total tidal area of the estuary within the mouth of the River Mersey at New Brighton is 22,500 acres. The mean total volume of tidal water passing in or out of the estuary four times a day is 4,455 million cubic feet. The mean rise or fall of the water above tide level is 10½ feet; that is, the mean vertical range of the tide at Liverpool is 21 feet, reaching 31 feet on equinoxial springs and 10 feet on lowest neaps. This would give an available power of about 100,000 horses, if it could be utilized; but this is of course an impossibility. In some estuaries the flood tide is caught by dams in a kind of dock and made to work mills in its ebb, but with a rise and fall of six feet it requires a dock area of 10 acres to give 20 horse power. But tide mills are very expensive in their prime cost, and they are rarely resorted to unless Nature has favored their use by unusually high tides or by convenient geographical configuration. The power executed by tidal rivers is much less than is usually considered. The total tidal energy of the Thames at London Bridge is 320 horse power from which we could not extract usefully more than 100 horse power and that only by stopping the whole navigation of the river. The available energy passing through one archway is only 20 horse power. The total available energy of a slow shallow tidal river like the Thames is therefore comparatively small, and its inconvenience would be so great that it is not worth consideration. It is different with a constant flowing river. In a constant moving mass of water the work done per second by the stream depends on the pressure exerted by the water on the effective float area exposed to the stream, and on the rate at which the water flows. The whole energy of a stream running at five feet per second (3.4 miles per hour) against a resisting float surface of five square feet would exert approximately 11 horse power, and if the efficiency of our machinery be 50 per cent. 10 square feet will give us about one effective horse power. Hence it is not a difficult problem to utilize the energy of a current of water on a small scale, especially as the energy increases as the cube of the velocity. An extremely ingenious hydraulic motor has been devised by two young engineers, Messrs. Purdon and Walters, of Great George street, which, moored in a stream, absorbs the energy of the moving water in a novel and effective way, and converts it directly into electrical energy. One is going to be fixed in the upper reaches of the Thames to form a charging station for electrical launches. The energy of the falling river will thus be utilized to drive boats up the stream against its own resistance. The quantity of water going down the Seiont from the beautiful lake of Llanberis is approximately five million gallons per day, and it falls about 300 feet. Hence the whole energy of the river, if it could be utilized, would supply a constant power of 320 horses. There are already several mills on the stream utilizing some of this power; but enough remains, at any rate, to illuminate the streets of Carnarvon with the elec-

FIG. 18. THE LIGHTING BY ELECTRICITY OF THE BUOYS IN GEDNEY'S CHANNEL, NEW YORK HARBOR.

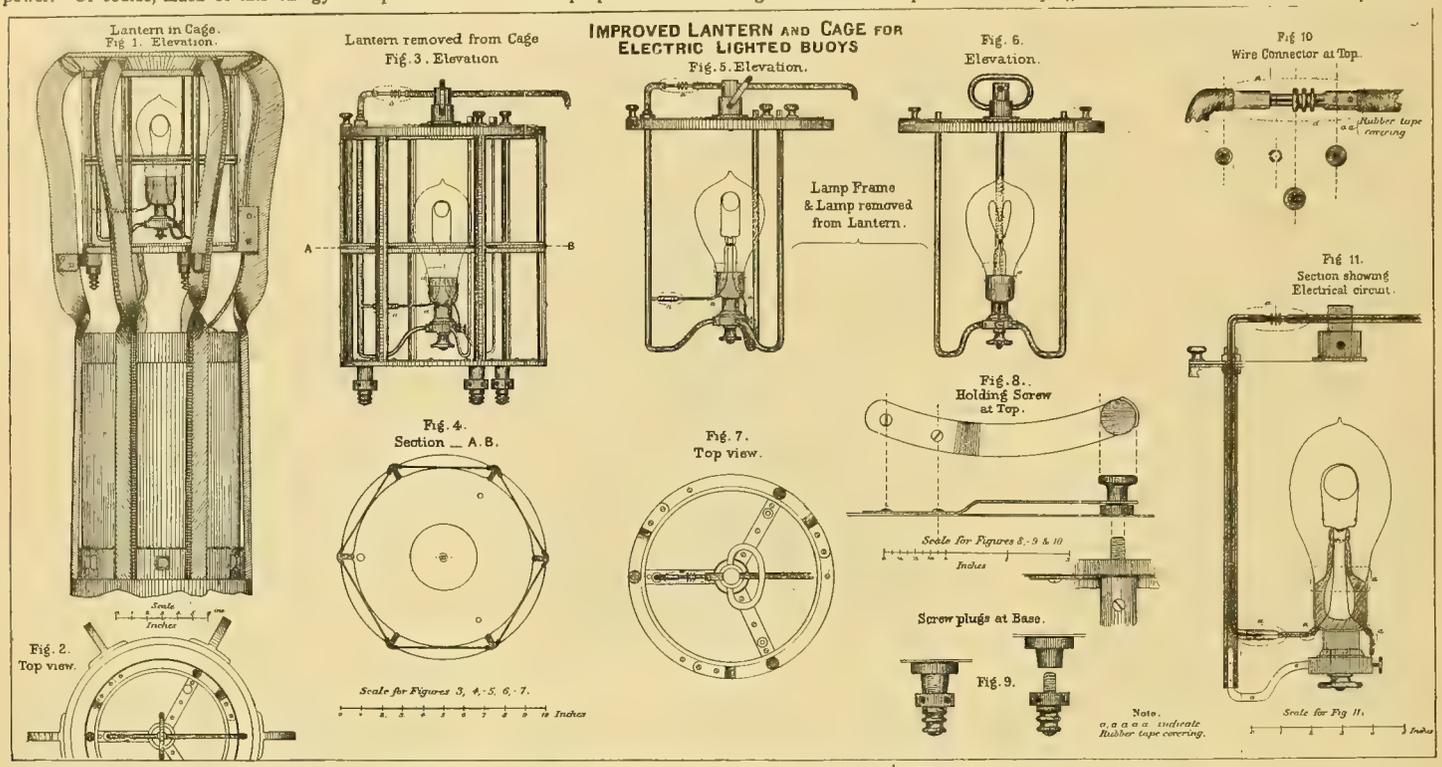
1. Abstract of a paper read before the Liverpool Welsh National society and the Liverpool Engineering society.

tric light. Forty million gallons of water will be daily brought to Liverpool from Lake Vyrnwy when the system is complete. The top water level of the lake is 820 feet above the level of the sea. The total energy continuously expended by the fall will therefore be about 7,000 horse power. Of course, much of this energy is expended in overcoming the friction against the sides of the aqueduct, in delivering the water into the houses of the consumers in Liverpool, and in maintaining the service, but there must be a good deal of energy wastea; and it is well worth the consideration of our water authorities whether some utilization of this wasted energy in waterworks generally cannot be effected so as to deliver it in the form of electrical energy in our streets and buildings. The whole of the streets of Liverpool could be brilliantly lighted by the energy wasted in the Vyrnwy aqueduct.

Water as a source of energy is found where Nature has placed it, and not where it can be most conveniently used. The electrician has, however, interfered with Nature, and has enabled man to extract the otherwise wasted energy, and to lead it where he wills. The energy of moving water has hitherto been much sought after in the United Kingdom, because coal is cheap, but now that strikes are rampant, the wise seek wind and water.

Wind is a somewhat fitful source of energy, but it has served its purpose and has done good service in the past. It is still in great request upon the ocean and in lands where coal is dear, and air is cheap. It is much used for irrigation, and its energy can be stored either by raising water or by accumulating chemical energy in secondary batteries. Mr. Brush in Cleveland, U. S. A., has used a windmill to light his house, and Carwardine & Co., in the City-road, London, utilize about three horse power in this way every evening. An ordinary windmill, having four sails, in a pleasant breeze of 10 miles an hour, gives about two horse power, and the small American circular mill, so much in request now, gives on the average about 11 horse power. The power exerted increases with the area exposed, and with the cube of the air velocity. A wind, blowing at the rate of 10 miles an hour, or, say, 15 feet per second, will exert such direct pressure on a sail 130 square feet in area that it will drive a boat before it with the power of a horse. The largest sailing ship in the world has just been launched at Port Glasgow, which carries a sail area of 57,000 square feet and has a tonnage of nearly 4,000. Such a wind would exert upon her a power equivalent to 440 horse power. Wind is, however, practically available only for small powers, and in exposed positions on land. There are, however, many places where country houses could be supplied with the comfort and luxury of the electric light if this errant force of Nature were curbed and brought under subjection.

While our wants are so readily and so cheaply supplied by our coal fields there is little chance of much attention being directed at present to other sources of energy; but with the diminution of our output, and the cranks of our labor communities, the attention of our manufacturers and of the custodians of our health, safety and comfort must be directed to those neglected energies which are now "wasting their sweetness on the desert air."



FIGS. 1 TO 11. THE LIGHTING BY ELECTRICITY OF THE BUOYS IN GEDNEY'S CHANNEL, NEW YORK HARBOR.

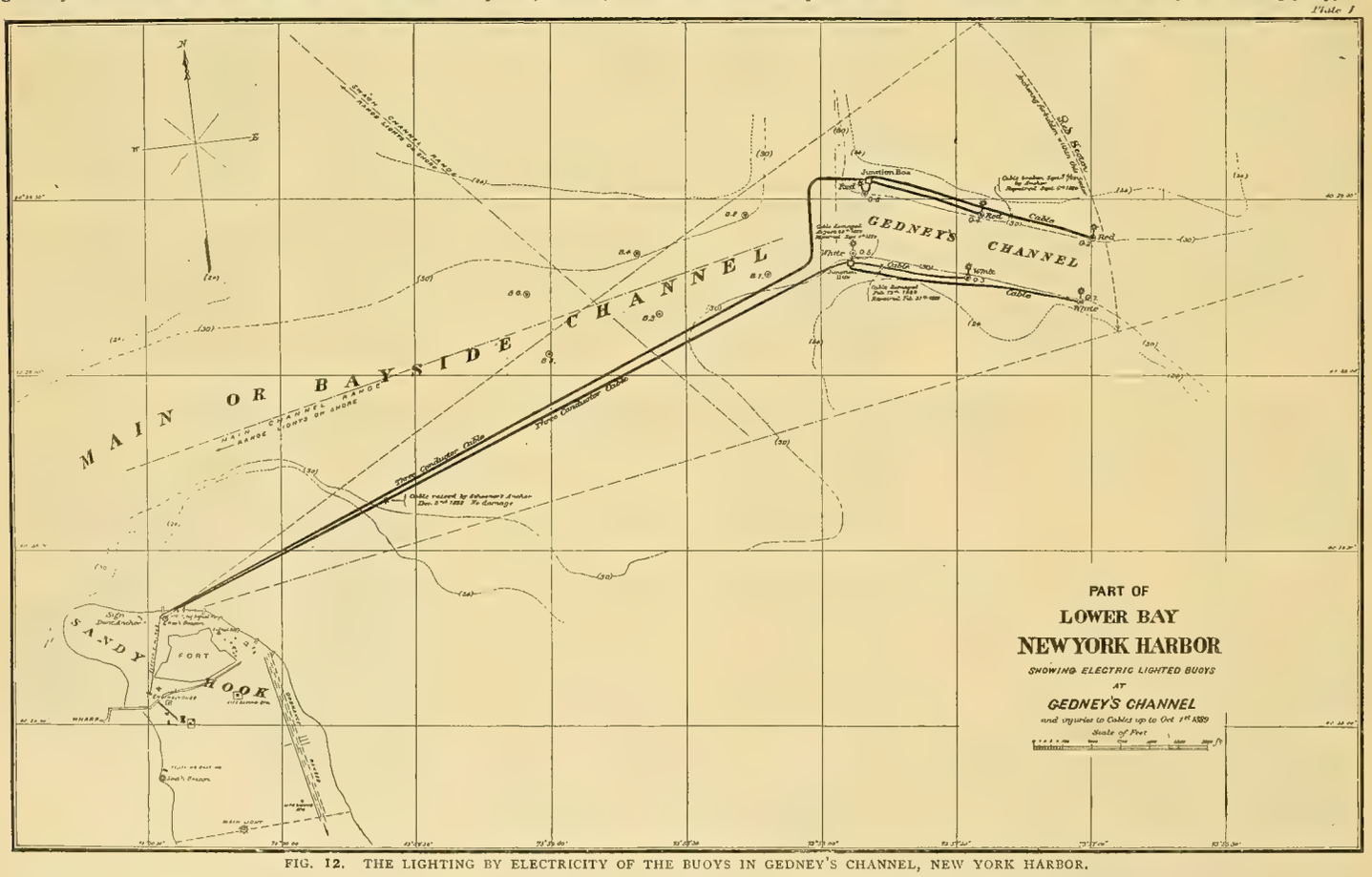


FIG. 12. THE LIGHTING BY ELECTRICITY OF THE BUOYS IN GEDNEY'S CHANNEL, NEW YORK HARBOR.

American Institute of Electrical Engineers.

The annual meeting and election of the American Institute of Electrical Engineers was held at its headquarters, 12 West Thirty-first street, New York city, on Tuesday, May 17th. The following named officers were elected: President, Frank J. Sprague; vice-presidents, A.E. Kenelly, Nickola Tesla, Oscar T. Crosby; managers, Charles Wirt, Angus S. Hibbard, Dr. Michael J. Pupin, Charles P. Steinmetz; treasurer, Geo.M. Phelps; secretary, Ralph W. Pope. The officers holding over from last year are as follows: Vice-presidents, T. D. Lockwood, Carl Hering, William J. Hammer; managers, J. C. Chamberlain, P. E. Delany, H. A. Foster, H. Ward Leonard, Dr. Louis Bell, Herbert Laws Webb, Prof. A. G. Compton and James Hamblet. Chicago, June 6th, 7th and 8 h.

"The council's report, which was submitted at the annual meeting, presents the following facts:

Ten regular meetings and one special meeting of the council have been held during the year, at which the average attendance has been eleven, the largest number present having been thirteen and the smallest seven.

"The last general meeting of the Institute was held in New York city May 20th and 21st, and occupied two days. Eight other meetings have been held. At these meetings twenty-four papers and reports were read and discussed, and have since been printed and distributed to the members.

"The institute was invited to unite with other engineering societies in the establishment of engineering headquarters at Chicago during the Columbian Exposition. As the plans of the exposition developed, however, it appeared that the proposed electrical congress would require the undivided support of all electrical organizations, and for this reason your council deemed it wise to decline entering into the proposed arrangement. It was subsequently decided that the Institute should support the action of the World's Congress Auxiliary in making preparations for the World's Electrical Congress, in order to do its share in making the congress a success.

"In accordance with the instructions of a meeting of the Institute, the following named delegates were appointed by the council to represent the Institute at the Frankfort Electrical Congress in 1891: Carl Hering, Nikola Tesla, Prof. Richard O. Heinrich and Dr. Edward L. Nichols. With the exception of Mr. Tesla, all the delegates were in attendance, and their report was duly submitted to the council and printed in the transactions.

"At the meeting of February 16th it was decided that the general meeting of 1892 be held at Chicago, in order that an opportunity might be offered the western members of the Institute to participate in its proceedings. It was believed that the standing of the Institute as a national body would be enhanced by the holding of its meetings in other cites than New York, provided experience proved that this might be successfully done. The date was subsequently fixed for June 6th, 7th and 8th.

"The report on membership shows an increase of seventy-four during the year, making the present membership 615. This includes three honorary members, 179 members and 433 associate members. The net expenses during the year amounted to $5,952.19.

"In accordance with the instructions of the last annual meeting, the secretary and the treasurer, acting as trustees, made a special deposit of the $350 previously reported as a building fund; also $500 surplus from the general fund, making a total of $850. The treasurer's cash balance on April 30th was $245.53, and the secretary's cash balance the same date $25.56, making the current balance carried forward to the next year $271.09."

Electric Railways Considered in Providence.

An interesting meeting of the Commercial club of Providence, R. I., was held on May 14th. The subject under discussion was "The Electric Street Railway in Its Relation to City Life." There was a large attendance of the leading citizens of Providence, and the speakers were T. C. Martin of New York, Prof. Elihu Thomson and O. T. Crosby of Lynn, and Henry M. Whitney of Boston, There was an elaborate banquet. Among other things, President Whitney of the West End company of Boston, said: "No person, to my knowledge, has been seriously injured since the system was put in Boston, three years ago. From that day to this, while it is true two or three horses have been killed, to my knowledge no single person has received any injury worth talking about at all. That this is a deadly current is shown to be a mistake. Hardly a week passes that a line man does not receive a shock, and burns his fingers, perhaps. I know of no serious case. There is no suit against the company alleging injuries from this cause. The experience of the people I represent has been one so far of entire approval of the system as a whole. I am not here before this body of men to say I do not think the wires objectionable. I would be glad if they could be dispensed with."

Electric Plant at the Western Wheel Works, Chicago.

One of the large factories of Chicago is that of the Western Wheel Works, at the corner of Wells and Schiller streets. The output is mainly bicycles, and about 800 men are employed. All the operations appertaining to the manufacture of bicycles are carried on at this factory, which is said to be the largest of its kind in the world. Seamless steel tubing imported from England forms the

FIG 2. ELECTRIC PLANT AT THE WESTERN WHEEL WORKS, CHICAGO.

basis of the machines, and the various processes of shaping, forging, brazing, polishing, japanning, plating and erecting are very interesting. Ball bearings are used almost exclusively, and about five million of the tempered steel sphericles are consumed every year. It is interesting to note that these little metal pellets are harder than glass and are guaranteed by the manufacturer not to vary a two thousandth of an inch one from another. An electroplating plant of considerable dimensions forms one of the departments of the factory. Two small Eddy dynamos furnish the necessary current, and about 2,000 gallons of solution are constantly in use. From 10,000 to 15,000 pieces of metal are nickel-plated daily, and the yearly bill for nickel is about $3,000. Superintendent Otto Unzicker has charge of the factory.

An isolated plant for lighting the entire factory, shown in Fig. 1, was lately installed by the Mather Electric company, under the supervision of F. A. Baux, Chicago agent. It has given entire satisfaction, and is highly spoken of by the officers of the company. The plant consists of two 50 kilowatt standard Mather dynamos driven by a remodeled Atlas engine, belted to countershafting. About 1,400 16 candle power lamps are wired throughout the factory and a few arc lamps. The switch-board, Fig. 2, is provided with all necessary switches and instruments, and is handsomely finished with polished copper bars and nickel fixtures. The brush-holders of the dynamos are also nickel-plated, the plating having been done in the factory. George D. Van Tassel is in charge of the plant, which is undoubtedly one of the model factory installations of the city.

FIG. 1. ELECTRIC PLANT AT THE WESTERN WHEEL WORKS, CHICAGO.

National Trade Press Association.

A movement was recently inaugurated in Chicago by the represenatives of the leading trade and class newspapers, having for its object the perfecting of an association for social intercourse, and for the betterment, in various ways, of the business interests of the advertising solicitors connected with the technical press. Several meetings have been held, and on Thursday, May 19th, the members met at luncheon and adopted a constitution and by-laws and elected officers for an organization, to be known as the National Trade Press association. The representatives of nearly every prominent trade or class newspaper published in Chicago, or represented by a business office in this city, have already signed the roll of membership, or have expressed a willingness to do so, and the building up of a strong social organization is confidently predicted. Until permanent quarters are secured, meetings will be held on the first Tuesday of each month at some prominent hotel club room, at which time a lunch will be served, papers read, and the regular business of the club transacted. The following is a list of the officers elected for the ensuing year: President, W. A. Carroll, *Scientific American;* vice-presidents, Gilbert C. McDuff, *Johnson's Directory;* J. F. Connor, *Electricity;* Clarence P. Day, *Manufacturers' Record;* D. H. Ogden, WESTERN ELECTRICIAN; treasurer, M. J. Bulkley, *Electrical Review;* secretary, W. Forman Collins, *Electrical Engineer;* directors, J. P. Tuttle, *Western Brewer;* J. W. Dickerson, *Street Railway Journal;* John C. Burnell, *Brewers' Journal.*

Another application for a receiver for the Dubuque Electric Light & Power company has been made. It is filed by the holders of the first and second mortgage bondholders and other creditors. The application will be heard in the United States Court at St. Louis before Judges Caldwell and Shiras. The deputy United States marshal has levied on the power house and other property of the company to satisfy former judgments.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

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It is expected that the new Atlantic cable between Africa and South America will be completed and ready for operation in July. This cable is now being laid, and will be 2,165 miles in length. It is expected that the new cable will aid materially in attracting British capital to South American enterprises. The enterprise is essentially English. The scheme is backed by English capital, and the work is being done by English engineers. The cable was made in London, and represents the latest ideas in submarine work.

In the WESTERN ELECTRICIAN of April 23d the Bernardos system of electric welding was illustrated. In this issue another article on the same subject is presented. Considerable interest has been manifested in this process, both in this country and Europe, and many central station managers have undoubtedly had occasion to utilize this method. George A. Redman, superintendent of the Brush company at Rochester, N. Y., in a recent communication, refers to the article published April 23d, and adds: "We have been successful twice in the last year in repairing cracked armature spiders by brazing them together with an arc from a constant current dynamo."

ONE of the principal objects of the visit of Prof George Forbes to this country was an inspection of the work accomplished in the line of utilizing the power of Niagara. A small portion of the power is to be delivered mechanically near the tunnel, but the greater part is to be transmitted to the consumers by electricity, and Prof. Forbes had been retained as consulting electrician. The London engineer was greatly impressed with the vastness of the project and the amount of work already done, and has no doubt that the result will give a conspicuous example of the advantages of the electrical transmission of power. He does not think, however, that it is practicable to transmit power from Niagara to the World's Fair, agreeing with many leading American electrical engineers in this respect.

MUNICIPALITIES, as a rule, in their dealings with electrical companies, are not particularly consistent. An instance at hand is found in the recent communication of the chief of the Milwaukee fire department to the city council, in which attention is directed to the fact that the city fire alarm wires are still on the poles of the Western Union company. For more than a year the Milwaukee city officials have been doing a good deal of talking about burying wires, etc., all of which, of course, is directed against the electric corporations of the city. The telephone company has built conduits in which to place its wires, and the telegraph company, according to the chief of the fire department, is also removing its poles, and, unless the council moves quickly in the matter, the city will find itself in the predicament of having no fire alarm service or being compelled to erect new poles for the city wires.

THE city council of South Omaha, Neb., has passed an ordinance providing for an "occupation tax," by which special taxes are levied on nearly all the industries of the town. Attorneys pay $5 a year; brokers, $35; barber shops, $5; coal dealers, $50, and so on. Electric light companies are taxed $150, while telephone and telegraph companies will each have to pay $25. The imposition of a tax of this kind is unusual, but no doubt the exigencies of the city finances require it. The tax on electric light companies is too high, however, especially in view of the fact that such undesirable enterprises as rendering works are only required to enrich the city treasury by $50, while those public benefactors, the lawyers, get off with $5. No wonder the local electric light companies endeavored, although unsuccessfully, to have the rate reduced to $100. There is a noticeable tendency on the part of municipal governments to mulct electrical corporations as much as possible, the impression evidently prevailing that the business of supplying electric lights yields immense profits. This idea, although widely diffused, is erroneous in the great majority of instances. It is nevertheless cropping out all the time, and the action of the South Omaha council is simply a recent expression of it.

WHEN the Cincinnati papers set out to "roast" any person or body of citizens they leave no doubt in the mind of the reader as to their intention. The recent contest over the contract for the city lighting gave opportunity for many heated articles of this description. One that appeared in the *Post* recently was of such an exaggerated character as to be really humorous. It began in this fashion:

In the oozy swamps of fever-plagued East Indies is found the hooded snake. It lurks in secluded places, but as near as possible to lonely roads, where it may strike its poisonous fangs into unwary travelers. A characteristic of this serpent is its unconquerable and malignant disposition. Even when one thinks it exterminated, if he but turn away for a moment, it will spring up with expanded hood, gleaming, hateful eyes, ready with its deadly stroke. The very breath of this crawling, hissing reptile is said to be as injurious as the shade of the upas tree. The gas company, like the hooded snake, appears to admit no defeat and to be ever on the alert to fasten its deadly fangs upon the corporate body of the city. Defeated in the great light fight, it now stands ready to use every obstacle to block the way of the Edison company fulfilling the contract awarded it last Friday night.

No doubt the Cincinnati gas company is very wicked—gas companies frequently are—but the cause of electric lighting will not be aided by intemperate attacks such as the foregoing. Little good can be accomplished by likening a gas company, or any other company, to the disagreeable hooded snake, with its injurious breath. Attacks of this character are not far from being ridiculous.

SINCE the publication of the editorial in the WESTERN ELECTRICIAN relating to Senator Peffer's bill providing for the establishment of an experimental station for the purpose of determining whether electric power could be profitably applied to the propulsion of farm machinery, considerable popular interest has been awakened on the subject. A number of the daily papers have come to the front, and are indorsing the action of the Kansas senator. The Binghamton, N. Y., *Herald* most sensibly remarks in replying to certain "young journalists" who have been finding a source of amusement in the Peffer bill, that "If Congress would make as liberal an appropriation for this purpose as it did for certain idiotic experiments in 'rain making' not long ago, which served to make that august body the laughing stock of the civilized world, the ultimate result would not be one whit less valuable to the people of the United States than that of the historic appropriation of $30,000 with which Morse's experimental telegraph line was built from Washington to Baltimore half a century ago." The *Herald* wisely adds a suggestion, too, that the experiments should be put in charge of intelligent and technically trained electrical engineers, such as those, for example, "who have revolutionized our methods of municipal transportation."

An Illinois journal also makes the amusing, but none the less forcible, remark that "it would be vastly more sensible to spend money in the manner proposed in Senator Peffer's bill than to blow it away in a futile pop gun attack upon the rain clouds."

The WESTERN ELECTRICIAN has already recorded its views on this subject, and the indorsement of the Peffer bill by the daily papers is entirely in accordance with them. If the proper men are placed at such an experimental station, who will aim not only to demonstrate scientific points, but likewise commercial ones, a new field for the electric motor and also the electric light, will undoubtedly be opened. The builder of farming implements and the electrical manufacturer are now strangers; bring these two together with the one object in view, of demonstrating the practibility of such an application of electric power, and we are constrained to believe that it would not be more than a year before even the most verdant of our agriculturalists would begin to estimate the profits that might be secured through the employment of electric power.

IMPORTANT action was taken by the committee on grounds and buildings of the World's Columbian Exposition company on Monday by which it seems that the matter of the award of the contract for the incandescent lighting is settled in favor of the Westinghouse company, the committee having unanimously passed a resolution in its favor, the alternating system to be used at a rental of $399,000. It cannot be asserted, however, that the action of the committee is entirely conclusive, for if anything has been developed in the strenuous contest of the last eight weeks, it is the fact that the result is never certain until the contract has been actually signed. Once before the committee passed a resolution on the subject, and at that time it recommended that the contract be given the Edison Thomson-Houston company at $5 95 per lamp, but, on the advice of Vice-president Higinbotham, this action was re-considered and new bids were sought, with the result that the committee has decided in favor of Mr. Westinghouse. An element of doubt as to the final settlement is involved by this precedent; but it is the general belief, nevertheless, that the present decision of the committee will be confirmed.

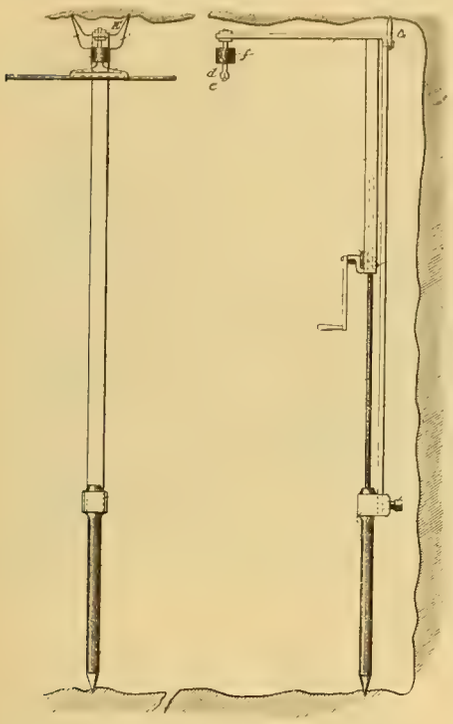
The competition for the contract has been very keen, not to say bitter, and the contest will become a memorable one in an industry noted for active business rivalries. Neither side can boast that its procedure has been above criticism, and there is not a little, taking the conduct of the negotiations from first to last, that the electrical fraternity will look back upon with regret and which will not add to the reputation of the industry before the people.

It is not known whether an attempt will be made to prevent the installation of incandescent lamps at Jackson Park other than those of Edison manufacture by legal means, in view of the pending decision of the new Federal Court of Appeals. But it is reasonably certain that no attempt will be made to shut off the light of the World's Fair, once the plant is in operation. The situation, then, may be summed up as about like this: A contract will in all likelihood be executed with the Westinghouse Electric & Manufactuing company, and, if put in actual service in lighting the buildings, the plant will not be disturbed during the fair. It is, of course, impossible to predict what the decision of the court will be and what course the Edison-Thomson-Houston company will elect to take after it is made known.

Conductor Support.

The cut shows a side and end of an extensible standard that was designed particularly for carrying the wires for a trolley system in a mine.

The device is essentially a post with a pointed lower end, with a lug or bracket cast upon its upper end. This lug has in it a hole for the passage of the standard, whose position may be fixed by the set screw. This standard has an arm and sharp points which project upwards. To he outer end of the standard is secured the clamp for the



CONDUCTOR SUPPORT.

wire. One end of a screw threaded rod rests upon the top of the lower post, and the other end passes through a nut formed in a bevel gear, which meshes with a miter gear carried by the same bracket and is revolved by a handle as indicated.

To use this extensible stand the conductor is first secured in the clamp and then the whole device is placed so that the points at its opposite ends are adjacent to the bottom and top or other opposing walls of the mine. Revolving the handle forces the pointed post and standard in different directions until the points take a firm hold in the walls, when they may be held in position by the set screw. This support is the invention of E. C. Morgan, Chicago.

The "V. & H." Electric Heater.

The feature of this heater is the employment of a forced draught in connection with the heating coils, the designer, B. C. Howard of Baltimore, Md., claiming that, without the forced draught, no electric heater can be thoroughly successful, as dependence on radiation means enormous radiating surface or else a large expenditure of power. The chief advantages claimed, therefore, are great efficiency and durability, due to the comparatively low temperature to which the resistances are heated. Mr. Howard lays stress on the fact that, in most of the ordinary types of heaters now in service, which are essentially nothing but resistance coils, in order to be of any value, the coils must be highly heated; so highly heated, in fact, that various devices have been patented for preventing the rapid oxidation that such high temperatures entail. Methods of embedding the wires in fine clay, or sinking them half way in porcelain, etc., have been tried.

This principle of the "V. & H." heater is such that no embedding or similar expedient is required, for the coils are normally not necessarily at a higher temperature than 180° or 190° F. There is no oxidation, it is stated, and every particle of heating surface is free to radiate, thus giving the highest possible efficiency. This is made possible by employing mechanically, so to speak, a small portion of the electricity to drive a small fan, less than 1-12 horse power being necessary—just sufficient to set the air in motion. The speed of the air over the coils is a matter of experiment, of course, as too high a speed will not allow the air to be heated before passing out of the heater.

The wire used in this device is iron, tinned bright, and in the 500-volt car heater the size is about No. 24. To heat an ordinary car and keep it at a comfortable temperature requires about 1,000 watts, of which about 100 watts are used in the fan motor. The heater has four separate coils, which may be connected in different ways to give more heat in starting a car on its run or in extremely cold weather. It has been calculated that the fan, being in series with the coils, will take on a higher speed, according to amount of heat required. It is almost impossible to burn out a heater, the coils being wound on porcelain strips set well apart.

The illustration shows the coils apart from the case and the method of winding. The first layer of wire is supported by four porcelain rods, 6 inches by ½ inch, backed by a steel brace. Over this layer, slipped into slots in the cross, are four more porcelains, supported by the first four, all running longitudinally, these in turn being overwound with wire, and so on until the cross is filled. The natural spring of the wire takes care of all expansion, so that the wires by buckling to the side do not change their relative position when heated. The heater complete goes under a car seat, and the fan is opposite a round hole, cut in a panel, preferably the stove panel. Air is drawn from both ends, is thrown out the middle opening, and in this manner a continuous and rapid circulation of air is maintained, with the double advantage of warmth and ventilation.

In a test in Syracuse during the last winter, the "V. & H." heater thoroughly warmed a car in twenty minutes, and kept it at a comfortable temperature, while the outside thermometer was below the freezing point. The ammeter showed a current of 2.5 amperes at this time.

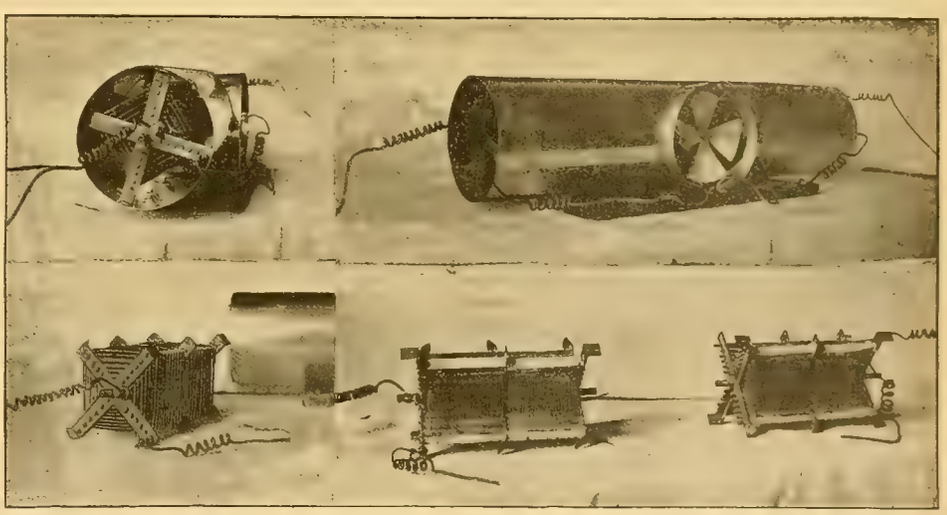
Electricity at the World's Fair.

The committee on grounds and buildings was in session from 11 A. M. to 5. P. M. on Friday of last week considering the incandescent lighting contract for the World's Fair. Reports were received from Mr. Butterworth, ex-solicitor-general of the fair, and W. K. Carlisle, the attorney of the exposition company, to whom had been referred the question of the legal ability of the Westinghouse company to do the work, in view of the pending appeal to the appellate court from Judge Wallace's decision in the great lamp suit of last year. It will be remembered that the judge decided in favor of the Edison patent on the incandescent lamp, suit having been brought against the United States company for infringement. In view of the fact that the Edison company had slept on its rights for several years, however, allowing others to engage in the manufacture of incandescent lamps without interference, the judge decided to withhold injunctions compelling other companies to desist from the manufacture of lamps pending the decision in the higher court. In view of Judge Wallace's standing and attainments, the Edison people have little doubt that his judgment will be affirmed. In that event it was considered by some of the directors that it would be difficult, if not impossible, for the Westinghouse company to carry out its contract. The lawyers who were asked to give an opinion on the subject were not exactly agreed. Mr. Carlisle was inclined to the belief that it would involve an element of considerable risk to give the contract to the Westinghouse company, but Mr. Butterworth was not so decided. The committee discussed the situation from every possible standpoint, as may be judged from the length of the session. The opinion was advanced that it would be inadvisable, perhaps, to install alternating machinery entirely, as the plant will partake much of the nature of an exhibit of the highest development of incandescent electric lighting in America, and it was thought desirable to show the direct current system in operation also. With this idea in mind it was suggested that the contract be divided and half of the lighting be supplied by the Westinghouse company on the alternating system and half by the Edison Thomson Houston company on the direct current system. Messrs. Insull, Griffin, Sunny and Beggs, representing the latter company, were in waiting in an outer room, and during the afternoon they were called in and the plan of dividing up the work was laid before them. They demurred greatly to this proposition, but did not definitely assert that they would not accept it. No representative of the Westinghouse company was present, and there was no means of determining whether the compromise would be accepted on its part. Adjournment wrs accordingly taken until Monday to give both sides an opportunity to think the matter over. Mr. Westinghouse was notified of the situation.

Noticing a statement in some of the Chicago papers, which are very unfriendly to the "trust," that the Thomson Houston-Edison company had threatened the World's Fair with injunction proceedings, for infringement of patent rights, if the Westinghouse bid was accepted, Captain Griffin called on Attorney Carlisle last week and explained that his remarks in the committee room had been misconstrued. He had no desire to place himself in the position of threatening the World's Fair. While the company did not propose to surrender its rights, he did not think that if a lighting plant was fairly established at the exposition, the company would take steps to enjoin its use. This announcement had the effect of creating a much better feeling toward the consolidated companies.

After a session lasting over three hours the committee on grounds and buildings came to a decision on Monday evening. It was that the contract for the incandescent lighting for the World's Fair be awarded to the Westinghouse Electric & Manufacturing company at its bid of $399,000. The actual signing of the contract depends, however, on the condition that Mr. Westinghouse shall, on or before June 10th, execute a bond in the sum of $1,000,000 that he faithfully carry out the provisions of the contract. The sureties on this bond must, of course, be approved by the World's Columbian Exposition, and on the acceptance of this document the contract is to be signed. The resolution arriving at this settlement of the matter was adopted by the committee unanimously.

The large bond required is intended, of course, not only to insure the proper performance of the work itself, but to protect the exposition, as far as is possible by a heavy money penalty, from legal interference, on account of possible infringement of patent rights in doing the lighting required. It is generally conceded that once the plant is in operation no court can be found in the United States that will shut off an essential portion of the lighting, nor is it at all likely that anyone will seek to do so. Should an injunction be sought by the Edison-Thomson-Houston company, it will probably be after the decision of Judge Wallace has been upheld by the appellate court—should such prove to be the case—and before October 1st, the time set for the operation of a portion of the plant. The decision is expected within a month. If the combined companies should seek such a restraining order, the explanation would probably be advanced that



THE "V. & H." ELECTRIC HEATER.

they were the owners of the fundamental lamp patent, and that it would be unjust and unfair to ignore their hardly-won rights at the World's Fair. On the other hand Mr. Westinghouse is reported to have asserted that he has one hundred thousand lamps in stock. It is possible that a portion of these lamps are of Edison manufacture. There could be no legal objection, of course, to the use of such lamps. As far as the bond is concerned there is little doubt that Mr. Westinghouse will be able to secure it.

Mr. Westinghouse and Mr. Terry awaited the decision of the committee on Monday in an adjoining room. The former declared that he was opposed to the proposition to divide the contract, and that he would not accept it. The exposition, he said, had expressly stipulated for bids on the entire installation and should abide by its determination. Messrs. Griffin and Beggs were called before the committee, but their presence was not required for a great length of time. Shortly afterward the decision was announced.

It is idle to deny the fact that much feeling has been stirred up over the question of the electric lighting at the fair, and many serious charges aimed at the persons concerned have appeared in the newspapers of Chicago and elsewhere. There is not the slightest doubt that everybody interested will be heartily glad when the whole thing is over, and that a great sigh of relief will go up. The citizens of Chicago in general and the electrical fraternity in particular are keenly interested in the contest, and the words "trust" and "Westinghouse" can frequently be heard in conversation in the offices, clubs and restaurants of the World's Fair city. Some of the charges alluded to have included Col. R. C. Clowry, general superintendent of the Western Union company and a World's Fair director, but he has not been content to remain passive under fire, as the following letter, published in the *Chicago Times* of May 19th shows:

In an article printed in your paper this morning in reference to the bids for incandescent lighting for the World's Fair grounds the following language is used. "Some comment has been caused by the fact that Director Clowry, who is vice-president of the Western Union Telegraph company and a stockholder in the Edison company, is now sitting as a member of the committee on whose recommendation the contract will be awarded."

The so called combination is made up of the Edison General Electric company of New York, the Thomson-Houston, Brush, Excelsior, and several other companies. I have no interest whatever in the Edison General or any of these companies. I have a small interest in the Chicago Edison company, a local Cook county corporation. This company declined at the outset to bid upon the work at Jackson Park, believing that if they should be awarded the contract there would be no profit in it; neither will they have any interest whatever in the work if it is awarded to the Edison General and other companies.

The first bid received from the combined companies was $18.50 per incandescent lamp, and, as frequently stated in the papers, Charles H. Schwab and myself were appointed a special committee to ascertain if this bid could be reduced. We worked upon the subject for at least two weeks and succeeded in getting the bid down from $18 50 to $5.95 per lamp and as there were to be some 92,000 lamps the saving would be about $1,154,600.

We were not empowered to close any bids, but to report to the ground and buildings committee, and when we made our report we were congratulated by the different members of the committee on the work performed.

Up to this time the lowest bid made by Mr. Westinghouse was $6.90 per lamp. I was called away from the city when this bid was made and was absent for three weeks, during which period, as I understand it, several meetings of the committee were had and the bids were reopened at the suggestion of Mr. Westinghouse. While absent I noticed a good deal of gossip in the newspapers about certain parties, myself and others, being interested in the Edison company, and upon my return I stated the facts to the committee and offered to withdraw during the consideration of the incandescent bids, but the committee unanimously declined to grant my request. I shall, however, place this request before the committee again for their consideration.

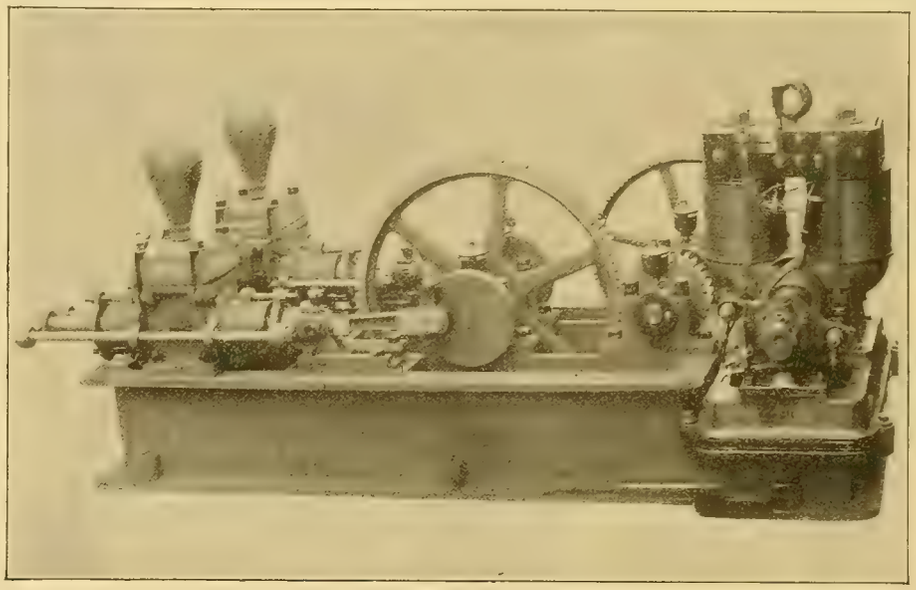
These World's Fair committees are made up of very busy men. We receive no compensation whatever, and it is altogether a labor of love. It is difficult to secure quorums at committee meetings, and I shall only be too glad to be relieved from as much of the work as possible, as I am kept fully occupied with the business of the Western Union company.

The committee on grounds and buildings and Chief of Construction Burnham, have been exceedingly successful in breaking down prices upon bids submitted for work, and, in my opinion, deserve a great deal of credit. In fact, it has become a common saying among bidders that it is not a question of how much they can make, but how much they can afford to lose in order to participate in the work upon the World's Fair grounds.

Last week the committee on grounds and buildings awarded the contract for the "rubber covered" wire for the arc light circuits at the World's Fair to the Safety Insulated Wire & Cable company, accepting its bid of $155 per mile. The construction department will re-advertise for bids for the lead-covered cable.

A Koenigsberg correspondent of the *Elektrotechnischer Anzeiger* of Berlin writes to that journal: "Our city will be represented at the World's Fair in Chicago, in the exhibition of German engineering industries. Among its exhibits will be a model of the five-wire system, of which this city alone has a complete installation."

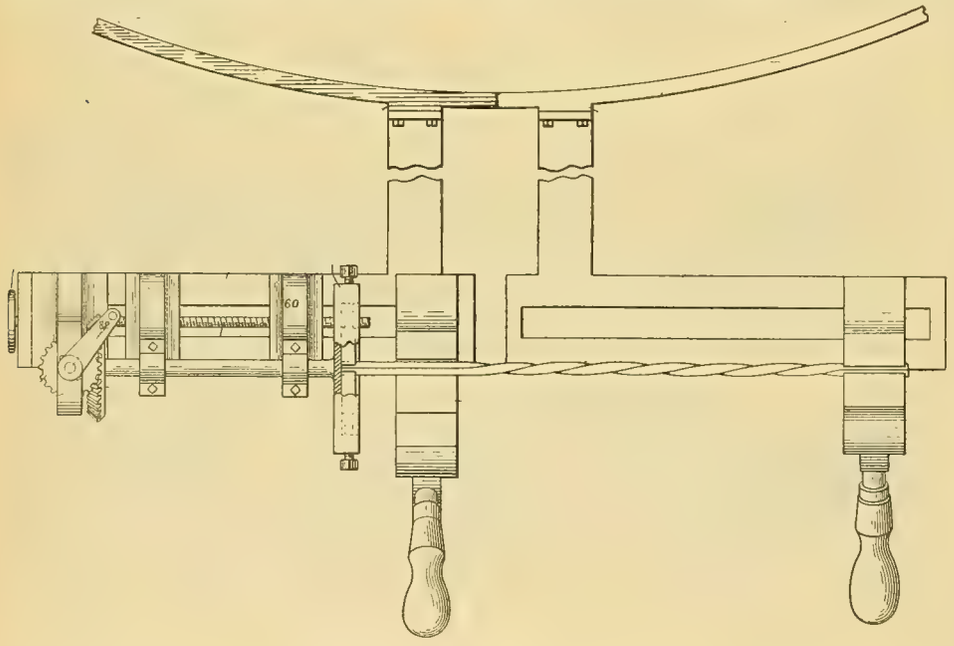
By a recent ruling of the treasury department Hartmuth & Co. of Vienna will be allowed to send over carbons for electrical use at the World's Fair, duty free, provided the products are actually consumed for the use of the World's Columbian Exposition and not sold. This result was brought about largely through the efforts of Herr Goldschmidt, the Austrian consul-general.



ELECTRICALLY OPERATED PUMP.

Electrically Operated Pump.

In the accompanying cut is shown an electrically operated pump. The combination consists of an Edison standard motor, with a Deane duplex double acting pressure pump upon the same special bed plate. These pumps have outside packed plungers, with the valves arranged above the cylinder in such a manner that they can be uncovered for examination or repair without removal of any pipes. The covers of the valve chests are held down by swing bolts. To remove these covers it is only necessary to loosen the nuts and swing the bolts away without removing them. The pump is operated by the motor by means of a double gear. The equipment is placed on the market by the Edison General Electric company.



AN ELECTRICAL METAL TWISTING MACHINE.

An Electrical Metal Twisting Machine.

The cut illustrates one of a number of special machines for forming metal bars, strips, etc., that have been designed by George D. Burton of Boston.

Mr. Burton has found that where the electric current is employed for heating bar shaped blanks, the metal heats from the interior instead of from the exterior, as is the case in the ordinary blacksmith's forge; also that there are no gases introduced into the metal when it is electrically heated, and consequently when the blank is twisted no scale is formed and the metal is left clean and free from blemishes. Moreover, in addition to the above, he found that the bars retains the electrically produced heat longer than that of the ordinary surface heating forge.

Referring to the illustration, it will be seen that the machine employed to produce twisted metal bars for stair-rods, fence-pickets, and other ornamental metal work is extremely simple in construction. To use this apparatus, one end of the metal bar to be twisted is placed in the clamp to the right and the other end in the left hand clamp, the bar extending through the last mentioned clamp into the jaws of a third clamp. The first two clamps are closed tightly upon the bar and the electric current switched on. The current passes from the positive coil of the peculiar ring-shaped converter shown above the clamps, through the bracket conductor leading from the ring, thence through the clamp through the bar to be heated and back to the converter.

The metal rod under the action of the heating current is heated in a few seconds to a forging temperature throughout that portion of its length which spans the space between the clamps with handles, while the ends which are directly in contect with the clamps will remain

cool in the metallurgical sense of the term. The current is now switched off quickly and the central clamp released from the bar. A crank at the extreme right of the machine is then turned, the end of the bar being still held in its clamp. The rotation of the shaft causes a twisting of the bar, as represented. The bar may be twisted more or less, as desired, and is then released from the clamps and removed from the apparatus.

Gearless Motors for Street Railway Work.

English electrical engineers are showing considerable interest in the work that has been done in this country in the application of gearless motors to street railways. "The idea of placing an armature upon the driving axle of an electrically propelled vehicle is an old one," says the London *Electrical Review*, "but it did not obtain a practical application until about two years ago, when the first of the locomotives for the City and South London electric railway was built. It was not a very difficult task to design motors for railway locomotives running at the rate of twenty miles per hour, and capable of developing upwards of 50 horse power, but when it came to the question of machines for tram cars whose axles revolve at 100 or less revolutions per minute, then engineers preferred to keep to the beaten track of using some kind of reduction gear between the armature and the car axles. The problem has entered into every traction engineer's mind; one and all have made calculations as to the possibility of constructing slow speed motors of reasonable dimensions, weight and efficiency. If weight had been no object, dimensions and efficiency seemed to bar the way to the adoption of this desirable mode of electric traction. Another point which deferred pioneers was the fear that an armature, keyed directly upon a car axle, would soon shake to pieces.

"An American, Prof. S. H. Short, had the courage of going beyond mere calculations and surmises, and he has for a considerable time been engaged upon experiments with gearless motors. The Westinghouse company of Pittsburgh, also has been working in the same direction, but until recently we have had little or no definite data relating to the performances of such motors, which now form the theme of a paper read by Mr. Short before the Chicago Electric club."

Prof. Short's paper was published in full in the WESTERN ELECTRICIAN, April 16th. Commenting upon the data presented in this paper, the *Electrical Review* says:

"These tests are by no means conclusive. No mention is made of the types of motors which were brought into competition with Mr. Short's own machine. Two things struck us when examining the curves. One is that as high an efficiency as 70 per cent. could be obtained with the gearless motor, and the other curious phenomenon is, that with all the motors the efficiencies fell off rapidly when the motors were yielding less than 10 or 11 horse power. Considering that in most cases two such motors are placed upon a tram car, and that with ordinary speeds in cities the power on the car averages about 6 to 7 horse power, or 1 horse power hour per car mile measured at the terminals of the motor, it seems to us that there is some deficiency in the design, at any rate, of the machines used in Mr. Short's experiments. What should be aimed at in traction motors is not a high efficiency at one particular speed and load, but a good all-round efficiency within a wide range of loads and speeds, and this has been attained by engineers in England. We tested motors in London several years ago which gave an average efficiency within a range of from 2 to 12 horse power, of over 70 per cent., and these, we believe, have been still further improved."

Proposed Chicago and St. Louis Electric Railway.

Much incredulity has been expressed in relation to the proposed air line electric railway between Chicago and St. Louis, over which it it claimed that trains will be run at the rate of 100 miles an hour. There is no doubt, however, that a survey of the proposed route has been made, and residents along the line are greatly interested. It is proposed to run the road in a perfectly straight line, not turning aside for villages or towns. The route projected is 248 miles long, 36 miles shorter than the most direct steam railway line. A mass-meeting of citizens of Christian county, Ill., was held at Edinburg recently. The electric railway was indorsed and a direct right-of-way through the county granted. At that meeting Dr. Adams, the father of the project, stated that grading would begin near Edinburg next month, and proceed toward St. Louis and Chicago. Railroad contractors from every part of the country, it is said, have expressed their willingness to construct the road. One of the power stations is to be located at Edinburg.

In conversation with a St. Louis reporter, Dr. Adams said that plans are now being drawn for the twenty bridges for the electric road over steam railways. These bridges will have an approach of 1,000 feet. The highways, of which there are 246 along the line, will pass over the electric road by means of viaducts with approaches 102 feet long. The motor, which is of Dr. Adams' design, will be mounted on the driving axle directly. The driving wheels will be six feet and a half in diameter. The speed will be regulated not by switches and resistance coils, but by a new device, which Dr. Adams says he does not care to divulge until he has obtained patent rights. It is said that terminals have been secured in Chicago and St. Louis, but Dr. Adams does not care to state their location at present.

"If the new electric railroad to St. Louis proves to be the success as to speed expected," remarks the *News* of Joliet, Ill., "the advertising man may write it down as 'the only line from Chicago to St. Louis without change of cigars.'"

Ampere-Centimetre, a Measure of Electro Magnetism.[1]

By CARL HERING.

It appears from the following deductions that an electric current multiplied by the length of the circuit will represent the number of magnetic lines of force generated by this current, or, in other words, that the number of lines of force generated by a current can be measured by the product of the current and the length of its circuit. A unit current passing through a unit length of circuit appears to generate a certain fixed and constant number of lines of force. This, of course, has reference to the electro-magnetism of the current itself, and does not include the influence of any magnetic bodies in the neigborhood.

First of all it is necessary to show that amperes multiplied by length will give a unit of a similar nature to magnetic lines of force or flux in order to show that an equivalent between the two may be given without trangressing the laws of physics. This may be shown conclusively by the aid of the dimensions of these units in the absolute system. The dimension of current is $m^{1/2}\, l^{1/2}\, t^{-1}$, while that of magnetic flux (that is, number of lines of force, not their density per square centimetre usually represented by H or B, nor the intensity, as it is sometimes called) is $m^{1/2}\, l^{3/2}\, t^{-1}$. It will be seen that the former multiplied by a length gives the latter. This shows conclusively that ampere centimetres or ampere feet and magnetic flux are units of the same kind and can therefore be equaled.

Having determined this point, the following appears to show that every unit length of a circuit conveying one ampere generates a fixed and constant number of lines of force. Using absolute units, the intensity of magnetization (or number of lines per square centimetre) at the centre of a circle of one turn, according to the well-known formula, is

$$H = \frac{2c\pi}{r}$$

in which r is the radius in centimetres and c is the current.

Now, the intensity of the field is different in different parts of the area enclosed by the circle, being greatest nearest to the wire, but it may be assumed that in all circles, large or small, the ratio of the intensity at the center to the average intensity in the whole circle is a constant. Let this ratio be called K, then the total number of lines will be equal to the intensity at the center multiplied by the area, and by K; that is

$$M = \frac{2c\pi}{r} \times \pi r^2 \times K = 2c\pi^2 rK$$

By dividing this by the circumference will give the number of lines per unit length of the circuit—

$$2c\pi^2 rK \div 2\pi r = C\pi K$$

or per unit of current, this is equal to πK. It will be seen that this is a constant and is independent of the radius r. This means that the number of lines per unit length and per unit current is the same for all circles, and therefore also for a straight line, which is a circle of infinite radius.

From this it appears that, knowing this constant number of lines per ampere, per centimetre, or foot, the calculation of the total number of lines generated by any circuit or coil would merely be the product of the current, the length of the circuit and a constant. It should be remembered, however, that this deduction supposes theoretical conditions; that is, a filamentary wire having no appreciable diameter. How far the size of the wire introduces an error remains to be determined. At all events, if the diameter of the wire is small as compared with the diameter of the coil, and specially if the coil, as it usually does in practice, contains iron which appears to concentrate the lines in it, and therefore probably attracts those circulating in the body of the wire itself, it may doubtless be assumed that the ratio of the flux in two coils would be equal to the ratio of their ampere feet, which proportion might be of use in dynamo construction.

The above deductions were made by the writer a number of years ago, but as they did not appear to agree with some existing laws at that time, the matter was laid aside. It seems, however, that subsequently some dynamo builders have advocated and used this system of calculation in preference to the other, and it was therefore thought best to publish this proof, hoping that [illegible] formed on this subject, might point out the discrepancies, if any, and perhaps show the extent of the application in practice of calculating the magnetic effect of a current from the ampere-centimetres of the circuit.

1. Read at the meeting of the Electrical Section of the Franklin Institute May 3, 1892.

Electric Railways in England.

Although electric railways have proved successful in this country, English engineers, with few exceptions, have expressed the belief that American methods would not meet the requirements of English practice. Thus far, however, English engineers have been unable to present anything superior to the American systems, despite the fact that they have the benefit of the experience gained in this country. They have been watching the progress of the electric railway in this country closely, and evidently have come to the conclusion that there is something in the electric system even worthy of their consideration. According to the English papers, experiments have been in progress at Bradford with a view of testing the electric motor. An arrangement was made for the operation of electric cars for several weeks. The terms of the agreement were that $2,500 should be devoted to carry out experiments lasting over several weeks. If at the end of this term the municipal authorities were satisfied with the results of the running, they would buy the car, with motors, switches, etc., complete. The initial trip is described by the *Electrical Review* of London, which says: For the purpose of the experimental run the corporation selected a stretch of a quarter of a mile on the most difficult section of the tram lines, over which usually run the steam trams. Save for a few yards, the track is a hill, with an average gradient of 1 in 14, and includes a sharp curve. Temporary overhead wires were erected for the most part being slung to the buildings on each side of the roadway. The current was obtained from the corporation electric lighting station. Two small 300 volt Siemens dynamos connected in parallel were employed. The car used was one specially built, nine or ten feet long, of a carrying capacity of thirty-six passengers. Two double armature motors with worm gearing were used.

According to the same English authority:

There can be no question of the success of the experiment, so far as the actual running up the hill is concerned, but, of course, there must be coupled with this success the cost of driving the car. With a full complement of passengers, 45 amperes at 300 volts has been found necessary, but on one occasion, when the car carried forty-three adult passengers, seven more than the usual number, 70 amperes, or nearly 30 horse power, was required for the greater part of the journey. It is, perhaps, to be regretted that the experimental course did not include a level section of the line; in fact, it seems to us that if the electric car has been tried for the purpose of ascertaining the cost of climbing the hill, a somewhat unfair test has been made. It may be that the only question at issue was the ability of the electric car to get up a steep hill. In any case, a run which included a level track would have been far more satisfactory, for one might then have arrived at some determination regarding the performance of this particular car. Strict comparisons might not have been possible, but at any rate some rough idea of the capabilities of the car would have been gained. On the journey down the hill the control of the car seemed absolute. It was shown by a sudden removal of the trolley from the conductors that the tram suddenly stopped. This was, no doubt, due to the motor for the moment acting as a generator, and the action of this current would tend to force the car in the opposite direction to the one in which it was traveling, thus causing a sudden stop. As an experiment, no doubt, this was of great interest, but such a method of stopping the car would neither be wise nor generally useful, except on an emergency.

The demonstration which has just taken place at Bradford is full of significance, for it showed some of the conditions which electric traction will have to meet in England.

To run electric cars over a straight bit of road on the overhead system may not present insurmountable obstacles, but in a scheme to run electric tram cars through crooked thoroughfares, up hills of heavy gradients, and round sharp corners, grave problems will be met. It is an open question how far American practice and experience will assist in overcoming the difficulties peculiar to English towns. The abolition of the steam car from the streets of Bradford, Huddersfield, Batley, Dewsbury, and other towns, would, no doubt, be of immense importance; but when one considers that in Huddersfield there are long, hilly streets, which have sometimes three and four cars on at the same moment, the sudden demand for extra horse power would be so great that a plant of considerable dimensions would be necessary to meet the demand.

The Bradford experiments have been carried out under the best conditions, everyone being anxious to make the matter a success. Shopkeepers and householders have willingly given consent for the fixing of supporting wires on to the houses, thus facilitating matters much. We believe, however, that the overhead wires are voted by many to be an eyesore. This is scarcely understood when one considers that steam trams have long been tolerated, and that streets are, in the first place, supposed to be subservient to traffic.

Bernardos Process of Electric Welding.[1]

By W. Alsop.

The system of electric welding known as the Bernardos process has been introduced into England from Russia, which is the home of its invention, and in this paper I have much pleasure in giving a short description of its operation. The process is one which makes it difficult to define its limits or its usefulness. It has recently been adopted by a leading firm of steel and iron tube makers, and the particulars of some of the applications hereafter described have been kindly supplied me by one of a party of engineers who were invited to witness them. The plant consists of several machines, but the method of working is very simple. An ordinary lighting low-tension continuous current dynamo is used; to this a battery of Bernardos accumulators is connected, and into this the current flows continuously. When the welding circuit is closed the current flows from the dynamo and accumulators through a large regulating resistance. By these means a discharge equal to about twice that of the capacity of the dynamo is obtained, and the load factor of the plant is high. The welder practically consists of a carbon pole, connected to a flexible conductor, so that it may be moveable. The carbon point is applied to the metal to be dealt with, which becomes the other pole of the circuit, and on withdrawing the carbon point an arc is produced, the intense heat of which rapidly raises the particular locality over which it is held to the necessary heat. When that is reached at the end of a few seconds, the weld is completed by the use of the hammer. In the plant referred to the welding is effected by the following arrangements: A mechanical arc heater employed in welding thin sheets; an apparatus employed for making special pipe fittings; an apparatus where steel and other castings are repaired; an apparatus where a pump rod was being repaired; an apparatus for welding flanges on tubes; an apparatus for cutting out retort lids; an apparatus for welding lead accumulator pipes; an apparatus for drilling or perforating holes in wrought or cast iron.

You will notice that an important feature in the process is the employment of accumulators, the plates of which are of a different construction to those of ordinary use; they consist each of a lead frame, with straight and serpentine wires of lead crossing from side to side. These are laid together on an iron plate, and a small carbon pole is applied over each point where it is desired to joint the lead, and the instant application of the current acts like a soldering iron. Each minute joint is welded in not more than a second of time.

In parallel with the terminals of the dynamo or battery, as many welding machines as may be desired can be connected, and every welder is able independently to vary his current and pressure to suit the work in hand at the moment. It will be seen that with these various machines and apparatus that this is a large plant, it being one of 150 units.

While the process appears to be superior to anything previously introduced for tube welding purposes generally, its special value consists in its applicability to work which the older methods have been unable to cope with or their application to which has been uneconomical For instance, large fittings were rarely seen with outlets of a greater diameter than six inches, and even these could only be made at a great expense by a few highly skilled workmen. If large diameters were required, whilst the cost of labor was almost prohibitory, the fitting could only be made with iron five eights or three-quarters of an inch in thickness. It is claimed, however, that with the aid of the Bernardos process fittings of any size or shape, and of any thickness, can be produced with flanges of any desired thickness welded on. The system has been applied to various species of hydraulic work, and to iron barrels for the conveyance of petroleum and compressed gas. In making bodies of compressed gas—cylinders about nine inches in diameter and of plates one-eighth of an inch thick—the cylinder which is about 15 inches long, is fixed with joint batting and is heated in about 4 inch lengths by the arc, which is vibrated by machinery, and after the expiration of about 45 seconds a power hammer is brought into use. The operation is then repeated with the next four inches, and the tube is completely welded in four minutes. To do this work the machine took about 150 to 200 amperes at 50 volts, and sometimes as much as 300 amperes, which would be equivalent to 15 units. The welding of a 7½ inch flange, ⅝ inch thick, on a 3 inch pipe is an operation taking ordinarily only two minutes. The pipe is mounted in a lathe, the loose flange placed on the end, and the whole is revolved; the carbon pole is then brought into contact with the end of the pipe, just inside the box, and withdrawn so as to leave an arc, 1½ or 2 inches long. This has the appearance of a stream of molten metal on looking at it through smoked glass. In a few seconds the inside of the flange and the end of the pipe are at a welding heat, the current is stopped and a roller placed against the revolving piping. These operations being repeated two or three times, a sound weld is the result. A peculiar application is in the ready cutting of heavy sections by literally fusing the metal through and along any lines desired. By this means channels, joints or ang e irons may be cut to template with considerable accuracy. On keeping the current concentrated on one spot, a hole is rapidly fused through the metal without raising the temperature of the plate or girder, except in the immediate locality of the operation. By slowly moving the carbon point the hole becomes elongated until you have separated the article from side to side. This appears to have strongly impressed one of the leading firms of wagon builders, and they have arranged to purchase a plant principally on this account. One very important application of the process has been made by a large firm of steel makers, near Newcastle-on-Tyne. When a steel casting shows any sign of unsoundness it is sent into the electric shop, and the defective part having been removed, the hollow place is built up by fusing small pieces of steel into it. Several improvements have been introduced lately into the process, one of which is the employment of a power hammer driven by an electric motor, which is under the control of the workman, and can be instantaneously brought into operation when the metal is sufficiently heated. This is important, because to insure success in this kind of work rapid working of the heated metal is absolutely necessary. Samples of the remarkable repairing work which has been accomplished by the new process include a cast steel wheel which had been broken in ten places and mended; steel honey-combed castings repaired; a hollow wrought-iron pump rod 5 inches in diameter at fracture and ½ inch thick, and various specimens of hydraulic tubes and fittings. A steel piston rod of the largest size, which had been repaired in the slot-hole, is particularly interesting as illustrating an exceptionally difficult job which had been perfectly mastered. The tests made after welding by the Barnardos process show how good the results are; better than one would anticipate when it is seen how the metal seems to literally boil immediately within the action of the arc. Notwithstanding this, there seems no appearance of the metal being burnt. Among the specimens which were viewed by the visitors to the works referred to at the commencement of this paper, many were of steel, and a curious condition develops itself in the steel welds, as at that point the strength seems to be diminished to that of iron of similar quality, which one would anticipate if carbon only is dissipated, but for all this it is said the work of the apparatus is singularly satisfactory.

1. Read before the Northern Engineering Institute, New South Wales.

Application of Electricity to Hoisting Machinery.[1]

By Reginald Bolton.

The application of steam to cranes was a substantial advance in the direction of increased power and isolated points of generation, and that of hydraulic power, despite its inherent disadvantages was a still greater step in affording the means of distribution of that power, while the utilization of compressed air for a similar purpose is equally practicable, but has not received the development which its manifest advantages afford, by reason chiefly of its low economy, which the author considers is still capable of considerable improvement.

The use of high and low speed ropes, belts, and shafts is extremely widespread in effecting the propulsion, in certain positions, of hoisting machinery, and in manufacturing engineering scarcely a workshop or a warehouse exists wherein some one or other form of its transmission of power is not thus employed.

The whole essence of the application of electric force in this connection lies in its sub-division and transmission over a distance. It is essentially a transmitter, and not a generator, of power. It is evident, therefore, that these competitors are chiefly systems of distribution, not isolated and self-contained applications of force. Thus it has to compete with steam and water power, compressed air, flying ropes, tumbler shafts and gear, hand power, and show inherent advantages over any and all, and, in addition, present a considerable economy; while the first cost must be within reasonable limits. The author has devined its distinctive advantages in these comparisons as follows:

Cheapness.—Where an electric plant is in existence the first cost of an electrical crane is even less than a steam crane.

Handiness.—There is no raising or laying down steam, no carriage of coal and water to difficult positions. The crane is always ready while the current is on. No feed pump to attend to.

Cleanliness.—There is no steam, water, heating, ashes or sparks; the gearing is always cool to handle.

Safety.—While steam cranes add to insurance the electric crane does not. The tension of 110 volts is absolutely harmless.

Quick Work.—The power is so directly applied that more can be got on to a crane than by any other system. By suitable arrangements loads can be handled and adjusted to a hair's breadth.

Variable Power.—The motor takes only the power required to lift the particular load opposed to it; in this respect comparing most favorably with the hydraulic system

Economical Working.—When not in use the electric crane wastes no power like rope and shaft travelers, no fuel like steam cranes. No time is lost in raising steam, in fetching fuel, stoking or fetching water. As the crane can be controlled from a considerable distance, the operator may be placed in the very best position to deal with his work.

Simplicity of Gear.—Finally, for the special purposes of propelling hauling gear, the electro motor possesses the especial merit of a high and regular initial speed, capable of reduction by simple means to any given rate of speed.

As general design has an important bearing upon the successful working of the machine, it should be noted that it will not suffice to treat the motor as a mere rotating instrument to be connected up to the hoisting gear in the manner of an ordinary steam engine, and treated as such.

Motors are, of course, of considerable variety, and can be obtained in many forms, with high or low centers of rotation, and to suit all varieties of tension and capacity. They all possess, however, certain special eccentricities, which have to be carefully provided for in any application to mechanical duties especially to those of an irregular character, and it is to the means of so doing that the author desires to direct attention. The most important peculiarity is their capacity for usurping and developing power for which they are unfitted. This may be described as a saturating process, or "sucking up," wherein the motor will, if supplied with a certain current, utilize as much of it as corresponds with the resistance imposed upon its rotation. It will be perceived how extremely useful and advantageous such a natural capability is, until it exceeds the designed limit of the machine, when it immediately becomes a danger, inasmuch as the carrying capability of the wire, connections, commutator, and brushes, may be overrun, and heating thereby set up to such an extent as to burn out or destroy the insulating materials. It will be evident that this effect is most likely to be found in cases of overloading the motor with mechanical work, and that this is especially likely to be the case in connection with hoisting machinery. A like result may be feared if an excess of current be switched into connection with the idle motor, for then current which would not be excessive for the actively repeated passage of the moving coils of an armature, may be too much for that particular coil which happens to be in the position of receiving or transmitting the entire amount. This is more particularly probable in the case of reversible motors, wherein it is possible that a reversal of the full current may take place even before the complete stoppage of the motor.

Thirdly, there is in the reversal itself a possible disadvantage, in the liability to sparking at the brushes during the period of stoppage and re-starting.

Lastly, a direct connection of the motor shaft to spur-gearing is liable to produce injury to the commutator of the machine by excessive vibration.

These peculiarities sum up the weaknesses of electo-motors, which are, in all other respects, admirably effective, simple and useful machines, developing, as they do, the force supplied to them in the most direct manner possible at a high initial speed, with the minimum of working or wearing parts, and with extraordinary efficiency, amounting to as much as 90 per cent. output of the energy delivered into them.

At the outset, then, it appears that a motive engine, possessing such excellent qualifications, is likely to produce results superior to those of more complicated and inefficient mechanism, and experience fully bears out the assumption.

The author, by a study of the American practice in electrical cranes, and of the foregoing considerations as regards the motor, arrived at the conclusion that the secret of the successful application of the system to hoisting machinery lay in the direction of adaptation of that machinery to the essential features of the motor, and not in the bare connection of the latter to existing contrivances.

For an entirely satisfactory adaption of electricity to a crane, there are thus several conditions.

From the Mechanical Point of View.

(*a*) It should be impossible to overload the motor.
(*b*) The motor should not be reversible.
(*c*) The load should be brought to bear upon the motor gradually, without shock.
(*d*) The connection of the motor to the crane gear should not be by direct toothed gearing.
(*e*) The gearing should be direct and simple.

From the Electrical Point of View.

(*f*) The motor should be run at a continuous speed.
(*g*) It should be impossible to over supply it with current at starting.
(*h*) No end thrust should be permissible upon the motor shaft.
(*i*) The field magnets should not be short-circuited by the metal of the crane.

It is to be regretted that these conditions, perhaps from lack of consideration, have been in some cases neglected by designers, with unfortunate results, though, no doubt, such occurrences are probable in the initiatory stages of any new application of energy.

It is, on the contrary, a satisfaction to be able to point to numerous instances of successful installations where the proper conditions have been applied, and the author would add that there is no reason why very considerable success should not attend the addition of electro-motors to many existing hand, steam or power cranes and engines, provided that the connection is made with proper safeguards. To comply with the whole of the recited conditions, the author designed a special system of crane-gearing and a frictional safety connection between the motor and gear, the subjects of his patents of 1890 and 1891.

These details are all combined in the construction of the electrical ship's winch, which has proved a practical success in all the conditions it has worked under.

Turning now to the question of overhead travelers, attention is drawn to a traveler designed for erecting-shop and foundry use. The gearing is all at one end, and the operator is seated in a cage below it, close to the motor, which is easily accessible. The general arrangement corresponds with the best modern practice, and the entire motions of the crane are controlled in full view of the load. The arrangements of motor, safety device and gear and reversing motions are based on the same design as the preceding.

The load is always sustained by the worm attached to the winding barrel or barrels, and it must be reversed to lower. This it does, however, at a higher speed; all the motions are reversed by frictional sliding or expanding clutches from one motion shaft driven by the motor, but operating without shocks. The current is supplied by an overhead, or side, bare copper conductor, upon which is pressed a copper shoe on a spring rod mounted on the crane and connected by a lead to the crane switch. The switch is designed so that on its being thrown over it supplies current first to the field magnets, next through a resistance to one brush, then fully to one brush, next through a resistance to the other brush, and then fully to both brushes. This arrangement works admirably, the motor starting and stopping with ease and certainty.

In simplicity, quietude and rapidity, these electrical overhead travelers far surpass the best rope or shaft trav-

1. Abstract of paper read before the English Society of Engineers.

eler extant, and no one who has once worked one could fail to be impressed thereby. When it is recollected that the motor absorbs only that amount of power usefully utilized, and none at all when it is stopped between lifts, that its high speed enables very direct and simple gear to be employed, and that it is in itself an extremely efficient engine, the remarkable results attained by the use of electricity in this connection are easily explicable.

Mr. Earl, of the London and North Western Railway, at Crewe, conducted a careful experiment with a view of establishing the relative merits of a rope and electric crane, and although this was not done in a manner advantageous to the latter, yet the following was the striking result:

A load of 8 tons was first lifted by the crane as it stood before alteration, when the power absorbed was found to be 19.5 horse power. The crane gear was then attached to an electro-motor mounted on the crane, when the same load was lifted at the same speed, with an expenditure of only 11.1 horse power. This is a remarkable economy of no less than 43 per cent.

At McIntosh, Seymour & Co.'s works at Auburn, New York, there is an electrical traveler of 15 tons power, with a longitudinal traversing motion of over 300 feet per minute, and a cross traverse of 120 feet per minute, and with this weights can be handled in any direction to $\frac{1}{16}$ of an inch by the operator in the cage. The owners state that it represents a great saving in power and time over their previous mechanical cranes.

At the Morgan Works, Alliance, O., there is a 15 ton traveler which works with most remarkable smoothness, ease, and economy. Every crane in these important works has been altered into electrical driving with success and economy. A small high speed engine driving a Thomson-Houston dynamo, in a small engine room almost without attendance, supplies all the power.

At the Altoona Works, on the Pennsylvania Railroad, there is a traveler of 100 tons power, built by William Sellers & Co., which proves a highly successful and useful machine, and by it a 65-ton locomotive is lifted and transferred in five minutes, an operation which previously occupied many hours. The result is partly due to the use of two independent crabs with separate motors upon them.

Finally, it may be argued, that all these conditions must be produced at a serious extra first cost, but such is not really the case, as a comparative estimate will suffice to show, while a far larger outlay on the electric installation would be not only justifiable but judicious, in respect of the serious gain in economy of power and labor.

The use of electricity in out-door and movable cranes is in its infancy, and only two or three examples exist of the application. It is regrettable that these have been limited in their results, owing to the neglect of those precautions of design, the adoption of which in the case of shop travelers has produced such success.

At the same time, the subject is exciting a wide interest, more particularly among owners of large numbers of isolated cranes, such as docks and harbor authorities. In these cases, the question of relative economy with other systems comes largely into view.

Farming by Electricity.

It will interest the farmers to learn that a certain bill which Senator Peffer recently introduced in Congress is not simply the humorous matter that some persons supposed it to be. Told in the clumsy, congressional phraseology, the bill provides "for the establishment of an experimental station for the purpose of determining if electricity can be profitably used and applied as a motive power in the propulsion of farm machinery."

Save for a few humorous outbreaks on the part of one or two correspondents, the bill has been but little noticed. Even farmers themselves are apt to look with skeptical eyes upon the prospect of a coming golden future when grain will be reaped by the manipulation of a dynamo, and when the pressing of a button will do all the chores. To sit in a shady spot with a pipe and conduct harvesting operations by transferring plugs in a switchboard would make farming but a joke.

Yet, if some of the statements of certain electricians are to be believed, something like this may not be impossible. One writer in a current magazine declares that the day is not far distant when the entire farm labor, from the preparing and tilling of the ground to the transportation of the crops to the railway station, will be performed by electric motors. And, in view of the other remarkable accomplishments of modern electrical engineers, it will not do to scoff at this proposition.

At any rate it would be vastly more sensible to spend money in the manner proposed in Senator Peffer's bill than to blow it away in a futile pop-gun attack upon the rain-clouds.—*Chicago Daily News Record.*

Electric Light in Medicine.

There recently died at Vienna the mechanician, Josef Leiter, a man who, in concert with eminent physicians, spent many years of his life in zealous study and experiment in order to realize one of the most modern and remarkable ideas of medical science, says a correspondent of the London *Electrical Review*. He was engaged with the solution of the question how far the interior of the human body can be made accessible to the eye of the physician. Before his death he had the satisfaction of knowing that his merits were fully acknowledged in a recent work by the distinguished neurologist, Prof. Lewandowski.

The medical world is already able to illuminate the interior of the mouth, the pharynx, the stomach, eye and ear with the electric light. This is effected either by the direct introduction of the source of light into the organs concerned, or by the reflection of the light. At first the light of incandesced platinum wire was used, but latterly the well-known carbon filaments of the glow light have been universally employed. The "mignon" glow lamps, scarcely larger than an ordinary pea, were first shown at the Vienna electrical exhibition, and were successfully adapted to this use by Leiter. A number of apparatus for both methods of introducing the electric light (direct and by reflection) have been devised. The instruments for the use of reflected light do not differ in principle from those used for solar light. The electric light has, however, the advantage that the medical expert is rendered independent of the freaks of the weather. This principle can, of course, be combined in all possible manners with concentrating lenses, reflectors, etc. The first apparatus of this kind emanated from Vienna, where they were executed in 1883 by the optician Jirasko, at the instigation of Prof. Mosetti von Moorhof.

In the direct introduction of light we distinguish two modifications, illumination properly so-called and diaphonoscopy. This latter method depends on the fact that human flesh is, in thin layers, translucent. If we hold up the open hand with the fingers close together before a brilliant light (not otherwise visible to the observer), the fingers appear at their margins translucent, and transmit a reddish light. This method is used in dentistry. The patient bites a small gag of vulcanite, the lateral process of which, projecting into the mouth, supports a mignon lamp. The interior of the mouth is brilliantly illuminated, and the dentist can look into the inside of the tooth and detect any morbid changes in the enamel, the dentine, the roots, the gums, etc.

The most interesting method at present is that by which the light is directly introduced into the cavities and passages of the body. In examinations of the pharynx a mignon lamp is placed in the shaft of the mirror, and the rays are allowed to fall into the pharynx, which is thus brilliantly illuminated and reflected to the eye of the observer. Much more complicated is the introduction of light into the stomach, which is first evacuated by means of the stomach pump and afterward expanded with air after the apparatus has been introduced. This apparatus is a long tube, which has at its closed lower end a glass window, behind which is placed a mignon lamp connected with the battery by wires. When the current is turned on the filament becomes ignited, and illuminates through the window the interior of the body, and a small mirror makes the illuminated parts visible to the observer.

Very favorable reports on the results of such investigations have already been furnished by Profs. Oser and Mikulicz.

It will be perceived that the electric light plays already a not unimportant part in the art of healing, although we see only the beginning of its career.

Atlantic Cable Between Africa and Brazil.

The new Atlantic cable that is to be laid between Senegal and Pernambuco has been shipped from England, and is now on its way to the African coast in the British steamship Silvertown. It was constructed at the Telegraph Works of London, and was taken aboard the Silvertown coiled up in three tanks and ready for paying out at the bow end of the vessel, not at the stern, as was formerly the custom The cable is 2,165 miles in length, of varying thicknesses, ranging from 2½ tons per knot to 4¼ tons, according to the depth of the water in which it is to be laid, while the shore ends weigh about 15 tons per knot. At Senegal the shore end is to be covered by a but and left in charge of an electrical engineer, who will be in communication day and night with the cable-bearing ship. Signals will be exchanged every five minutes during the whole operation of laying the cable to Brazil. In the deep sea the cable will be paid out at the rate of ten knots an hour, though large allowance must be made for stoppages through impediments a thousand fathoms deep. According to the engineer in charge, the line will be laid and the Silvertown back in England before the end of the month of July. Aboard the steamer there is a large staff of engineers and assistants, who work in four hour shifts.

New Electrical Dictionary.

An advance copy of the second edition of a dictionary of electrical words, terms and phrases, by Prof. Edwin J. Houston, has just been received. The book bears very little resemblance to the first edition which was published in 1889, and which is now so familiar to electrical readers. It is practically a new book, as it has been entirely re-written and revised. The book is an octavo and contains 562 double column pages printed on heavy paper, The type used is such that the titles stand out most prominently on the page. The definitions are given in two styles of type, the larger being used for the definitions proper, while the descriptive matter of a more general nature is given in a smaller face of type. The illustrations are 570 in number and cover a very wide range of electrical apparatus. Definitions are given under about 5,000 distinct titles and nearly as many more titles are entered for the sake of giving cross-references to other titles under which their definitions may be found.

Mild Criticism.

The newspapers of Bloomington are continually making life a burden for the managers of the electric street car system in that city, says the *Gazette*, of Champaign, Ill. In a recent issue of the *Pantagraph* there was an item which claimed for Bloomington the distinction of having the poorest railway system in the United States. Bloomington is a city of 20,000 people, covers a great deal of territory, and the alleged electric cars run twice an hour—sometimes. The people of that town claim that the system used there was probably used in Jerusalem before the crucifixion. Everything goes with the company. When the motors are disabled they hitch a team of mules to a summer car and business goes on uninterrupted.

CORRESPONDENCE.

New York Notes.

New York, May 21. It will be remembered that I called attention, in the last New York letter, to the fact that the insurance companies of Newark, N. J., had raised their rates and had agreed, with the fire underwriters, that wires are to be strung in accordance with the rules adopted by the National Insurance bureau and National Electric Light association in 1891. Since May 15th the rule has been that fire insurance policy holders using electricity, or desiring to do so, must pay the insurance companies an extra rate for the privilege, unless the local electric light company agrees to furnish them with certificates guaranteeing that the insulation has been done in strict accordance with the rules and regulations of the Underwriters' association. This arrangement is by order of the Newark committee of the association, middle department. On policies where the rate is one per cent. or less, twenty-cents per $100 is charged. If the rate is over one per cent., twenty-five per cent. of the annual rate is required

The Underwriters' association has been trying to secure from the electric light company a contract binding it to do the wiring as required by the rules of the association. These rules are based on those adopted by the National Electric Insurance bureau and the National Electric Light association in 1891. The association has agreed to furnish the electric light company, free of cost, a book of the necessary blank guarantee certificates, with stubs attached, and its proposition requires the electric light company to fill out a certificate and stub for every applicant, keeping the stub and forwarding the certificate to the office of the board of underwriters, where it would be kept on file for the benefit of the insurance agents. The electric light company objects to signing such a contract on account of a few rules, a compliance with one of which would necessitate an expensive change in the rearrangement of the company's wires. This particular rule requires that wires must be strung twelve inches apart, which is farther apart than the company's wires are at present. The Underwriters' association claims that it has learned on good authority that the fires in Newark during the last six months caused by electric lights improperly put in caused damage amounting to over $100,000, and something had to be done. In the opinion of the insurance men the danger of fire from electric lighting is one that the assured should be quite as much interested in providing against as the insurance companies. The people, however, whom the underwriters are trying especially to reach, are the installers of the electrical work and wiring, whom they believe are, for the most part, doing their work in a very defective manner. Being unable to control them is the reason why the proposed extra charge for giving any electric light permits was decided upon. This movement was really ordered to go into effect March 1, last, but it was delayed for various reasons.

The old electric light privilege, issued to a policy holder making application for the same, simply gave the permission "provided the wires are properly insulated and the light protected by glass globes, enclosed at the bottom." The text of it further stipulated that if used in show windows, chimneys, with spark arresters, must be placed at the top of the glass globe. An effort has been made by the insurance men to have an expert electrician appointed by the city, conferring on him the power to issue the guarantee certificate. The matter has already been brought to the attention of the common council. It has also been suggested that an electrician be attached to each fire company in the city.

On Monday last, Dr. G. A. Leech of Washington made some experiments at the offices of the New York Phonograph company, with the idea of applying the phonograph to the cure of deafness. Dr. Leech is a believer in the efficiency of such an application, and it is said he has introduced the instrument into his practice. Deafness in most cases, the doctor says, comes from catarrh. The passage from the throat to the ear becomes choked, and a coating forms on the bones of the ear which interferes with vibrations. Dr. Leech's idea is that a vibratory force applied to the ear by means of a phonograph must quicken the ear drum and affect the coating of the inner bones. Gradually this coating must be dislodged, and with the completion of that process hearing will be restored. This may happen in the majority of cases in about two months, he thinks, with daily treatment of twenty minutes' duration. Dr. Leech has prepared a variety of cylinders to produce different sound effects. The sensation is said to be pleasant to the deaf. To persons of normal hearing the sounds rumple and clatter like the noise of a railroad train. Musical cylinders are not necessary to the treatment, although

in certain cases bugle calls, cornet solos, and the chimes of loud bells may be used to advantage.

A section of Brooklyn was temporarily eclipsed on Wednesday night owing to a fire in the station of the Citizens' Electric Light company, in DeKalb avenue, Navy street and Hudson avenue. About 9:30 o'clock a sheet of flame suddenly illuminated the two-story frame building recently erected as an extension to the Navy street wing of the works. Simultaneous with the breaking out of the fire there was a sudden extinguishing of the electric lights supplied by this company in a large part of the western district. The lights were out only about twenty minutes, and within fifteen minutes the fire was under control. The loss will not exceed $5,000. W. F. O.

Milwaukee, Wis.

MILWAUKEE. May 21.—At the last meeting of the common council Alderman Foley introduced an ordinance to repeal the ordinance granting to the Western Union Telegraph company the right to string aerial cables in the business district of the city. The aerial cable system was agreed upon as a compromise between underground wires, which some of the city officials demanded, and the old overhead system. In the business district, the telegraph wires are being arranged in cables and carried along the alleys. The company has nearly completed the work, and it is probable that it would claim heavy damages from the city in case Alderman Foley's ordinance should be adopted. It is very probable, however, that nothing more will ever be heard of the Third Ward statesman's measure.

Chief Foley, of the fire department, has requested the common council to appropriate $10,000 for placing the fire alarm wires in the conduits of the Wisconsin Telephone company. The Western Union Telegraph company, the chief states in his communication to the aldermen, is removing its poles, and if the fire alarm telegraph wires are not placed in the telephone conduits, poles would have to be erected for them, which would be a much heavier expense. The chief's recommendation will undoubtedly be adopted.

It has been raining almost constantly since the first of the month and work on the new electric railways has been greatly delayed in consequence. Henry C. Payne, of the Villard syndicate, states that the Bay View line would have been in operation by this time but for the rain. Now, he says, he cannot tell when it will be completed. The North Avenue line is expected to be in regular operation in about a week. It is the intention of the company to rebuild the old lines before it commences work on any new routes.

The Thomson Houston people may convert the street railway at Madison into an electric line.

The E. P. Allis company will build a large engine to furnish power at the World's Fair. It will form part of the Allis exhibit and will be of the quadruple expansion type and of between 3,000 and 4,000 horse power. The company will also exhibit several smaller engines and a complete saw mill in operation. The value of the Allis exhibit will exceed $150,000.

The wages of the men employed in operating the Becker line will probably be adjusted on the Villard scale: 17 cents an hour, eleven hours to constitute a day's work. C.

PERSONAL.

C. H. Bird, of the Crowell Clutch and Pulley Company, of Westfield, N. Y., was in Chicago this week.

F. H. Underwood, president of the Underwood Manufacturing company of Tolland, Conn., was in Chicago for several days last week.

President Elias E. Ries, of the Ries Electric Speciality company, of Baltimore, was a visitor last week at the New York office of the WESTERN ELECTRICIAN.

Charles E. Gregory of Chicago has fully recovered from his protracted illness, and is again ready to engage in business. Mr. Gregory returned last week from a trip through Wisconsin greatly improved, and was warmly welcomed by his numerous friends in Chicago.

NEW INCORPORATIONS.

Pernaux Electric company, New York, N. Y. capital stock, $2,000; to manufacture electrical instruments.

Yonkers Machine company, Yonkers, N. Y.; capital stock, $5,000; to construct power plants, electric light plants and other apparatus.

Rockbridge Hotel, Power & Electric company, Glasgow, Va.; capital stock $150,000; hotels, electric plants, real estate and improvements, and railways.

Fiberite company, Ballston Spa, N. Y.; capital stock, $20,000; to manufacture, buy and sell fiberite conduits, battery cells and other electrical specialties.

Brownsville Electric Light company, Brownsville, Pa.; capital stock, $7,000; generating and supplying light, heat and power by means of electricity to the borough of Brownsville; E. D. Fulton, Uniontown, Pa.

General Fixture company, New York N. Y.; capital stock, $600,000; to manufacture, buy, sell, lease and use all kinds of gas and electric fixtures.

South Side Railway company, Denver, Colo.; capital stock, $150,000; building and operating a system of electric railway lines in the county of Arapahoe.

Edison Electric Light & Power company, Trenton, N. J.; capital stock. $200,000; to supply light and power by means of electricity; G. D W. Vroom, Trenton, N. J.

Enterprise Electric company, Chicago, Ill.; capital stock, $25,000; to buy, sell and deal in electrical supplies; Enterprise Electric Co., 315 Dearborn street, Chicago, Ill.

Pine Grove Water, Light & Power company, Pine Grove, Colo.; capital stock, $15,000; to furnish water works and electricity to the inhabitants of Pine Grove, Colo.

John L. Gisk Ideal Rheostat company, Jackson, Mich.; capital stock, $10,000; to manufacture and sell rheostats and electrical appliances; Clarence H. Bennett, Jackson, Mich.

Hope Electric Light & Power company. Carterville, Ill.; capital stock. $20,000; to furnish electric light and power to corporations and individuals; F. C. Zimmerman, Carterville, Ill.

Aluminum Insulated Wire company, New York N. Y.; capital stock, $2,000; to manufacture and sell insulated cables and wire and electrical machinery, instruments and supply.

Elk Ridge Coal & Coke company, Elkhorn, W. Va; capital stock, $60,000; general mining business, making electricity and selling same, boring for minerals, petroleum, oils, etc.; H. C. Flesher, Elkhorn, W. Va.

Atlantic & Western Telephone company, Chicago, Ill.; capital stock, $5,000,000; the manufacture, use and licensing of electric speaking telephones throughout the United States; Henry P. Caldwell, 126 Washington street, Chicago.

Pullman Electric Light & Power company, Pullman, Wash.; capital stock, $25,000; to operate electric light and power plant, to furnish light and power for any purpose; Pullman Electric Light & Power company Pullman, Wash.

Prospect Street Railway company, Ashtabula, Ohio; capital stock, $10,000; building, acquiring, operating and maintaining a street railroad, to be operated by steam, electric, horse or other motive power; James Reed, Ashtabula, Ohio.

Cicero Light, Heat & Power company, Cicero, Ill.; capital stock, $150,000; furnishing electric light, heat and power for street, commercial, manufacturing and household purposes; Farlin Q. Ball, 122 LaSalle street, Chicago, Ill.

Harrisburg & Mechanicsburg Electric Railway company, Harrisburg, Pa.; capital stock, $75,000; constructing and operating an electric railway from Harrisburg to Mechanicsburg, Robt. Snodgrass, Harrisburg, Pa.

Newtown Electric Light & Power company, Newark, N. J.; capital stock, $150,000; construction and operation of works for the supply and distribution of electricity for light and power, etc.; Blackwell Bros., 140 Pearl street, New York, N. Y.

Universal Electric company of the city of New York, (incorporated in W. Va.) New York, N. Y.; capital stock, $2,000,000; buying and selling patents relating to the application of electricity to commercial objects; Jas. E. Chandler, 50 Broadway, New York, N. Y.

Standard American Electric company, (Incorporated in W. Va.,) New York, N. Y.; capital stock, $3,000,000; manufacturing and dealing in electrical machinery of every description; contracting for electrical plants for heat, etc.; Chas. N. Codding, 45 Wall street, New York, N. Y.

Western Temperature Regulation company, Chicago, Ill.; capital stock, $60,000; selling, erecting, operating and handling the Johnson Electric Service company's patents for temperature regulation, and controlling mechanical fixtures; Chas. A. Barker, 193 Van Buren street, Chicago, Ill.

Indianapolis Light & Power company, Indianapolis, Ind.; capital stock, $600,000; to generate electric current, and the distribution and sale of such current, for light, power and other purposes; also the manufacture, purchase and sale, erection and leasing of all kinds of apparatus, machines and supplies used for electrical purposes or in connection therewith, including power generating apparatus; also the lighting of cities and towns, public and private, with electric light; also constructing, owning, purchasing, using, selling and leasing underground conduits and manholes.

ELECTRIC LIGHTING.

Eau Claire, Wis., is to have a new electric light plant.

An electric light plant is to be installed in New Llano Tex.

The gas and electric companies at Youngstown, O., have united.

The village of Green Island, N. Y., will be lighted by forty-three arc lamps.

By the explosion of a steam pipe on the evening of May 17th, the service of the Detroit Light & Power company was temporarily interrupted. It will take about $500 to repair the damage.

The Madison, Wis., Electric Light company is making extensive additions to its plant.

It is asserted that old paintings can be photographed better by electric light than by sunlight.

A new station will be erected on the river front in Toledo by the Toledo Electric company.

W. H. Waddell and T. W. Slelton have received a contract from the city of Lexington, Va., to put in an electric light plant.

The Haywards, Cal., electric light works, owned by Chisholm & Farrel, were destroyed by fire on May 9th. The loss is over $100,000.

By a vote of 2,351 to 83, Burlington, Ia., has decided to grant an electric lighting franchise to some responsible company yet to be selected.

The electric light plant at Niles, O, was damaged by lightning during a recent storm to such an extent that it could not be used for some time.

The Wauwatosa, Wis., Electric Light & Power company has decided to discontinue furnishing the village with street light, because it did not pay.

A dispatch from Paragould, Ark., states that on May 10th the electric light plant was struck by lightning, the dynamo ruined, and the engineer severely burned.

The city council of Hackettstown, N J., has offered an electric light company in that town $1,200 per year for eighty-five lamps to burn the dark parts of all nights.

The Waukesha, Wis., Electric Light company has a dynamo base consisting of single stone 6 by 8 feet, ranging from 6 to 8 inches in thickness, and weighing over two tons.

Mayor Moore of Ashtabula, O., has an idea that the electric lights furnished the city are not of 2,000 actual candle power, and a committee of the council will investigate the matter.

The Edison Illuminating company has sued the city of Easton, Pa., for $1,421.96, alleged to be due the company for materials, electrical work and wiring, and current used in the municipal buildings.

There is a difference between the city authorities of Chicopee, Mass, and the local electric light company. The former want arc lights for $70 a year, while the company asks $77.50. There is talk of the formation of a new company.

The injunction served by the electric light company upon the village trustees of Warsaw, N. Y., restraining them from taking action upon the application of the gas light company to erect wires and poles for electric lighting has been withdrawn.

The Citizens' Electric Light company of Helena, Mont., which has been absorbed by the Helena Electric Light company for a consideration of $23,750, has applied to the district court for an order for its dissolution. The liabilities of the company will be protected by the Northwest Thomson-Houston company of St. Paul.

The stock of the Boston Electric Light company has been listed at the Boston Board. The company was incorporated in 1888, under the general laws of Massachusetts, and has outstanding $1,257,800 of stock and $300,000 of bonds. Its financial statement shows a surplus over and above all liabilities of $225,420 20.

The Chicago & Northwestern Railroad company will erect a large lighting plant at the southwest corner of Kinzie and Kingsbury streets, Chicago, at a cost of between $25,000 and $30,000. The plant will be used for lighting the passenger station and yards of the company with electricity. The building will be two stories high, and will cover an area of 65 by 70 feet.

A special meeting of the stockholders of the Edison Electric Illuminating company of New York has been called for May 31st. The purposes of the meeting will be to take action upon a proposition to increase the capital stock of the company from $4,500,000 to $6,500 000, for the purpose of extending the present business of the company. For the purpose of such meeting the transfer books of the company will be closed from May 7th to June 1st.

The men employed in the central stations of Cincinnati want their working hours reduced from ten to nine, and if the demand is not granted a strike is probable. Both the Trades Union and Electrical Workers have united in the demand. The non-union men employed in the different plants are also in favor of the reduction, and will go out with the union men if it is not granted. The matter will be decided soon. The companies are disposed to fight the move, and are making preparations to fill the places of the men in the event of a strike.

Recently a number of the employes of the Beaver Valley, Electric Light & Power company of Beaver Falls, Pa., took complete possession of the power house, and for a time a riot seemed imminent. The men claimed that they had not been paid for six weeks. By preconcerted action they took possession of the plant and turned off the light, placing the city in darkness. Policemen were sent to the station, and several of the directors of the company also appeared. After the men had been assured that their money would be forthcoming within forty-eight hours, hostilities ceased. The company has been in operation only a short time, and its financial standing is considered good.

ELECTRIC RAILWAYS.

An electric line from Jerseyville to Hardin, Ill., is proposed.

A division of the Order of Electric Trainmen has been organized in Lincoln, Neb.

An electric railroad is to be built to connect Spokane, Wash., and Cœur d'Alene, Idaho.

It is stated that the Fourteenth street electric line of Oakland, Cal., will be in operation by July 1st.

The City Street Car company of Staunton, Va., has been granted authority to change from animal power to electricity.

On the first Sunday that the new San Francisco and San Mateo electric railway was in operation, 42,000 passengers were carried.

The contract has been signed for an electric railroad from Glasgow, Va., to the Natural Bridge, Virginia's great natural curiosity.

The Oakland. San Leandro and Haywards electric railway was formally opened to the public recently, and the event was celebrated with much circumstance in all of these California towns.

It is said that certain changes contemplated in the financial backing of the Crescent City Railroad company will result in the rebuilding of its lines and their equipment with electricity.

Two electric cars fell through an old wooden bridge in Toledo yesterday, says the *Detroit Journal* of recent date, The most remarkable thing about this, however, is that the *Free Press* does not cite it against the introduction of the "deadly trolley" into Detroit.

The Thomson-Houston Electric company has offered to put in an electric street car line at Madison, Wis., costing $125,000, providing the citizens of Madison will buy the company's bonds for 20 per cent. of that amount. The indications are that this will be done.

ELECTRIC MINING.

The new Vancouver Coal company, of Vancouver, B. C., will put in an electric motor.

It is said that the City Coal company of Decatur, Ill., is considering a proposition to operate its mine at Niautic by electricity.

The owners of the Riverside mine, which is located on the banks of the Madison river in Montana, expect to put in an electric power plant soon for mining and concentrating.

An electrical engineer has been making measurements and estimates preparatory to putting in electric power at the Candice mine near Ouray, Col. These preparations lead to the belief that the electric plant will be put in by the company at the foot of Red Mountain park at an early date.

The Granite Mountain and Bi-Metallic companies of Granite, Montana, propose to utilize the Flint Creek electric power to move their mining and milling machinery. When this power is secured the Granite company expects to do considerable experimenting with a view to utilizing electricity in the reduction of ores. It has laid aside a fund for this purpose.

The Delemata mine, El Dorado county, Cal., which is operated by electricity, handled at its mill in the thirteen months from July, 1890, to August, 1891, 43,000 tons of rock. Between the 1st of August and the 31st of December, the machinery dealt with 19,000 tons of rock. The gold was extracted at the average cost for mining and milling of 50 cents per ton. In October there was crushed 4,449 tons, which was mined and milled at a total cost of 43 cents per ton.

TELEPHONE.

A te lephone line to connect Baker City and McEwen Ore., is proposed.

Owing to a dispute in relation to back taxes the city of Philadelphia has stopped payment for its telephone service.

A village in Illinois rejoicing in the pleasing name of New Diggings is happy because it has a telephone exchange.

The Sunset Telephone and Telegraph company has applied to the city council of Oakland, Cal., for an ordinance granting it the exclusive use of the streets of the city for telephone purposes for a term of fifty years.

MISCELLANEOUS.

The most complete catalogue of electrical books ever published has just been issued by the Electrician Publishing company, 6 Lakeside building, Chicago, and will be sent post paid to any address. This catalogue contains a brief description, with the chapter headings, of every prominent work on electrical subjects printed in this country or Europe, to date. All orders for books from this catalogue will be filled promptly.

Assistant Secretary of the Navy James R. Soley has issued an order directing that an examination for the position of master electrician be held in the Brooklyn navy yard. This is a new position, and is made necessary by the large amount of electrical apparatus now in use in the yard. Following are some extracts from the order: "An examination of applicants will be held in the navy yard Tuesday, May 31st, for the position of master electrician at $6 a day. The examination will be open to all comers who can give evidence of experience in conducting the kind of work for which they seek employment, and who are citizens of the United States. Persons now holding positions at the yard will be admitted to competition on the same footing as other applicants. Applications must be addressed to the commandant before May 28th. The application should be accompanied by evidence of citizenship and by certificates from previous employers as to character, industry and sobriety, and skill in conducting the kind of work required. The examination will be practical in character, having reference exclusively to the requirements of the position to be filled. It will be directed to ascertain ing the applicant's knowledge of the business and his possession of the qualities that will enable him to get good work out of his men. The board will make inquiry to ascertain that applicants are fit for the work; that they have enough education to make reports, estimates and calculations; that they are of reputable character, sober and industrious habits, and that they have not been convicted of any crime or misdemeanor."

TRADE NEWS.

The Crowell Clutch & Pulley company of Westfield, N. Y., has just closed a contract with the E. P. Allis Engine company, of Milwaukee, Wis.

B. M. Downs, representing Wm. Brookfield, manufacturer of glass insulators and specialties, New York, has just finished a successful western trip, and returned to New York the latter part of last week.

The Buckeye Electric company, Cleveland, is doing a good business, and is finding a particularly ready sale for its "Buckeye" coiled filament lamp Trade is excellent, especially among central stations and street railroads.

President William H. McKinlock of the Central Electric company has returned from an extended and most successful western trip. Mr. McKinlock secured an order for the entire underground electrical system in one of the larger western cities. Okonite wire will be used.

The Ries Electric Specialty company of Baltimore, Md., has just increased its capital stock to $150,000, all of which, it is stated, has already been taken, and the company is now about to increase its facilities for turning out in larger quantities this well-known regulating socket. The Ries socket is rapidly replacing other sockets for residence and office lighting wherever it has been introduced.

Interest will be revived in the recent change in registry of the steamship City of Paris, when it is known that a large part of her equipment was manufactured in Chicago, and that every month large purchases of supplies are made here for her maintenance. Among other purchases made in this city for the vessel's original equipment was the belting used to run a large electric light installation on board and the packing for pumps and engines. The supplies were bought from the Chicago Rawhide Manufacturing company.

A company known as the Manufacturers' Exhibit Engineering & Construction company, with offices in the Monadnock building, Chicago, has recently been organized with R. J. Randolph, president; F. J. Howell, secretary and treasurer, and C. A. Goslett, general manager. These gentlemen have held prominent positions with the leading electric companies, and at present some portion of their work is closely allied to electric interests. A company of this character has a wide field before it, and the reputation of the gentlemen connected with it leads to the belief that success will be assured.

W. F. D. Crane, who has been widely and favorably known as manager of the railway department of the Engineering Equipment company, has just connected himself with the H. W. Johns Manufacturing company, 87 Maiden lane, New York, and will hereafter have charge of the electrical department of this company. Announcement has been made of the consolidation of the moulded mica insulating business of the Gould & Watson company of Boston with the Johns-Pratt company of Hartford. The Vulcabeston insulating material manufactured by the Johns-Pratt company is already well known to makers. and users of electrical machinery. Mr. Crane will give his special attention to the further developementof the large business of the H. W. Johns Manufacting company, selling agents of these materials.

The Hine Eliminator company of New York reports its April and early May trade as flourishing. Among those at distant points for whom orders have been filled may be mentioned, the Craft Refrigerating company, New Haven, Conn; Wm. Kirkup & Son, Cincinnati, O.; Kupfesh Bros., St. Louis, Mo.; Electric Light & Power company, Jefferson City, Mo.; Vinton & Co., Detroit, Mich.; Maser Hotel, St. Louio, Mo.; Kearney, Ark., Lumber company; Electric Light & Power company, Los Angeles, Cal.; Savannah, Ga., Crystal Ice company; A. J. Stillmed Meat company, Hanibal, Mo.; Fardger, Ark., Lumber company; Yoakum, Tex., Compress company; Crook & Hamer, Baltimore, Md.; Halifax Mill company; Iowa Insane Hospital, Independence; Rix & Birrill, San Francisco, and the L. H. Prentice company, Chicago. The Hine company writes that since the test of steam separators at Cornell University, in which the Hine eliminator made the wonderful record of an average of $98\frac{1}{10}$ per cent. in the elimination of particles from steam, the increase in the demand from steam plants, where dry steam or a purified exhaust is desired, has been really phenomenal.

BUSINESS.

While in Chicago recently Charles A. White, general manager of the Leo Magnetic Clock company of 620 Atlantic avenue, Boston, arraged for the opening of a Chicago office of his company at 116 La Salle street.

The Central Electric company, Chicago, reports considerable activity in the sale of Okonite wire, orders for last week aggregating one-half million feet. Manson and Okonite tape are also in fair demand.

The Chicago Rawhide Manufacturing company is constantly receiving large orders for rawhide belting and lace leather from England and the Continent. The lace leather made by this company has been adopted as standard by many users.

The Prouty Noiseless Motor company, 204 Dearborn street, Chicago, has perfected arrangements for the immediate manufacture of several motor cars to be used in illustrating the advantages of the system to different street railway companies. A factory has been fitted up at 52 Illinois street.

The Vulcanized Fibre company has taken the exclusive agency for the sale throughout the world of the insulating saddle staples. The company's machinery having been perfected, it is now prepared to offer these staples to the trade in a greatly improved form and in quantities to suit. This company has its headquarters at 14 Dey street, New York.

Clark & Marshall, dealers in electrical specialties, have recently moved from the insurance exchange building to room 413 Rookery, Chicago. The firm had comfortable quarters in the old location, but business was increasing so rapidly that more room became a necessity. A full line of electric supplies and specialties is handled by this house, and the outlook for business is reported as being very bright.

The Waddell-Entz Electric company, New York, has secured the contract for the complete electrical, generating and power equipment for the new *Mail and Express* building. This plant, which will embody all the recent improvements in electrical machine design, will comprise 300 horse power in dynamos, and nineteen motors from 40 horse power down. The generators will be coupled directly to four 75 horse power horrizontal engines.

J. L. Somoff of New York is at work on a novel order. He has in charge a Chinese dragon which is all bandmade and valued at several hundred dollars. Into this animal he is preparing to place an S-shaped tongue 8 inches long, made of ruby glass. The tongue is to be provided with a 16 candle power lamp filament. The animal will have green lenses for its eyes, and the wires will be concealed on the inside and connect with the batteries below.

The proprietors of the *Daily Palladium*, New Haven, Conn., have discarded their steam engine, and adopted electricity as the motive power for their presses. The Edison General Electric company has installed a 12 horse power motor in the *Palladium* building. The paper observes: "The motor occupies very small space. is noiseless, easy to manage, and does its work quite as effectively as the cumbersome and more expensive steam engine, and at far less expense."

The Premier Electric company of Brooklyn has secured control of the patents covering very fully its line of battery motors, and the use of the three-po'e self-starting armatures employed in these machines. This company is also manufacturing a new motor for use on continuous current incandescent circuits to fill the demand for a low-priced machine that may be attached to a lamp fixture and used to supply power for ventilating fans, sewing machines, dental mills, etc.

The Joseph Dixon Crucible company, Jersey City, N.J., in its illustrated catalogue just issued, makes a very pertinent remark. Referring to the fact that complaints aroccasionally heard of graphite or graphite productionse and that persons, without further investigation, will write to some mechanical paper condemning its use, the Dixon company says. If the graphite is pure and properly prepared, it should be of the greatest benefit." The company emphasizes, of course, the importance of purity and proper preparation.

The Detroit Electrical Works. Detroit, have found it necessary to open a New York office, which has been located in rooms 11 and 311 Metropolitan Telephone & Telegraph building, 18 Cortlandt street. This branch will be in charge of T. W. Warfield, as district manager. An office has also been opened in Boston, in No. 23 Fiske building. The opening of these eastern offices, when taken in connection with the large extensions the Detroit Electrical Works are making to the factory, will enable them to handle a large business in a manner that cannot fail to be satisfactory to patrons.

The Kester Arc Lamp Manufacturing company has recently been organized in Chicago, with offices and factory at 173 South Canal street, for the purpose of manufacturing an arc lamp for both direct incandescent and alternating circuits. The company has secured the patents issued to J. F. Kester, well-known through his former connection with the Kester Electric company of Terre Haute, Ind. Mr. Kester has spent a number of years in perfecting his lamp, and it is claimed that a novel idea has been successfully worked out. The officers of the company are as follows: President and general manager, J. F. Kester; treasurer, S. L. Jacques; secretary, C. J. Langhren.

The Jos. Dixon Crucible company of Jersey City, N. J., is sending to its many customers, and to the electrical trade in general, an illustrated catalogue containing forty pages of matter relating to graphite productions. Within this little volume prices are given, and also an account of some of the tests to which different forms of graphite have been

submitted. It will interest many to know that a customer of this company ran his peddling wagon through the state of Ohio seven years, on an average of three pounds of "Dixon's everlasting Graphite" grease per year. His average was 290 running days each year, and 22 miles per day, making a total of 44,660 miles. The Jos. Dixon Crucible company has been established since 1827, and claims that it is the only manufacturer in the world possessing its own graphite mines. Those interested in graphite should send for the Dixon catalogue.

The Eddy Electric Manufacturing company of Windsor, Conn., has been running its factory on an average of sixteen hours a day since last September, and is now building an addition of 50x154 feet to the present large works. The new structure is to be three stories high, having a fireproof boiler room 25x40 feet, finished in pressed brick. A contract has been given to the Roberts Iron Works of Cambridgeport, Mass., for one of that concern's 250 horse power improved boilers. A new Ball & Wood engine of large capacity will also be installed, and two Morse elevators will be placed in the building. It is the intention of the Eddy company to burn oil for fuel, and extensive experiments are being made to determine which oil-burning system will be adopted. Not a little credit must be given for the rapid growth and prosperity of this concern to Secretary and General Manager A. D. Newton.

The Risdon Iron Works, San Francisco, have recently made one 500 horse power Reynolds-Corliss engine for the Metropolitan electric railway, San Francisco; two 250 horse power engines of the same pattern for the Sacramento Electric Light company; two engines of 600 horse power each for the Sunnyside railway; two of 130 horse power each for the San Leandro & Haywards Electric railway, and one of 500 horse power for the Los Angeles Electric Light company. The Risdon Iron Works hold the sales agency for the Pacific coast for the Ball Engine company of Erie, Pa., and have closed contracts for this pattern of engine for a new electric lighting plant at Stockton for the Santa Cruz Electric Light & Power company, and for the Fresno electric railway. The capacity of the engine department of the Risdon Works has recently been largely increased, until now the concern ranks as one of the largest, if not the largest, builders of high grade engines in the Pacific states.

The Sunbeam Incandescent Lamp company, Chicago, has met with phenomenal success in exploiting the Sunbeam lamp, until there is to-day in the United States but one or two factories with a greater output. The principal reason for the enormous sale is of course the fact that the lamp itself is a superior one, in every way, but the company's excellent business management has had much to do with its success. As might have been expected the greater part of the sales is in the territory west of Pittsburg and Buffalo, still for some months the sale of the lamps has been pushed in the eastern states and with most satisfactory results. A leading consumer under date of Wilmington, Del., May 5th, writes: "We would say, however, that if you will maintain the present standard of your lamps, your competitors, as far as our experience goes, will need to improve their lamps very much in order to supplant yours with us." Another correspondent, under date of Watkins, N. Y., March 2d, writes: "We are positive we get one-half more light from the Sunbeam than any other make and shall give your lamps the preference." These letters each come from very conservative companies, and are highly prized by the Sunbeam people.

Recent shipments by the Ball Engine Co., of Erie, Pa., are as follows: Maryland Steel company, Sparrows Point, Md., one 50 horse power simple engine; Wilmington, N. C., Street Railway company, two 130 horse power and complete steam plant; J. C. Hubinger company, Keokuk, Iowa, one 300 horse power cross compound engine and condenser; J. W. Parker & Co. Philadelphia, Pa., one 50 horse power; Chesapeake Light & Power Co. Hampton, Va., two 150 horse power tandem compound, Moundsville Electrical company, Moundsville, W. Va., one 130 horse power. Niagara Falls Street Railway company, Niagara Falls, N. Y., two 130 horse power; Electric Light company, Elizabeth, N. C., one 100 horse power; Philadelpdia House of Refuge, two 50 horse power, one 100 horse power; Edison General Electric company, State House, Trenton, N. J, one 35 horse power; Schuylkill Electric Railway company, Pottsville, Pa., one 250 horse power; Electric Light company, Doylestown, Pa., one 130 horse power; Somerville Hotel, St. Clair, Mich., one 35 horse power; Freeport, Gas & Electric Light company, one 130 horse power; Warrenton Electric Light company, one 50 horse power; Pittsburg Iron & Steel Engineering company, Newcastle, Pa., one 50 horse power, one 80 horse power.

ELECTRICAL STOCK MARKET

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, May 21st, in New York, were:

	Bid.	Asked
Edison General Electric company, Capital $15,000,000	110	110½
Edison Illuminating company of New York	80	82½
" " " Brooklyn	84	90
" " " Boston	115	120
" " " Chicago	130	140
Edison Ore Milling company	15	20
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomson-Houston Electric company	65	66
" " " Preferred	29	30
North American Phonograph company	5	7
New York " "	2½	5
Automatic Exhibition company	¾	6
Westinghouse company Common	29	30
" " Preferred	15	46

ELECTRICAL PATENTS.

Issued May 17, 1892.

474,826. Incandescent Lamp Socket. Harry J. Gutman, Des Moines, Ia.

The lamp is held in the socket by pins upon the lamp base passing obliquely into a groove. Contact pins are held against the lamp terminals by a yielding pressure and are lifted by a key traveling in a slot cut in the socket casing partly oblique and partly horizontal.

474,827. Piano Forte. Francis W. Hale, Boston, Mass.

474,828. Medical Battery. Philip Hathaway, New York.

This invention is a battery and an induction coil contained in a casing and two metal electrodes in the circuit affixed to the outside of the casing and provided with sockets for the reception of the terminals of conducting wires.

474,835. Time Call. James Jones and James Jones, Jr., Brooklyn, N. Y.

A time circuit closing mechanism is combined with an alarm and electric circuits in a a call apparatus and removable checks are provided for fitting upon movable circuit closing check holders, which in assuming position to receive the checks are given the necessary motion to close the circuit.

474,847. Standard for Electric Wires. Edmund C. Morgan, Chicago, Ill.

474,848. Armature for Eectric Motors. Edmund C. Morgan, Chicago, Ill.

An armature comprising end plates, a perforated sleeve clamped between the end plates and soft iron cores, with coils wrapped thereon, inclosed by the end plates and sleeve.

474,852. Signaling Apparatus. Bernice J. Noyes, Boston, Mass.

This device comprises a register and bell normally connected in the signaling circuit, and a switch to cut out the bell for some signals and not for others.

474,853. Signaling Apparatus. Bernice J. Noyes, Boston, Mass.

474,854. Trunk Line System. Joseph J. O'Connell, Chicago, Ill.

This improvement is a telephone exchange system in which the lines are grouped upon different switch boards and trunk line connections provided between the several boards in such a manner that a line having its terminal upon one board may be connected with a line having its terminal upon another board through the medium of one of the trunk lines.

474,857. Electric Motor Mechanism. Elbert B. Phillips, Cleveland, Ohio.

The combination, with a car, of a propelling motor connected with the driving axle by means of a sun and planet gearing adapted to be engaged or allowed to run idly by arresting or freeing a movable part, and an adjustable gripper for said part so that when the gripper is applied the said part is arrested with yielding resistance.

474 907. Hotel Call System. Grant P. Greene, Chicago, Ill.

Each guest by means of a dial and push button is enabled to indicate different services required upon the annunciator placed in the hotel office.

474,912. Electric Battery. Alphonso S. Keating, Corry, Pa.

The improvement claimed is an oil receptacle attached to a battery cell between the solution and outside of the cell to prevent the creeping of salts.

474 913. Insulated Gear Wheel. George F. Lockwood, Saginaw, Mich.

474,921. Electric Switch. Gustav Piannkuche, Cleveland, Ohio.

The device is a snap switch by means of which a circuit carrying a current of high electromotive force can be broken with such rapidity that the destructive sparking may not occur.

474,945. System of Signaling. Henry A. Chase, Boston, Mass.

The signal transmitting apparatus is designed to have a uniform or constant rate of movement and the change in the character of the signal is effected by changing the rate of movement of the recording mechanism.

474,953. Automatic Potential Regulator for Electric Currents. Alvinis Lonzo Ellis, Chicago, Ill.

The device consists of a volt meter in the main circuit whose needle vibrates between opposed contacts to which circuits are connected and a motor in each circuit, one to set in operation mechanism to increase, the other to diminish, the strength of the field of an exciter dynamo through a resistance in series with the exciter's field magnet coils.

474,957. Rheostat. Albert B. Herrick, Bayonne, N. J.

A resistance conductor is insulated for most of its length, but is bare along the path of a switch arm which rubs directly on the conductor without the intervention of special contact blocks.

474,960. Terminal and Safety Catch Connection. Joseph Hutchinson, New York, N. Y., and Albert B. Herrick, Bayonne, N. J.

474,964. Electrically Heated Matrix Press. Willis Mitchell, Malden, Mass.

The invention is a matrix press, the combination of a hollow platen having studs formed on it with electric heaters fitting on the studs, the heaters being made of a wire wound on successive cylindrical walls, and being in an electric circuit.

474,977. Cupping Glass with Electrical Attachment. Francis Thomas, San Francisco, Cal.

474 980. Burgular Alarm. Robert G. Vassar, New York, N. Y.

474,984. Electric Locomotive. Charles Brown, Naples, Italy, and Gustav J. Melms, Chicago, Ill.

The principal feature is an improved power transmitting device in the nature of a worm gear to transmit the motion from the rapidly revolving motor shaft of the axle of the driven vehicle.

475,066. Electric Signal for Engines. James C. Ricketson, Milwaukee, Wis.

Device for use with marine or other reversible engines to indicate at a distant point the direction in which the shaft is revolving.

475,107. Electric Railway. John W. Grantland, Philadelphia, Pa.

Means for securing a uniform and continuous current throughout the entire length of the conduit and means for keeping the conductor dry.

475 137. Electric Lock. Frederick Morgenthaler, Brooklyn, N. Y.

475,159. Armature for Dynamo Electric Machines. Sydney H. Short, Cleveland, Ohio.

Improvements in the construction of armature cores and manner of assembling the parts so that the magnetic potential may he high and may shift with great rapidity without unduly heating the core.

475,160. Electric Railway Motor. Sydney H. Short, Cleveland, Ohio.

475,169. Electrically Heated Curling iron. Arthur H. Watson and Frank E. Antonini, London, England.

475,178. Electrical Forge. George D. Burton, Boston, Mass.

475,179. Distributing Apparatus for Heating Currents. George D. Burton, Boston, Mass.

475,180. Electric Connector for Converters. George D. Burton, Boston, Mass.

The claim is:

The combination, with a converter ring, of a connector consisting of a clamp provided with a binding post or socket and with hooks engaging said ring.

475,181. Electrical Metal Heater. George D. Burton, Boston, Mass.

475,182. Method of Electrical Metal Working. George D. Burton, Boston, Mass.

The method of heating desired portions of a bar of metal spanning the space between electrodes of opposite polarity, which consists in passing a heating currrent of electricity through the bar and applying to a portion of the bar between the electrodes while the current is passing there through a conductor which diminishes the resistance of the part of the bar which it bridges over and retards or prevents its being heated there.

475,183. Method of Electric Metal Working. George D. Burton, Boston, Mass.

Bridges over part of the bar which it is not desired to heat by a conductor thus reducing the resistance of that part of the bar.

475,184. Electrical Converter. George D. Burton, Boston, Mass.

The metal holders are arranged to hold metal to be heated and two converters are arranged to furnish currents of different potential with means to connect and disconnect the converters at will.

475,185. Electric Metal Heater. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

Adapted to heat metallic bodies of any shape or size, or heating special points.

475,186. Electric Forge. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

Adapted to heat a number of bars at the same time.

475,187. Apparatus for Cooking by Electricity. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

Apparatus in which the heat may be applied, regulated or withdrawn by simply regulating the current.

475,188. Metal Heating Apparatus. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

Adapted to heat short portions of a melted bar.

475,189. Electric Heater. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

475,190. Electric Cooking Apparatus. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

Adapted for broiling, roasting or cooking by electricity.

475,191. Flexible Electrode. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass

For heating bars of metal or tools to be forged or tempered.

475,192. Electric Metal Heater. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

Adapted for a number of different heating operations at the same time from one converter.

475 193. Electric Wire Twister. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

For producing ornamental spirally convoluted metallic bars.

475,194. Electric Metal Bending Apparatus. George D. Burton. Boston, and Edwin E. Angell, Somerville, Mass.

For effecting the coiling or bending of pipes and tubing.

475,195. Electrical Forge. George D. Burton, Boston, and Edwin E Angell, Somerville, Mass.

For heating the ends of bars from which articles are to be forged

475,196. Automatic Electric Forge. George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass.

Adapted to heat a number of bars at once and to allow the withdrawal of one without breaking the circuit,

475,232. Converting System for Electric Metal Heating. George D. Burton, Boston, Mass., Arthur H. Eddy, Hartford, and George T. Briggs, Windsor, Conn.

For speedily heating long and large bars for forging.

475,255. Rheostat. Walter A. Sterling, Denver, Colo.

A rheostat for controlling the brilliancy of incandescent electric lamps.

475,261. Device for Bending Electric Trolley Wires. Henry D. Winton, Wellesley, Mass.

475 264. Electric Metal Heater. George D. Burton, Boston, Mass.

Adapted for cooking food or for heating metals preparatory to forging or tempering the same.

475,286. Electric Lamp Holder. Joseph B. Moore.

A spring clasp for removably securing incandescent lamps to desks, etc.

ESTABLISHED 1848.

HEMINGRAY GLASS CO.,

Offices, Covington, Ky. Factories, Muncie, Ind.

STANDARD SCREW GLASS INSULATORS,

Glass Break Knobs, Floor Insulators, Battery Jars.

ARC LIGHT GLOBES FOR ALL SYSTEMS.

WORK ON SPECIAL DESIGNS SOLICITED.

WANTED!

A gents to sell our

Niagara Electric Motors and Dynamos

In cities where we are not already represented. Liberal discounts and exclusive territory to responsible dealers in electrical apparatus.

LOVELL MFG. CO., Ltd., Erie, Pa.

WANTED.

One second hand, 220 volt, Power Generator, from 30 to 50 horse power.

Springfield Electric Light & Power Co.,
SPRINGFIELD, ILL.

WANTED!

A GOOD LIVE MAN, with small capital, to take active interest in a growing and well established electrical concern, doing a specialty manufacturing general jobbing and construction business. Must be experienced in general business management, also possessed of sound practical knowledge. Address, "A. B." Care WESTERN ELECTRICIAN.

WANTED.

TRAVELING SALESMAN visiting Central Stations to handle a quick selling side line on commission. Address in confidence stating line you carry. "B. T." Care WESTERN ELECTRICIAN.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

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HERBERT H. EUSTIS, President and Electrician.

A LONG FELT WANT SUPPLIED.

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"Crescent" Overhead Line Wire. It will Surprise You.

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MANUFACTURERS OF ALL KINDS OF

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Topographic Surveys of any extent and character organized and executed.

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—WITH—

Double Cylinder Carbon

Element attached with zinc to cover. 147 sq. inch carbon surface. The element is everlasting, and is so guaranteed. Why use a battery with a chemical depolarizer that needs frequent renewal of the negative element.

LAW BATTERY COMPANY,

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SOMETHING NEW!

An improved 4 or 6 volt Combined Storage Battery especially for Dentists' use at very low price. Purchasers can exchange discharged for charged cells, without extra cost, beyond expense for charging the batteries. Manufactured by

J. K. PUMPELLY,
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CINCINNATI, O.

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LOCUST PINS.

Try a thousand Locust Pins, and you will order a car load.

PINS ALWAYS IN STOCK. SPECIAL PINS ON SHORT NOTICE.

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SCHINDEL & SCHINDEL, - - HAGERSTOWN, MD.

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ENGINES STEAM PUMPS
A.M. Morse & Co
ENGINEERS AND CONTRACTORS.
BOILERS COMPLETE POWER PLANTS

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MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,
218 Water St., New York.

CROCKER-WHEELER ELECTRIC COMPANY,

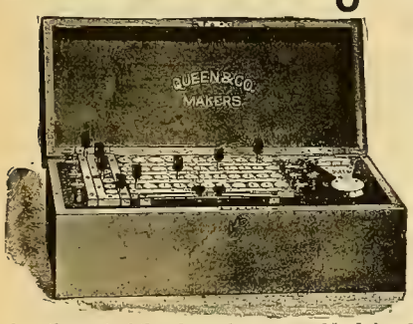
SLOW SPEED MOTORS.

¼ H.P. 500 Volt Armature, Ventilated. Constant Speed, 1,500.

The Motors are made with the best appliances and material obtainable, and embody every improvement of merit, with the intention that they shall be the Standard of their class.

430 West 14th Street. - - - - - NEW YORK.

Portable Testing Resistance Sets.



We claim that our "1891" TYPE Portable Testing Set is the most efficient of its class on the market. The coils are wound with platinoid wire and adjusted to a guaranteed accuracy of one-fifth of one per cent. The galvanometer is deadbeat, sensitive, and is unaffected by mechanical vibrations and proximity to masses of iron or intense magnetic fields. The total range is from .001 to 11,110,000 ohms.

We believe that no other testing set embodies these features, which are essential to satisfactory results.

It is possible to buy sets from ourselves or elsewhere at prices lower than the cost of the above, but we would advise all to examine the merits of our "1891" TYPE before purchasing any other.

Send for illustrated descriptive circular No. 285.

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Prompt Shipment. Reasonable Prices. Full Measure. No Charge for Boxing or Cartage.

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ELECTRIC AND GAS GLOBES,

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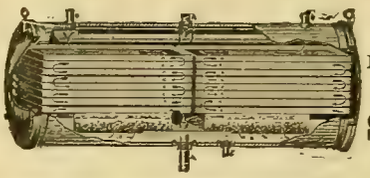

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Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

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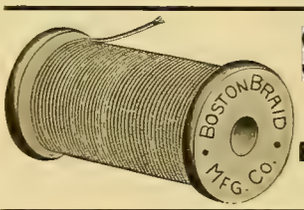

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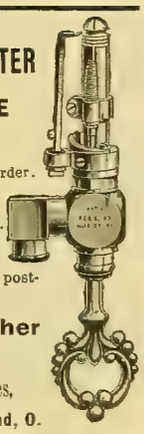

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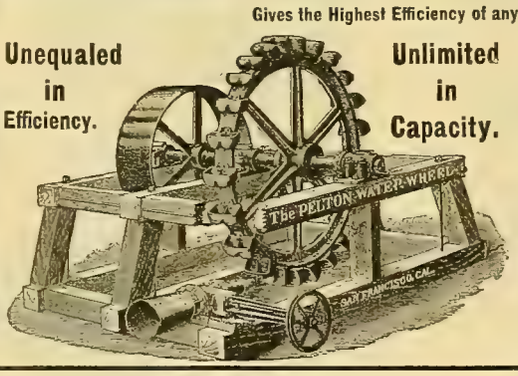

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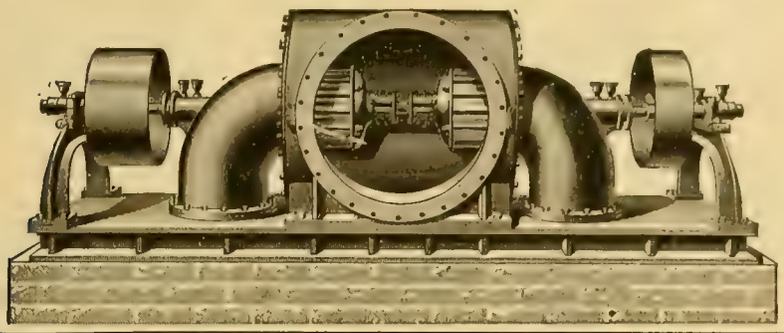

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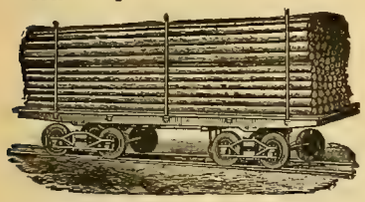

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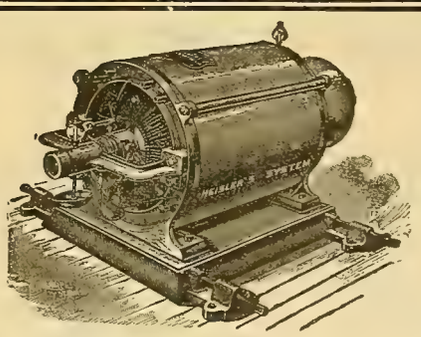

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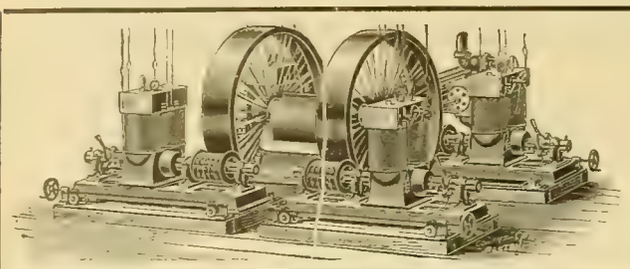

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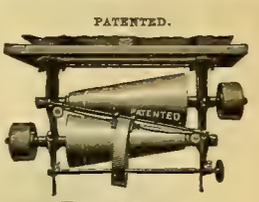

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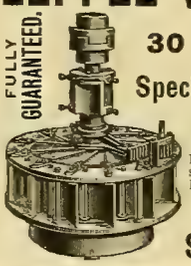

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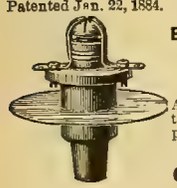

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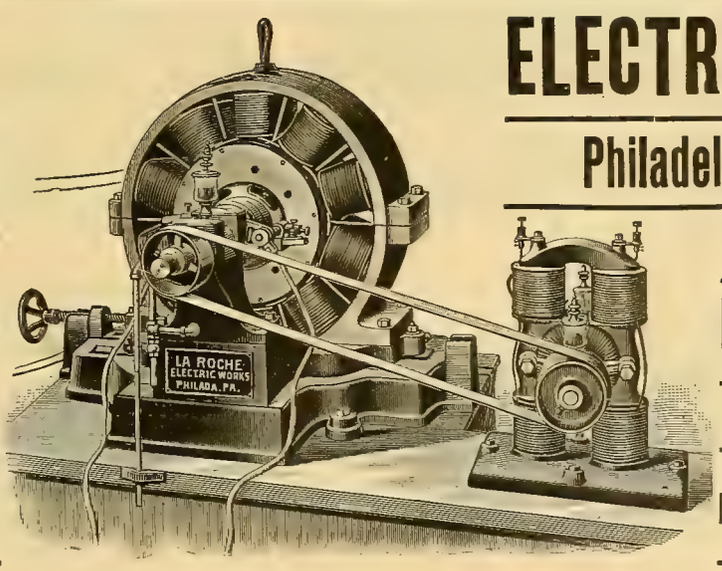

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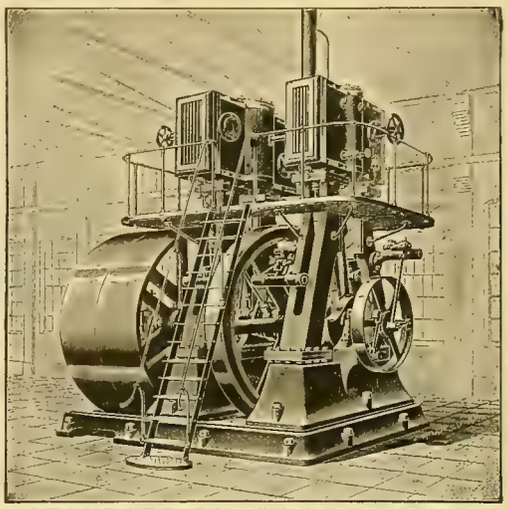

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Size of Engine	Diam. Cylinders inches H. P.	H. P.	L. P.	Stroke—Inches	Revolutions per minute	Horse-Power when cutting off at ¼ stroke in H. P. Cylinder: Cylinder Ratios 3⅓ to 1: 80 lb	95 lb	110 lb	Cylinder Ratios 4 to 1: 115 lb	120 lb	125 lb	Horse-Power when cutting off at ⅓ stroke in H. P. Cylinder: Cylinder Ratios 3⅓ to 1: 80 lb	95 lb	110 lb	Cylinder Ratios 4 to 1: 115 lb	120 lb	125 lb	Horse-Power when cutting off at ½ stroke in H. P. Cylinder: Cylinder Ratios 3⅓ to 1: 80 lb	95 lb	110 lb	Cylinder Ratios 4 to 1: 115 lb	120 lb	125 lb	Horse-Power Constant at 1 lb. M. E. P.
B	6	6½	12	10	370	44	51	59	53	59	62	55	66	70	68	70	75	70	86	97	95	99	106	2.2
C	6½	7½	13½	12	318	56	64	76	67	76	78	70	84	90	87	90	95	90	109	123	120	126	134	2.8
D	8¼	9	16½	14	277	83	96	112	100	112	116	104	125	133	129	133	141	133	162	183	179	187	200	4.16
E	9½	10½	19	16	246	109	125	147	131	147	152	136	163	174	169	174	185	174	212	239	234	245	261	5.44
F	11	12	22½	18	222	156	179	210	187	211	218	195	234	250	242	250	265	250	304	343	335	351	374	7.80
G	12½	13½	25	20	185	192	221	260	231	260	269	241	289	308	298	308	327	308	375	423	414	433	462	9.62
H	14	15½	28½	24	158	258	297	348	310	348	361	323	387	413	400	413	439	413	503	568	555	581	619	12.9
I	17	18½	33½	28	138	346	398	467	415	467	484	433	519	554	536	554	588	554	675	761	744	779	830	17.3
K	19	20½	38	32	120	446	513	602	535	602	624	558	669	714	691	714	758	714	870	981	959	1004	1070	22.3
L	21	22½	43	34	112	572	658	772	686	772	801	715	858	915	887	915	972	915	1115	1258	1230	1287	1373	28.6
M	26	28½	52	42	93	838	964	1131	1006	1131	1174	1048	1257	1341	1299	1341	1425	1341	1634	1844	1801	1885	2012	41.9
N	30	33	60	48	80	1096	1260	1480	1316	1480	1534	1370	1644	1757	1699	1757	1863	1757	2137	2411	2356	2466	2632	54.8
Mean Effective Pressure . . . Lbs.						20	23	27	24	27	28	25	30	32	31	32	34	32	39	44	43	45	48	
Ratio of Expansion						13½			16¼			10			12¼			6¾			8¼			
Per Cent. of Cylinder Condensation						18	18	18	20	20	20	15	15	15	18	18	18	12	12	12	14	14	14	
Steam per I H. P. per hour . Lbs.						17.3	16.9	16.6	16.6	15.9	15.2	17.0	16.8	16.4	16.3	16.0	15.8	17.5	17.2	17.0	16.8	16.4	16.0	
Lbs. Coal at 8 lb. Evaporation . Lbs.						2.16	2.11	2.07	2.07	1.98	1.9	2.12	2.10	2.05	2.04	2.0	1.97	2.19	2.15	2.12	2.10	2.05	2.00	

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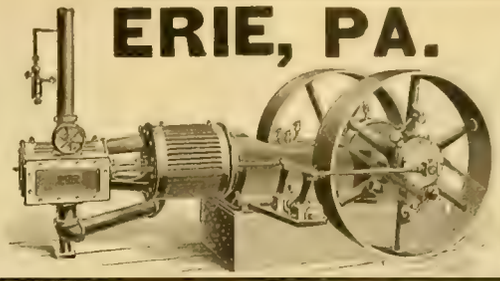

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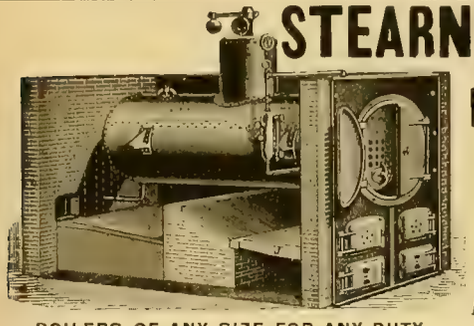

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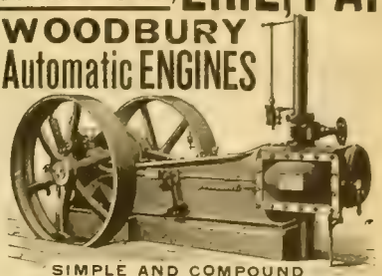

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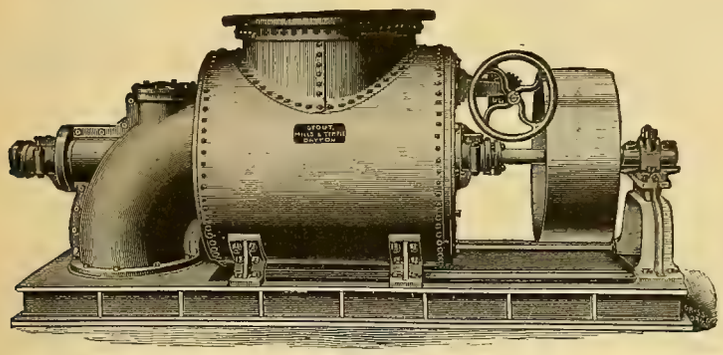

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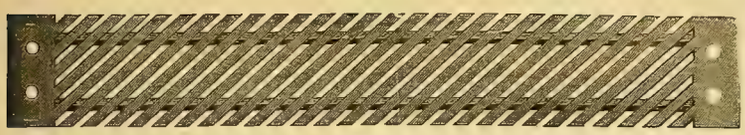

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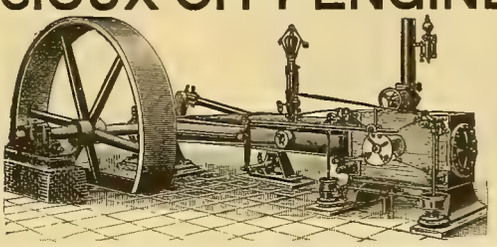

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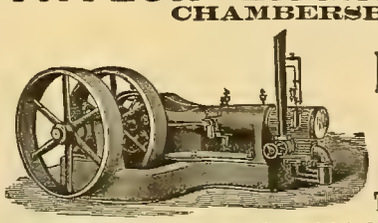

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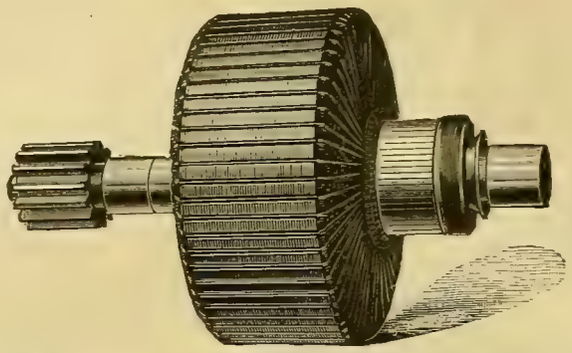

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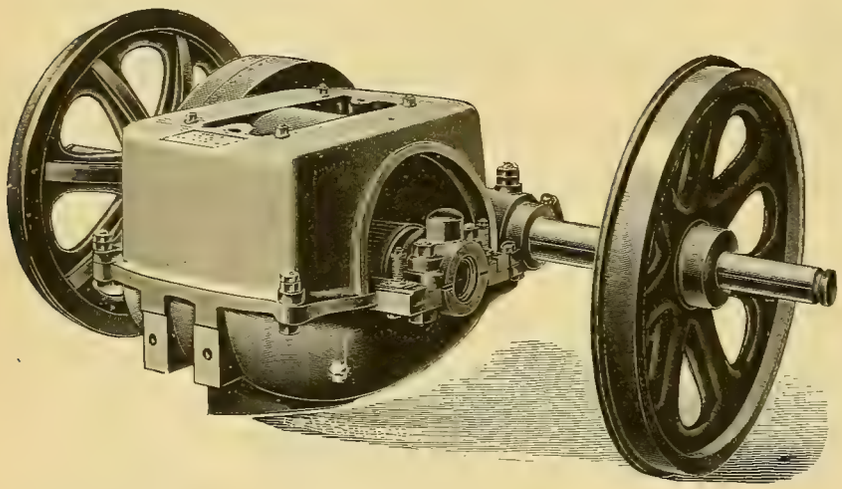

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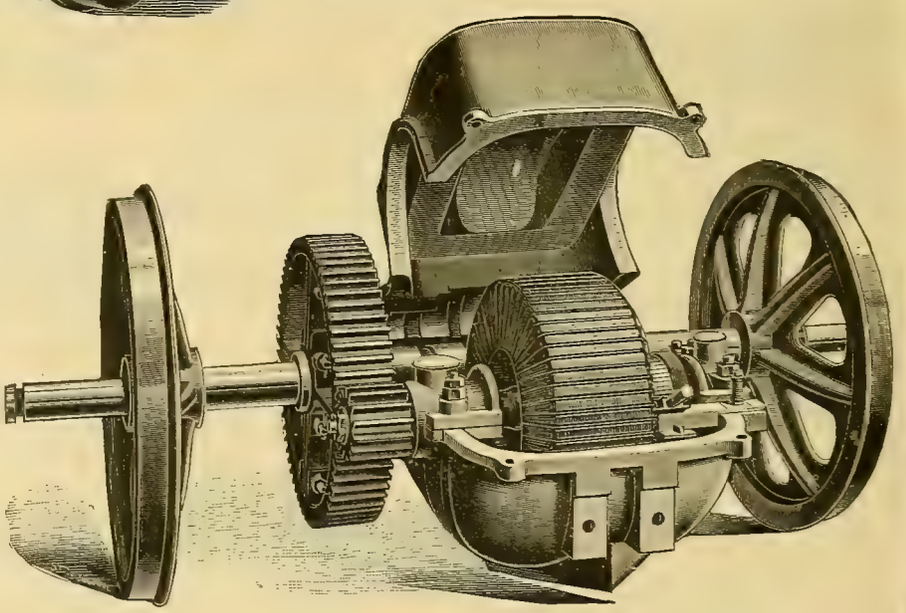

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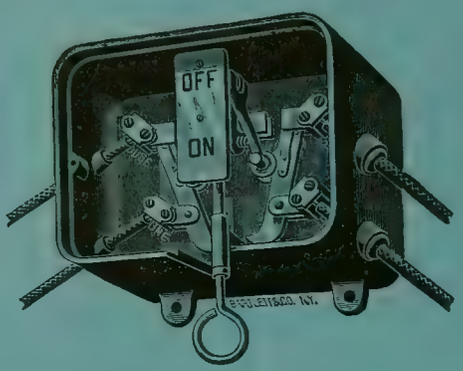

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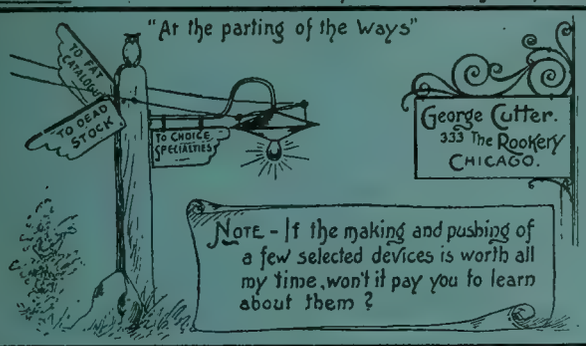

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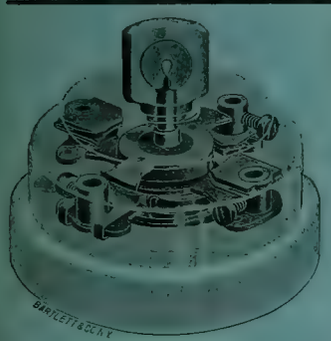

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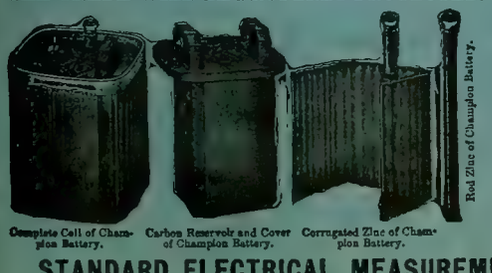

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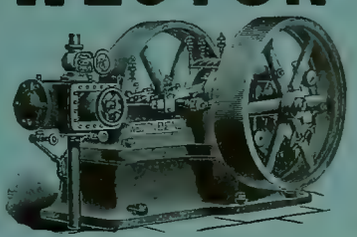

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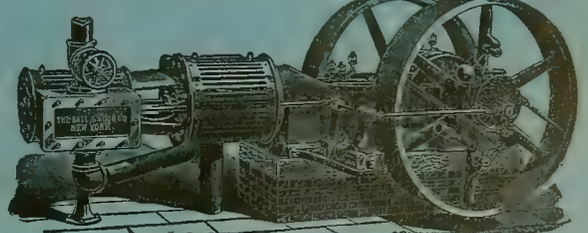

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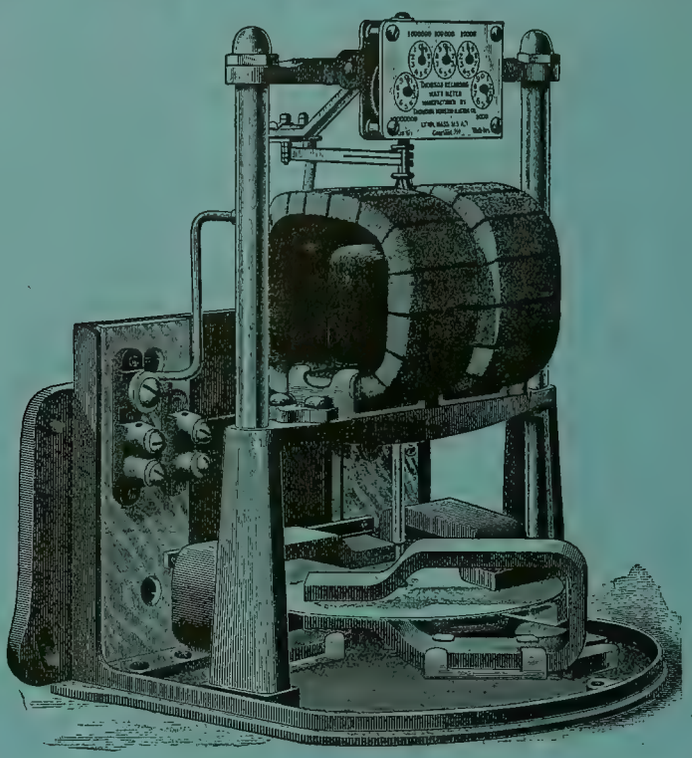

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Yours truly,
GERMANTOWN ELECTRIC LIGHT CO.,
(Signed) Chas. M. Allen, Supt.

LANSING, MICH., April 6, 1892.

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BOSTON, MASS.

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Yours truly,
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(Signed) E. F. Cooley, Supt.

Thomson-Houston Electric Co.,

PRINCIPAL OFFICE,
620 Atlantic Ave., Boston, Mass.

WESTERN OFFICE,
148 Michigan Ave., Chicago, Ill.

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Greeley & Co., The E. S.
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Ostrander & Co., W. R.
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Arc Lamps.
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Duplex Electric Co., Ltd.
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Electric Cons. & Supply Co.
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Westinghouse Electric & Mfg. Co.
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Knapp Electrical Works.
Samson Cordage Works.

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Premier Electric Co., The.
Pumpelly, J. K.
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Central Electric Co.
Detroit Electrical Works.
Electric Gas Lighting Co.
Electrical Supply Co., The.
Leclanche Battery Co., The
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Central Electric Co.
Detroit Electrical Works.
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Detroit Electrical Works.
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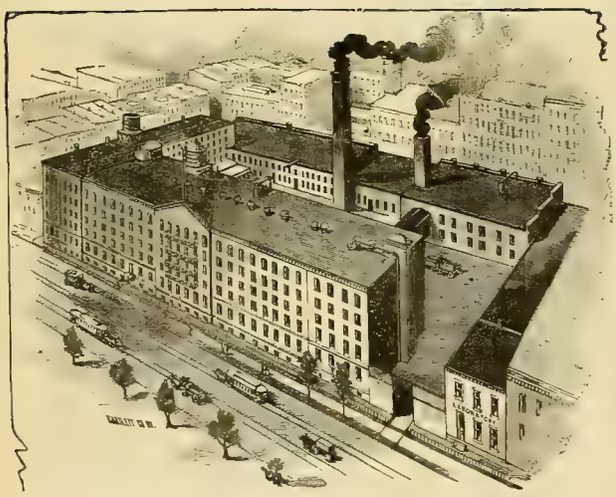

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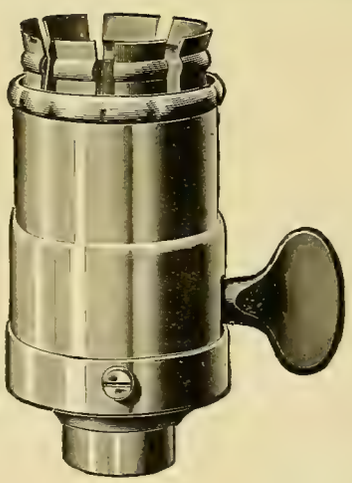

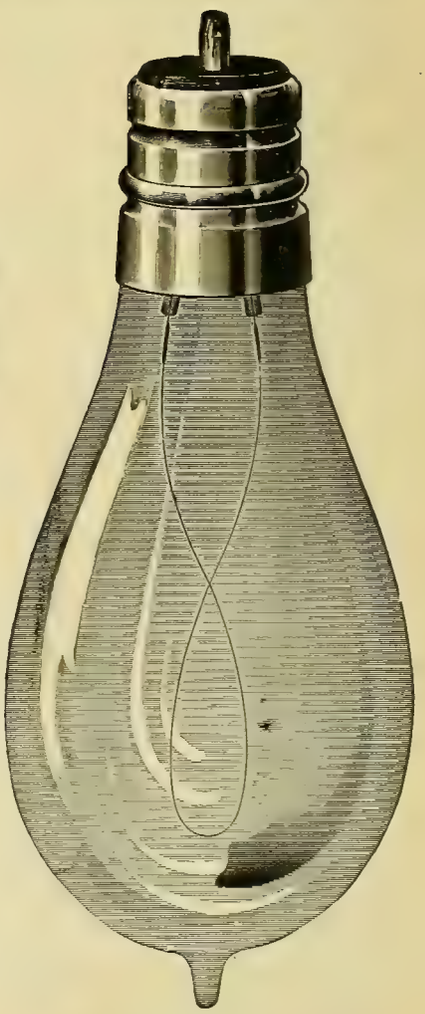

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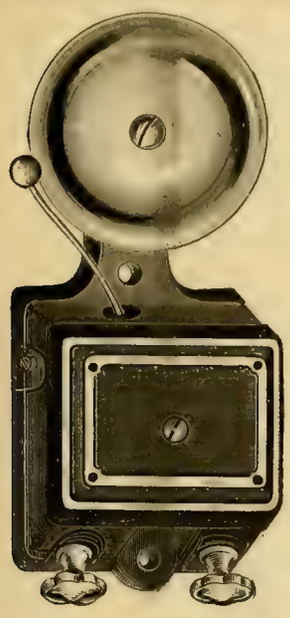

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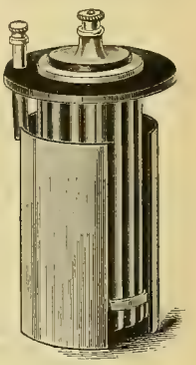

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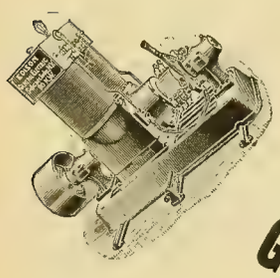

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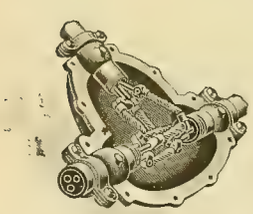

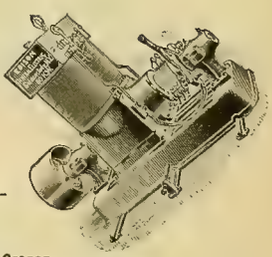

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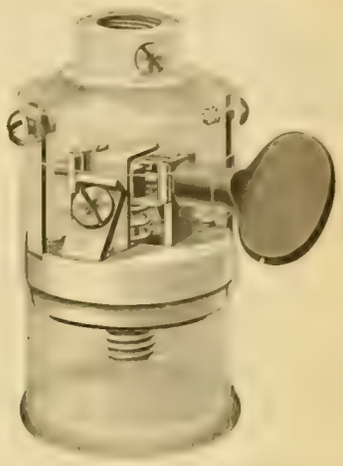

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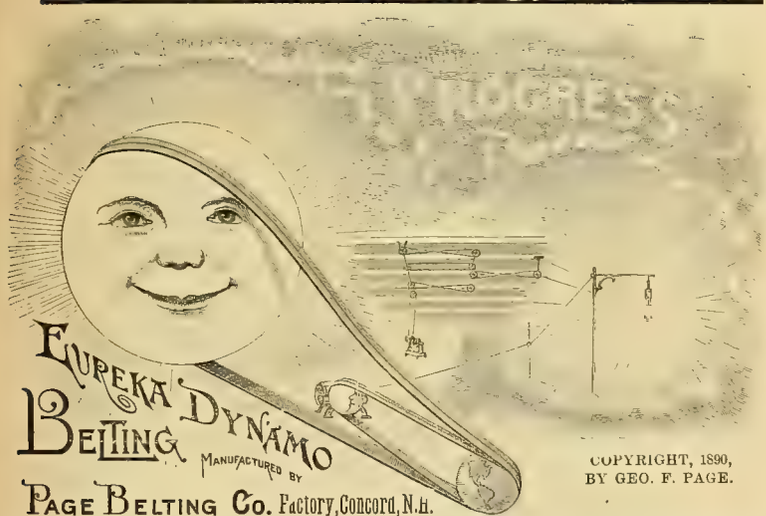

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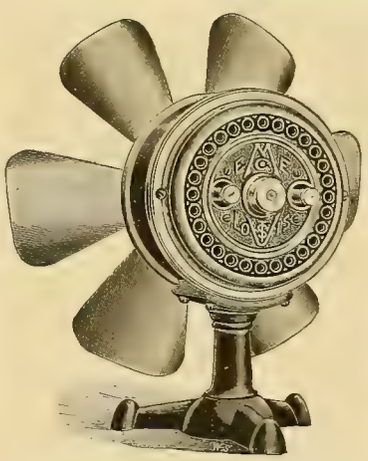

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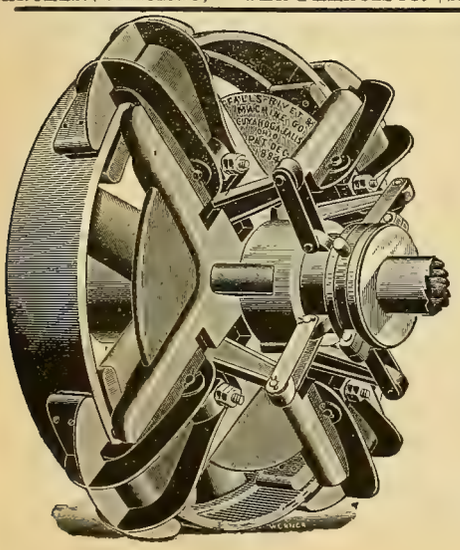

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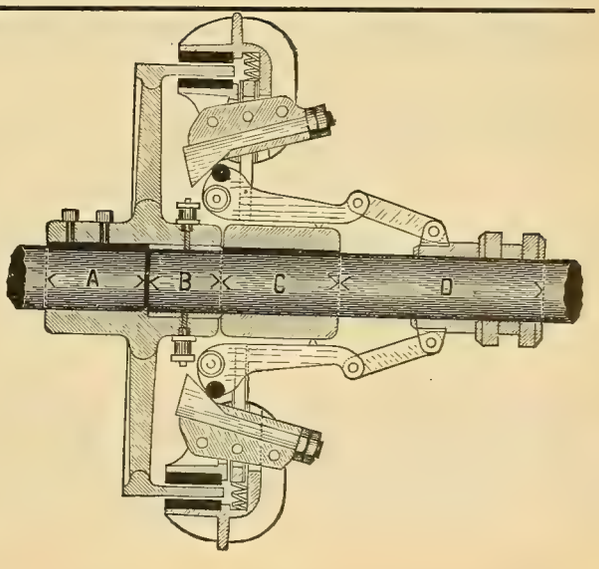

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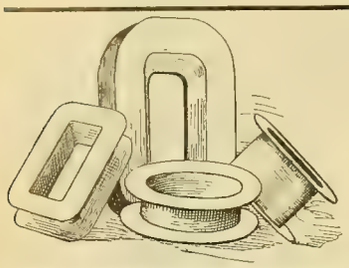

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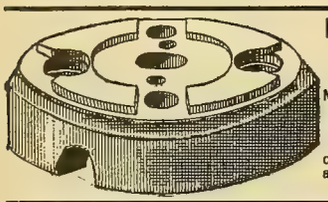

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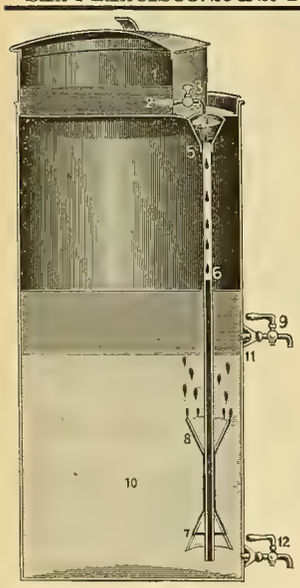

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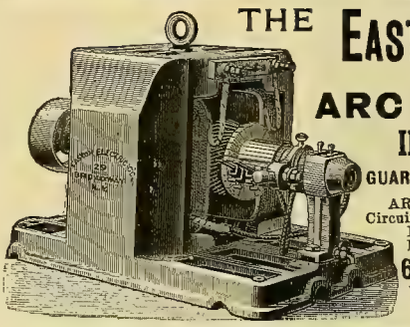

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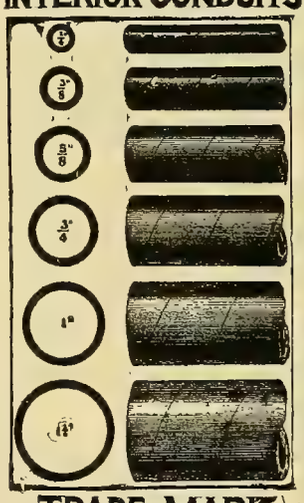

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The Westinghouse Electric & Manufacturing Company will at its own cost and expense defend any and all suit or suits that may be instituted by any party against purchasers for the alleged infringement of patents, when such alleged infringement shall consist in the use of apparatus manufactured and sold by it.

We call the attention of users of electric railway and lighting apparatus to the attempts being made by the Edison-Thomson-Houston electric combination, or Trust, to secure, by threat and otherwise, a monopoly of the electric lighting and power business, which they are not entitled to, and cannot secure by means of their patents. If they could succeed in frightening users into entering into contracts binding them to take only the apparatus supplied by the Trust, then such users would be subject to a contract, which they might have some difficulty in setting aside.

A proposed contract submitted by the Trust to one of our customers indicates that they intended to bind such customer to use exclusively apparatus manufactured by the Trust, and on such terms and for such prices as the Trust might name from time to time; and it is a fair presumption that the Trust would exact a margin of profit greatly above what is generally considered a fair manufacturing profit, in order to pay dividends on their immense capitalization (fifty million dollars capital stock, ten millions of which is preferred) and the interest on the proposed issue of ten millions of bonds.

The users of electric lighting and power apparatus, however, by refusing to purchase, except upon the terms and conditions on which they ordinarily purchase machinery, i. e., with the right to go into the open market unhampered to purchase their future supplies, or repairs, or alterations (as they should do), will always be free to select the best apparatus and details.

The Westinghouse Electric & Manufacturing Company sells all of its apparatus and makes all of its contracts on the above basis, and has never done otherwise, relying for future sales upon the merit of its apparatus.

We suggest the following as worthy of your careful consideration:

1. Enter into no contract with any electric light or power company except with respect to each purchase, and see that there are no hidden limitations or unreasonable provisions.

2. See that every contract contains a clause substantially as follows, for your protection as to patent matters, which clause is inserted in all of our contracts:

"The company shall at its own cost and expense defend any and all suit or suits that may be instituted by any party against the purchaser for the alleged infringement of a patent or patents, when such alleged infringement shall consist in the use of any apparatus, machinery or device, or parts thereof, manufactured or sold by the company, for which the purchaser shall have made all payments when due, provided that immediate notice of the institution of such suit or suits be given in writing by the purchaser to the company, and that the purchaser shall permit the company, through its counsel, to defend the same, and shall give all needed information, assistance and authority to enable the company to do so, and thereupon, in case of an award of damages in such suit or suits, the company shall pay such award, but the company shall not be bound to defend any such suit or suits, nor to pay any damages therein when the same shall arise by reason of the use of parts not furnished by the company."

3. Bear in mind that the agents of the Trust and its stockholders are numerous, and that specious arguments may be advanced, and threats used, to induce you to bind yourself to purchase apparatus only of the Trust.

4. If users of electric apparatus will act judiciously, then no Trust or Combination can expect to receive a higher price for apparatus than is warranted by fair competition.

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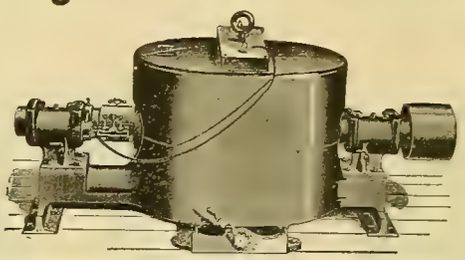

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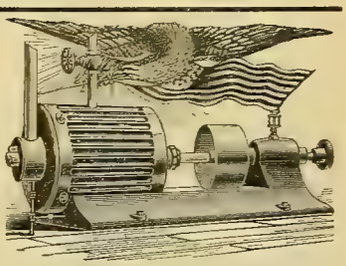

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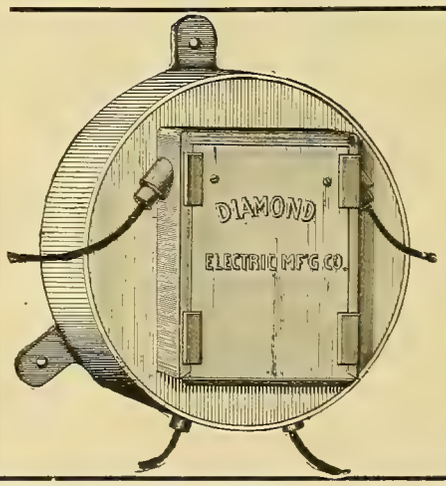

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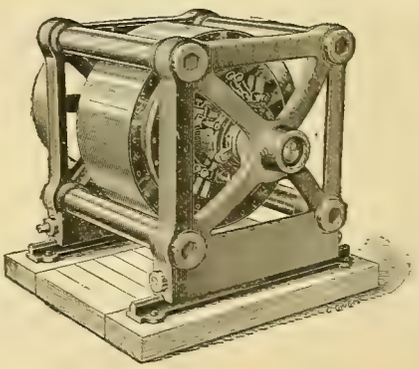

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Vol. X. CHICAGO, JUNE 4, 1892. No. 23

A Trip Under Water in an Electrically Driven Submarine Boat.

Many years ago the writer perused for the first time Jules Verne's "Twenty Thousand Leagues Under the Seas." To the casual reader the story would seem little more than a skillful depiction of a wonderful dream, or a fairy tale, but to anyone mechanically inclined Verne's vivid description of Captain Nemo's submarine boat, the Nautilus, is singularly suggestive of a future possibility. Without attempting to outline the plot it may be said that Verne in this book relates the adventures of a French professor, who, with his servant and one other companion, finds himself on board the Nautilus, which is under the the command of a mysterious personage, "Captain Nemo." The submarine craft, as described to the savant by its designer and commander, was truly a marvelous piece of mechanism. The boat was pictured as cigar-shaped, that is, it was "an elongated cylinder with conical ends." It was explained most plausibly how the vessel was lighted, heated and propelled by electricity, and how it was constructed so that, at the will of the pilot, it could be made to travel either on or beneath the surface of the sea. In short, Verne's fascinating story, told in his characteristic style and with that peculiar ability to present the improbable as most probable, left a lasting impression upon the writer. One generally finishes the book with the ejaculation: "Why cannot such a craft be built?" But in the writer's case it was with no thought that one day he, like the French professor, would have an opportunity of making a trip beneath the surface of the water in a veritable Nautilus. Such was his experience though, and this is the way it came about.

Several weeks ago the WESTERN ELECTRICIAN received information to the effect that George C. Baker of Chicago was constructing in Detroit, Mich., a submarine boat that, although not yet perfected, gave promise of being a very substantial realization of Jules Verne's ideal craft. Correspondence was opened with Mr. Baker, and this soon led to a personal interview, at which a representative of the WESTERN ELECTRICIAN was invited to accompany him on the first trial trip when the boat was to be left, so to speak, entirely to its own resources.

It should be stated here that the vessel had been subjected to a previous test on Friday, April 29th, in the river Rouge at Delray, near the city of Detroit, but on this trip a float was attached to the craft to indicate its position to observers in boats on the surface in case of accident during submersion. The river Rouge is about sixteen feet deep, and it is only at high water that the boat could be drawn entirely under the surface.

By this first test Mr. Baker demonstrated, among other things, the stability of his boat, and, what was more important, that the question of air supply was one that would give him no trouble. During the first trip the boat, although not under water for any great length of time, was hermetically sealed for fully one hour and three-quarters, and the crew, consisting of Mr. Baker and his assistant, W. C. Goddard, suffered no inconvenience whatever from a want of ventilation. As the query, "How do you get your air?" is the first one naturally asked, and is a question repeatedly put to Mr. Baker, it may be stated that on the second trip the writer was sealed in the vessel along with Mr. Baker and Mr. Goddard, for more than thirty minutes, and agrees with the former in his belief that two men could live in the closed boat for several hours and not suffer for air.

On the first run the boat was made to sink at will, and the only leak discovered in the shell was a very slight one at the joint of the turret cap, which closes the only opening into the boat. As may be understood from the description that will follow, the chances of this boat springing a serious leak are slim.

Tuesday evening, May 17th, was the date set by Mr. Baker for the representative of the WESTERN ELECTRICIAN to accompany him to Detroit to make the trip on Wednesday. No run was made on Wednesday, owing to bad weather, and Thursday's test was postponed for a like reason. It should be stated here that it was not thought advisable yet to subject the craft to the rough waters of the Detroit river, as the storage cells constituting the vessel's source of power were not secured so as to prevent shifting; and, further, the cells having only loose covers, the electrolyte would be liable to spill should the boat pitch about.

All of Thursday, then, was spent in an examination of the vessel and listening to the designer's account of how he came to attempt the solution of the fascinating problem of submarine navigation.

While in California on a pleasure trip six years ago, Mr. Baker first began to look into the question of coast and harbor defense. He was not long in reaching a conclusion that the ideal solution of the problem lay in the production of an efficient submarine boat that could be handled easily under water, and could carry a crew and torpedoes and place the latter where desired without appearing at the surface. In the prosecution of his studies a number of interesting experiments were tried. To satisfy himself exactly as to how the buoyancy of a vessel in water was changed by slight additions to its weight, or load, a bottle was weighted down with fine bird shot until the top of its neck was just flush with the surface of the water. A cork with a funnel-shaped hole through it had been placed in the bottle's mouth, and by this arrangement it was a comparatively easy matter to drop the shot into the bottle even after the cork had gone under the surface. With this apparatus Mr. Baker satisfied himself that through slight variations in its weight or its load, a vessel could be sunk to, and kept at, almost any desired depth.

At the inception of his ideas of a submarine boat, to make a practical test he first constructed a model about sixteen inches long. This little craft was built of sheet copper on lines that might be described as flat cigar-shaped, and it was driven by clock works. The boat was pointed at both ends, but its depth from keel to top was very much greater than its width; it was almost flat—in fact, when in the water the little craft was in appearance,

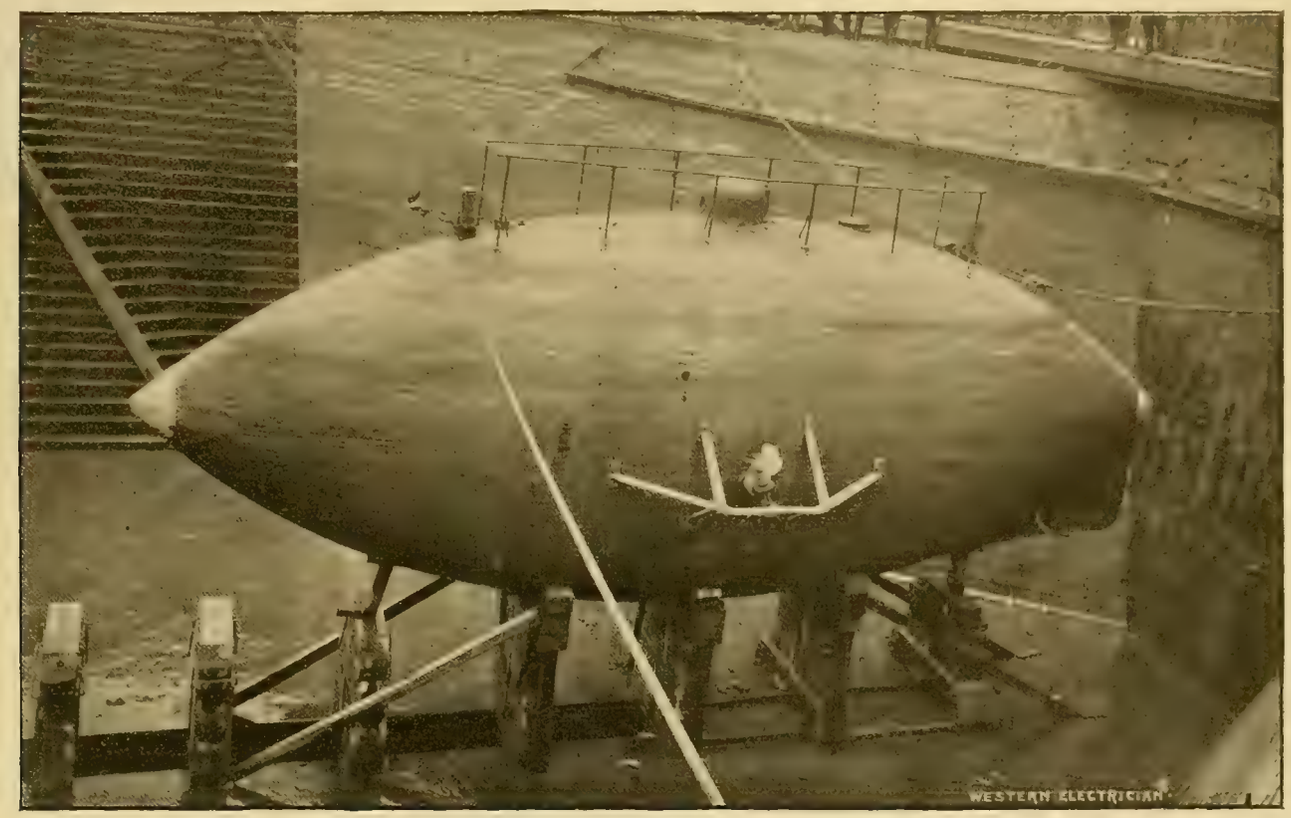

FIG. 1. A TRIP UNDER WATER IN AN ELECTRICALLY DRIVEN SUBMARINE BOAT.

not unlike the sunfish with which every small boy is familiar. This model was provided with two 1¾-inch screws, one on each side of the vessel's center; that is, the screw shaft passed through the boat's center, midway between the pointed stern and pointed bow, and midway between the keel and top. The screws were swung to their horizontal shaft by a sleeve, and were driven by bevel gearing. By this arrangement both propellers could be turned on the shaft, set to revolving at any angle, and thus made to force the boat ahead, back, up or down under the water. It should be stated here that Mr. Baker's theory in regard to the construction of an efficient submarine vessel was that the boat should be forced under water by her screws rather than be sunk entirely through the agency of an added weight such as water drawn into reserviors on board. In other words, it was his idea to so build a boat that by the introduction of water into reservoirs, in addition

FIG. 2. A TRIP UNDER WATER IN AN ELECTRICALLY DRIVEN SUBMARINE BOAT.

to ballast already on board, the vessel's buoyancy could, at will, be reduced to a minimum, and when thus suspended or balanced, so to speak, in the water, the screws were to be run at the proper angle to force the boat under. By driving the screws on an angle, the boat, he calculated, could be navigated at any reasonable depth. Another theory, the correctness of which he sought to establish through the small model, related to the proper location of the propellers. His belief was that the best construction would be to employ two screws, each so arranged that it could be set from within the boat to revolve at any angle in a plane parallel with the vertical center plane of the boat. In brief, these screws were to be connected so that they could be made to propel the boat forward or backward, either on or beneath the surface, force it down beneath the water, or lift it up to the surface. By locating the boat's propellers at or in the neighborhood of the vessel's center of gravity, Mr. Baker expected to secure great stability and be able to maintain the boat under all circumstances with its keel parallel to the surface of the water.

This expresses in a general way the fundamental theories involved in the construction of the first model, which, it may be stated, was exhibited to the writer by its designer during the recent trip to Detroit.

At the time the 16-inch model was built, Mr. Baker was president of the Baker Wire company in Des Moines, and owing to a press of business he was obliged to give up his experiments for two years. In 1888, though, he returned to the experimental work and built at that time in Chicago another model fifteen feet long by about six feet deep. This boat was designed for man power, but was found to be too light to stand the pressure of water during submersion. Through his tests with this boat, however, he was brought to a realization of how great should be the strength of such a vessel's shell, and he also gained a clearer idea of what an immense amount of power was required to submerge the vessel unless it was accurately weighted down and its buoyancy reduced to a mimimum.

The last experiment decided Mr. Baker, and he immediately set to work on the plans for the vessel about which, of late, so much has been said and written. In 1890 the contract for the shell of the full sized boat was let to the Detroit Boat Works of Detroit, Mich., and since that time the designer has been at work quietly, gradually perfecting a mechanism which, although confessedly still in an experimental and necessarily crude form, bids fair to mark a most important step in the development of the submarine boat.

It should be said here, to Mr. Baker's credit, that from the outset he has endeavored to work quietly, and has sought no notoriety. The moment, however, the first trial was made, wild and sensational accounts as to the wonderful possibilities in store for the vessel were sent abroad, and the daily newspapers, through these premature publications, have placed him in an unenviable position. The situation is particularly trying at present, owing to a recent report published, to the effect that the vessel was tested before Commodore Folger, chief of the Ordnance Bureau of the United States Navy, and did not work satisfactorily. The present correct description, therefore, of the boat and how it is operated during a trial trip, will enable the reader not only to judge for himself of the valuable results that are being brought about, but also to appreciate the fact that the solution of a great and most difficult problem has been undertaken and that work upon it is being prosecuted with care and good judgment.

The accompanying cuts, Figs. 1, 2 and 3, are excellent views of the craft, showing it in the dry dock and at the wharf at Boston's boat-house in Delray, near Detroit. Fig. 4 is a sectional view, which gives a general idea of the arrangement of the machinery in the boat. Figs. 5 and 6 are reproductions of photographs which show respectively the interior of the forward end of the boat and the interior looking aft. These pictures were taken with Mr. Baker at the wheel, and Mr. Goddard, his efficient lieutenant, at the switches, Fig. 5, ready to answer the pilot's signal bells. It will be noticed that the pilot stands on an elevated platform in the center of the vessel, and is in a convenient position to observe the boat's course through the glass-sealed portholes in the turret above him. The turret has in it five windows of thick plate glass, four in the sides and one in the top of the lid or cover. The only entrance to the boat is through the turret. The turret cap is provided on its under edge with a gasket of rubber tubing. To seal the vessel the lid has only to be swung around on the stud at the side, which forms its pivot or hinge, and then by turning a nut on the lower and inner end of the stud, shown in Fig. 6 just back of the pilot's head, it is let down and screwed tightly into place.

Contrary to one's impression after the first glimpse of the boat as it lays at its moorings in Boston's dock, there is ample room for two, or even more, persons to move about and operate the machinery without being uncomfortably crowded. The interior can not be called spacious, but were it not for the vitiation of the stock of air, the number of occupants which could be comfortably carried would be several more than those already taken—in fact, were it desired, quite a crew might be stowed away in the spaces between the steam and electrical apparatus. A glance about the interior shows that the vessel has been built to withstand an immense pressure from without. The shell proper is six inches thick, with a sheathing an inch thick. It is built up of strips of 3-inch oak 6 inches wide, nailed flat side together, with 9 inch spikes.

A close inspection of the two interior views will show the 3-inch edges of the oak strips and the manner in which they are joined.

The inside of the shell is not caulked at all, but in building the boat a waterproof oiled canvass was put on the outside between the 1-inch oak sheathing and the 6-inch

FIG. 3. A TRIP UNDER WATER IN AN ELECTRICALLY DRIVEN SUBMARINE BOAT.

shell. The boat is braced horizontally across its center line by eight 6x6 inch oak beams. There is in addition to this, around the center, a horizontal shelving of oak 12 inches by 3 inches thick, the shelving resting on the cross beams. The interior of the shell at the center is 13 feet deep by 8 feet wide, the outside length of the boat being 40 feet. Mr. Baker figures that these dimensions give him 1,500 cubic feet of air space. Of course, though, a considerable allowance must be made for the room occupied by the machinery. He estimates the weight of the whole boat at 75 tons, figuring it as disposed in the following proportions: 20 tons of shell, 30 tons of pig iron ballast, 13½ tons of storage cells and motor, 9 tons of engine, boilers, etc., 1½ tons of water ballast, and 1 ton of buoyancy. He calculates further that the shell will stand with perfect safety the pressure of the water at 150 feet below the surface, or about 75 pounds to the square inch.

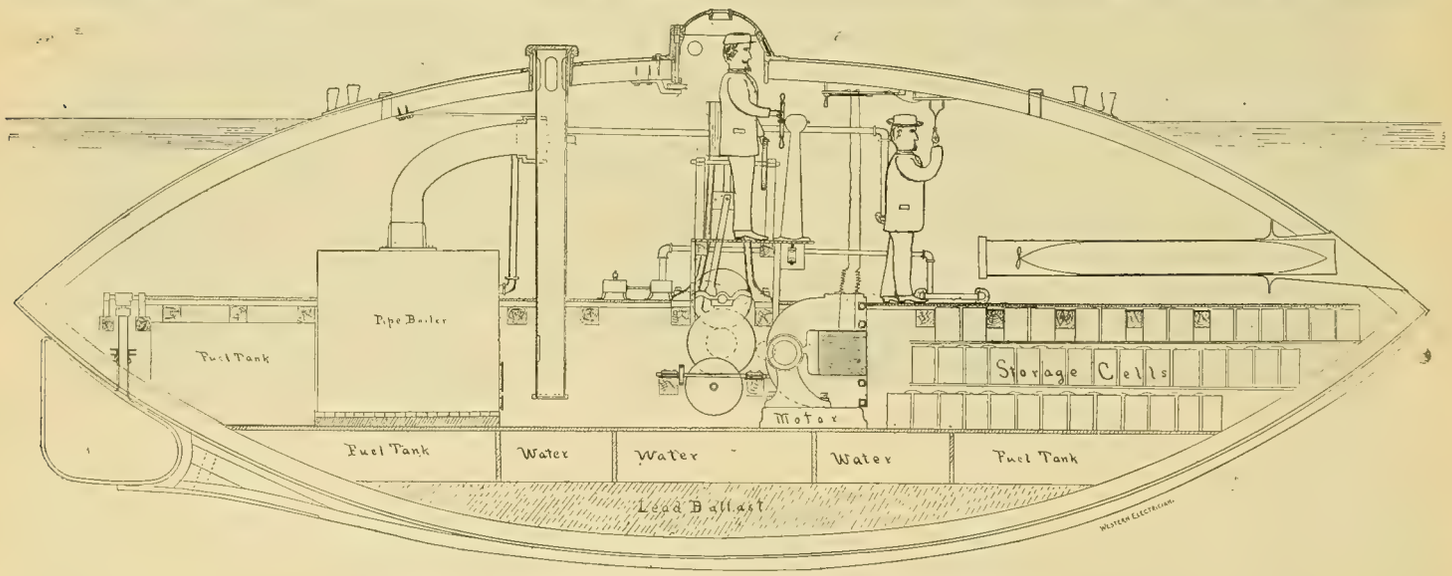

FIG. 4. A TRIP UNDER WATER IN AN ELECTRICALLY DRIVEN SUBMARINE BOAT.

Referring to Fig. 4, it will be seen that there is employed in this craft a furnace, boiler, steam engine, motor-dynamo and storage batteries. It is the designer's purpose to employ the steam plant to drive the dynamo as an electrical generator and in this way have a means of charging the battery. This may be done at the dock or at any other convenient place. When the charging has been completed the smokestack, which, while the fires are burning, is elevated above the boat, as shown in Fig. 2, is drawn down into the boat, as indicated in Fig. 3. The fire having been extinguished by closing the air-tight furnace doors the cells may then be applied to the dynamo to drive it as a motor. It should be explained that the cap of the smoke stack is in reality a valve, which, when the stack is

lowered, closes the only opening to the boat other than the man-hole.

It will be easily seen from the above how conveniently such a boat may be employed for harbor defense. Charging might be accomplished in, say, some out-of-the-way corner or cove and the storage cells be then relied upon exclusively for

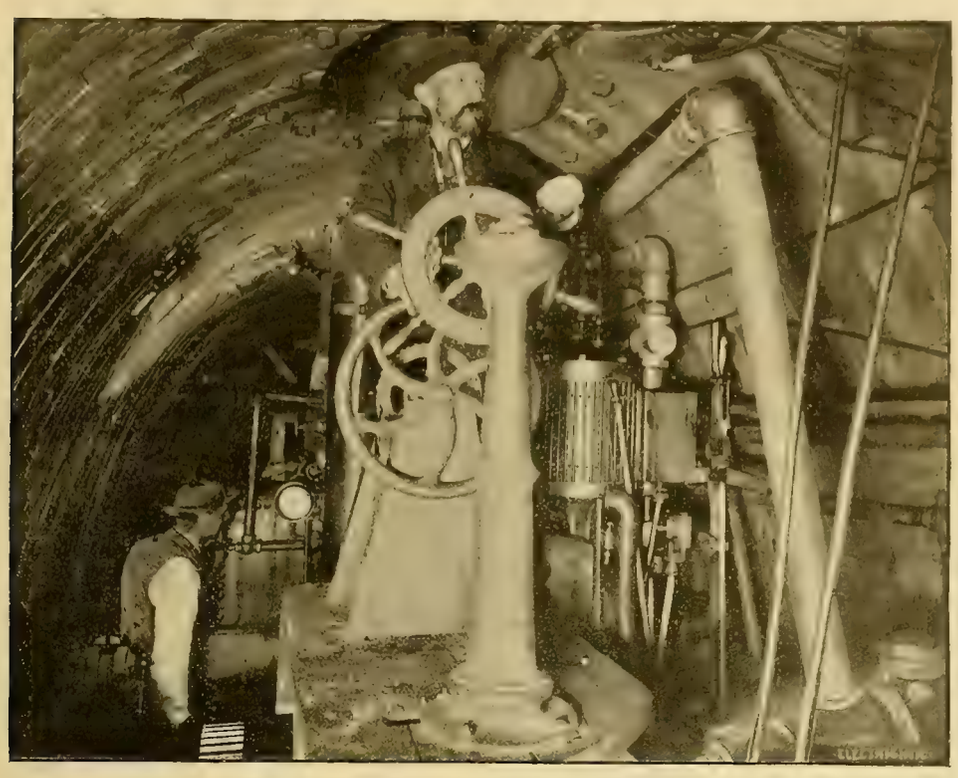

FIG. 6. A TRIP UNDER WATER IN AN ELECTRICALLY DRIVEN SUBMARINE BOAT.

power. The boiler employed in the boat is rated at a maximum of 60 horse power. It is an ordinary marine pipe boiler of the Roberts type and was manufactured by Chas. P. Willard & Co., Chicago. This boiler was tested to stand 220 pound's pressure but up to the present time it has never been run, in performing its present work, to a higher point than 120 pounds. In connection with the boiler there is a small Worthington duplex pump $4\frac{1}{2}$ by $2\frac{3}{4}$ inches by 4 inches. This pump is employed for feeding the boiler and also for drawing the water ballast out of the reservoirs at the keel of the vessel. No pump is required to fill the reservoirs as the water runs in of its own accord.

The engine in the boat is one nominally of 35 horse power. It is of the marine type, reversible, with links, etc., and was made also by Chas. P. Willard & Co., Chicago. A good view of this engine is presented in Fig. 6.

The electrical equipment consists of a 50 horse power motor built by C. D. Jenney of Fort Wayne, Ind., and 232 Woodward storage cells of the "M. S." type. The motor was designed for a pressure of 220 volts and runs at a maximum speed of 900. It is geared to the two screws, which are 24 inches in diameter from tip to tip of blades and four bladed, so as to drive them at a maximum speed of 300 revolutions per minute. This rate of revolution, it was calculated, would give the boat a speed of from eight to nine miles per hour. The gearing is very substantial and of steel. The motor is connected to run as a dynamo by the simple movement of convenient switches. When it is run as a generator it is speeded up to 1,025 revolutions per minute, so as to give a charging pressure of 220 volts. The cells are charged in four sets of 58 each and are discharged in two sets of 116 cells each, this arrangement giving at the motor an available pressure of 232 volts. In the top of the boat, within easy reach of the pilot's assistant, and shown partly in one interior view, Fig. 5, there is a convenient controlling switch connected with galvanized sheet iron resistance coils in the forward end of the boat. By this switch and a circuit breaker the speed may be varied to any degree that may be desired.

From the above it will be seen that the boat is most complete in its equipment and can be relied upon to generate its own supply of electricity. At present, though, the charging of the batteries is accomplished by a temporary plant, which Mr. Baker has erected under a shed just back of the boat house at which the vessel is laying.

The temporary charging equipment consists of a 300 light, 110-volt Edison dynamo. This machine is belted to a traction engine, nominally of 25 horse power, built by the Ames Iron Works, Oswego, N. Y. The engine and dynamo, together with a temporary switch-board containing the necessary ammeter, voltmeter and switches, are together under the shed. The dynamo is belted directly to the engine. For charging, the machine is speeded up so as to deliver current at an electromotive force of 135 volts. This plant is in charge of John S. Rowe. It should be mentioned in this connection that Mr. Baker has been rendered great assistance in carrying out the practical details of his work through the energetic efforts of his two assistants, Messrs. Goddard and Rowe.

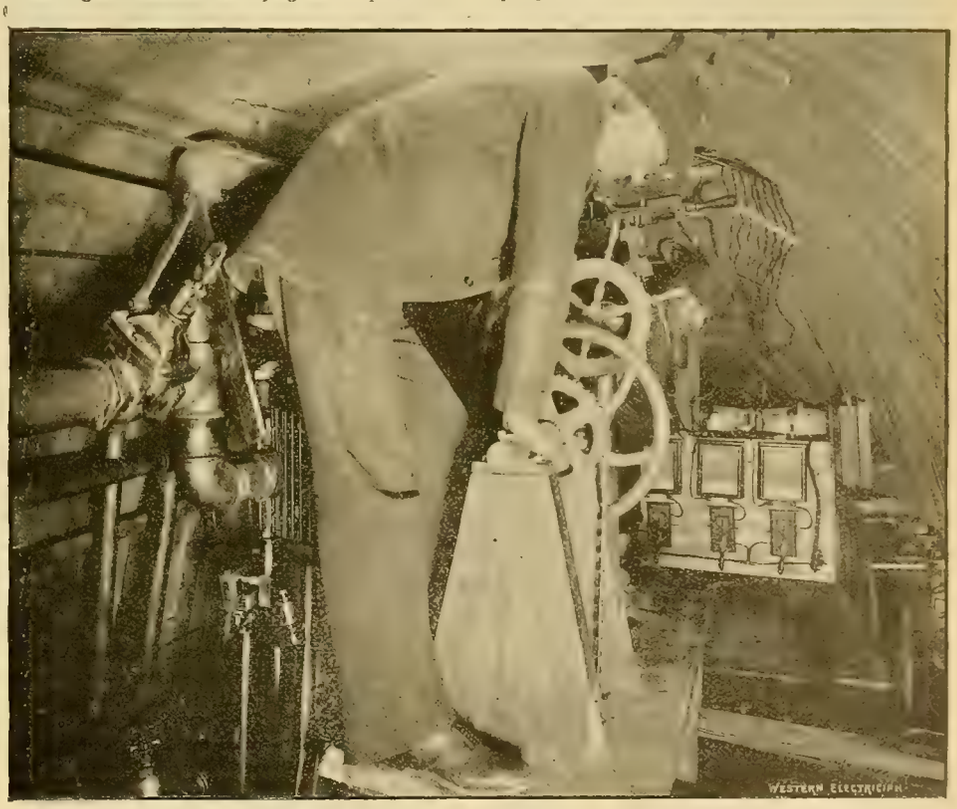

FIG. 5. A TRIP UNDER WATER IN AN ELECTRICALLY DRIVEN SUBMARINE BOAT.

When on Thursday, May 19th, the writer, in company with Mr. Baker, for the first time visited Boston's wharf, the temporary charging equipment was in operation charging the cells in the craft. On rounding the boat house a glimpse of the vessel as it lay tied to the [illegible] obtained. One's first impression is that the boat is quite small, but this may be accounted for as the [illegible] little of the hull appears above the surface of the water. On boarding the craft though, there soon comes a realization that one is treading the boards of a pretty [illegible] structure and one with a by no means contracted cabin or hold.

All day Thursday was devoted to charging and putting the machinery in first-class order. Friday morning the sun was shining brightly, but the wind was blowing such a gale that Mr Baker, for reasons already explained, [illegible] decided not to start out into the rough waters of the Detroit river. On returning to the boat at 3 P. M., however, the weather had moderated considerably, and Mr. Baker expressed his belief that before the afternoon was over he would be able to make at least a short trip. After waiting more than an hour for the arrival of H. H. Humphrey, agent for C. D. Jenney of Fort Wayne, who had sold and installed the motor and batteries and who was to be present at the trial, it was decided to make ready to cast off. Steam was gotten up in Mr. Boston's launch, the Thos. McGraw, and at twenty-three minutes of five the ropes were untied and the swift current swung the vessel around into the middle of the Rouge river.

The Rouge river is quite a narrow stream that empties into the Detroit river at Delray and the average depth of the water is about 16 feet, with a very narrow channel to the Detroit river. The distance from Boston's boat house to the point at which the Rouge meets the Detroit river is about a quarter of a mile, the stream curving slightly, Boston's boat house had been chosen by Mr. Baker as a dock on account of its offering him the advantage of more or less seclusion in which to carry on his experiments.

There was quite a crowd of spectators on the boat house wharf when the vessel was cast loose from her moorings, and on the deck of the craft were Messrs. Baker, Goddard, Rowe, Humphrey and the representative of the WESTERN ELECTRICIAN. As soon as the photograph of the boat had been taken, Fig. 7, Mr. Baker and Mr. Goddard went below and Mr. Rowe pulled away in the small boat, shown in the background, to take the photographer down to a wharf at the junction of the two rivers to obtain other photographs that are presented herewith, showing the vessel as it appeared laying on the surface and also beginning to be submerged, Figs. 8 and 9. Mr. Humphrey remained on deck until the mouth of the river was reached, and he then boarded the launch to be on hand to render any assistance should an accident occur.

Attention should be called here to the fact that the first trip was made with only Mr. Baker and Mr. Goddard in the boat, and with a float attached to the craft to indicate its position to those on the surface. In the pre

ent instance, though, no float was attached to the vessel, and it was for this reason that Mr. Baker decided it would be wise to be not too sanguine, but to take the precaution of having a responsible man like Mr. Humphrey in a launch on the surface where he might watch the maneuvers of the submarine boat.

Before boarding the launch it was agreed between Mr. Baker and Mr. Humphrey that a white card or a handkerchief shown at one of the windows in the side of the turret was to be the signal for help or a tow.

At this time, 4:48 P. M., the sun was shining brightly, with a few flying clouds, and the weather had so moderated that the surface of the Detroit river, although not calm, was by no means turbulent.

At 4:51 P. M. the writer left the deck and went down into the boat along with Messrs. Baker and Goddard. At 4:52, with the final injunction to Mr. Humphrey to "Look out for the white signal," Mr. Baker lowered the turret cap, screwing it down tightly, at the same giving the order to Goddard to "Let in a little more water."

With the lowering of the cap the solitary passenger took a last look at the outer and upper world, and, with lungs filled by a final gulp of fresh air, settled himself down at the feet of the pilot. Thus began an experience which although, as it proved, not made up of thrilling or startling incidents, was nevertheless exceedingly novel and

FIG. 8. A TRIP UNDER WATER IN AN ELECTRICALLY DRIVEN SUBMARINE BOAT.

ighly interesting. It is no trick, of course, to crouch in the hold of a submarine boat while it is being manipulated by others, but had the writer known that he was to be the first passenger, outside of the crew of two, that would make the trip in this submarine boat in the rough Detroit river—and without the float, too—perhaps he would have done more thinking and indulged in but little observation of the surroundings. But of all this he was at the time blissfully ignorant.

After closing the turret Mr. Baker was occupied in getting the vessel under control. For a few moments sharp commands were given and remarks passed which gave the two men in the hold some idea of what was going on outside and how the boat was acting.

"Let in more water, Goddard." "There she comes." "Hold on a minute; we may be drifting into shallow water; pull her back!" etc., etc. Such sharp orders as these, accompanied by the rapid bell signals to Goddard at the motor switches, not to mention the deafening whir of the gearing, were calculated to obliterate any idea of personal danger, and left but one thought, and that was that, so far, a trip in a submarine boat wasn't such a bad thing after all.

There was not much thinking done, though, for in a moment a quick touch on the shoulder from Goddard drew the writer's attention to the little round windows in the side of the turret. Since the closing of the turret lid, Mr. Baker had been gradually reducing the buoyancy of the boat by admitting water ballast to the reservoirs at the keel. The vessel had been settling farther and farther under the water, and at Goddard's signal the water line was at the center of the porthole window. By squeezing one's head and shoulders into the turret, a peep at the outside world was obtained through the moisture-coated glass. The eye was exactly at a level with the crest of the waves which beat against the windows, permitting only occasional glimpses of the shore and the small craft that crossed the vessel's track.

The outside world, however, was of little interest at such a time. The writer's crowning ambition was to go under water—to be completely submerged, in fact, and he had not long to wait before the order came to shut off the water. It required two or three careful manipulations of the water valve by Goddard before Mr. Baker felt that the buoyancy had been sufficiently reduced, and then, at 5 P. M., with the vessel running at its slowest speed and in the swift current of the river, came the order, "Now pull ahead, Goddard—give it to her, Goddard!" The motor did its work well, but the buoyancy had to be regulated to a still greater nicety. It was now 5:02 P. M Two minutes only had elapsed, and now the fishermen and photographer could be seen on the pier at the junction of the two rivers.

"A little more water, Goddard," was the last order, and this time, at just seven minutes after five, with the screw running at full speed, the writer, looking up through the window in the top of the turret, saw the water close over the boat, completely submerging it.

Down it went!

What was to be seen? How did the water look? How far did the boat travel? Such are the natural questions, but it is to be regretted that the only answer to them is that nothing was to be seen but water—and muddy water at that—and further, that it was impossible to estimate the distance covered under water owing to the fact that the boat was submerged in the middle of the river and in a swift current. The boat was down completely out of sight a number of times, and was maneuvered enough and in a manner to convince even the skeptical that the stay was only a question of an expenditure of power and a careful reduction of buoyancy, which latter desideratum was, of course, to be gauged in the present case only by the risk Mr. Baker was willing to take in admitting water.

The depth reached could only be gauged by the gradual diminution of the light coming through the glass sealed portholes; nothing could be seen a few feet away.

Goddard established a reputation as an estimator of depth on the first trip when, as Mr. Baker for the first time drove the vessel down quite a distance under water, he complacently remarked as the water darkened, "Now we are under, boss—sure!"

Mr. Goddard's belief was that in the trip herein described, the maximum depth attained was about ten feet.

During the time the boat was sealed there was absolutely no discomfort for want of air; it was very warm, though, on the inside, although the external air was quite chilly. All hands made the trip with coats off, and the pilot, it may be stated, owing to his hard work at the two wheels, was literally dripping with perspiration. The two wheels, one for the rudder and the other for changing the angle of operation of the two screws, having been newly fitted up, were quite hard to move.

At 5:27 P. M., just 35 minutes after Mr. Baker pronounced the boat "all tight," a white handkerchief was displayed from within against one of the glass windows in the turret, and the launch Thos. McGraw with Mr. Humphrey on board, was seen making for the boat. After a futile warning to that gentleman not to step on the nicely balanced craft, but unfortunately only heard by those within the plate glass windows, the pilot lifted the turret lid and with a "swish" the heated air rushed out. The pumping in of the water ballast, it should be noted, compresses the air in the boat. At one time during the trip when the buoyancy was being reduced, it was found advisable to raise the lid of the turret slightly for an instant to relieve the air pressure and thus facilitate the pumping; of course, though, it should be remembered, no fresh air was admitted, so the 35 minute enclosure may be relied upon as a good test for that length of time. But even had the boat been opened once during the 35 minutes above referred to, the previous experience and a more recent one by Messrs. Baker and Goddard, both eclipsed the time the writer was enclosed. On Tuesday of last week, May 24th, these gentlemen were sealed in the boat, running part of the time on the surface and part under the water, for two hours and forty-four minutes.

When opened on Friday's trip the vessel was weighted down to a fine point. The pumps, which could be thrown into gear with the motor, were now set to work and as the boat was towed up the River Rouge, the water ballast was gradually reduced to its normal quantity.

At 6:07 P. M. the novel little craft was once more at its moorings at Boston's boat-house, and thus ended an experience the remembrance of which will have a long life with one passenger at least.

English Electrical Units.

The English Board of Trade has originated a new name for its electrical unit. It is the "Kelvin," in honor of Lord Kelvin. A correspondent of the London *Electrician* raises his voice in protest against this, and says: "No doubt honor is due to Lord Kelvin, and it is an old saying that honor should be given to those to whom honor is due; but it is very doubtful whether the change will add to the reputation or popularity of the president of the Royal Society." In arguing against the needless complexity of electrical terms, the writer relates this instance: "In a recent case we had an inquiry from a learned judge—whose great ability is shown by the manner he mastered the difficulties of a difficult case—how the word 'ampere' was spelt, and whether it was the same thing as a volt." The letter concludes as follows:

Just imagine what would happen if—

A battery were called.....	"A Swinburne."
A transformer.....	"A Webber."
An earth return.....	"A Crompton."
A switch.....	"A Lane Fox."
A meter.....	"A Hopkinson."
A dynamo.....	"An Aron."
The three-wire system.....	"The Eustace Balfour."
A high-tention current. ...	"A Kennedy," and
A low-tention current.....	"A Ferranti."

Surely such a nomenclature would create confusion, even in the minds of those who heretofore had been supposed to know most about electricity. And yet this is, it would appear, what things are coming to.

The Largest Incandescent Lighting Station in the Country.

Since the return of Superintendent Church from the East, it has been practically decided that the new Edison triple expansion vertical engines, with multipolar dynamos, will be used for the new station of the Chicago Edison company at Harrison street and the river. These engines are of the marine type and are regarded as very efficient. The station will be planned for an ultimate capacity of 30,000 horse power, and engines of 8,000 horse power capacity will be installed at the outset. These figures indicate that the station will be the largest one for incandescent lighting in the country. Indeed, this claim is made for the Adams street station of the Chicago Edison company at present. No plans have yet been made for the new station, but the building will be very plain, and all the machinery will be on the ground floor.

Electricity at the World's Fair.

Mr. Westinghouse left Pittsburg on May 26th for New York to arrange for the bond for $1,000,000 demanded of him by the World's Fair directors as the condition for securing the incandescent lighting contract. In an interview he is reported to have said: "Having secured the contract, we are ready to go to work at once. We will have no trouble with the trust. We will have the entire plant of 89,644 lamps completed by December 1st, and nearly all of the lamps may be turned on in October if it is desired." An interesting statement is made by the *Financial News and Price Current* of Pittsburg, a devoted adherent of Westinghouse interests, to this effect: "The contract will yield a nice profit to the Westinghouse corporation. In addition, when the World's Fair is over, the machinery will be used in forming one of the largest electric light plants in the world for Chicago. This consideration did not enter into the figuring when the bid for the contract was prepared."

The *Manufacturers' Engineering and Export Journal* of London states that the Royal Commission of Great Britain has great difficulty to induce English manufacturers to exhibit at the World's Fair.

The World's Fair authorities have requested the city council of Chicago to direct the Hyde Park Electric Light & Power Company to allow the World's Columbian Exposition, or such persons or company as it may designate, to place on any of its poles, standing in public streets or alleys of the village of Hyde Park, wires or cables for the transmission of telegraphic messages to connect with the World's Fair grounds, this permission to continue in force for six months after the closing of the said exposition.

Chief Barrett of the department of electricity has been interviewed in Los Angeles, Cal., and he says that in the electricity building there is not room enough by one-third to meet the applications.

In accordance with the plan of allowing exhibitors to equip the electrical building for light and power, the department of electricity has issued the following circular to intending exhibitors:

Under the rules of the exposition it will be necessary to install all operating machinery in what is to be known as the general power plant in machinery hall. All generators will be established at that point, immediately adjacent to steam power of competent capacity. Between this power plant and the electrical building there is a subway six feet deep and six feet wide for the accommodation of conductors. Fire-proof vaults will be built at the point of entrance to the electrical building in which to install transformers, to comply with the National Underwriters' requirements. Headway averaging seven feet under the flooring, and foundation posts at intervals of twelve feet, will give ample wiring facilities.

It is the purpose to divide the building into equitable sections, and to assign these sections to the various exhibiting interests. Those to whom assignments are made will be expected to install their own generators, furnish cables between the plant and the building, and do all wiring, including the furnishing of conductors. Those who are given arc lighting to do will be expected to furnish carbons and attend to renewing them. Those undertaking to operate incandescent lamps will be expected to furnish all renewals and attendance. In addition to these items of expenditure, all exhibitors whose generators are operated from steam in the power station will be asked to pay, pro rata, the costs incident to the erection of the machinery. Belting from shafting to generators must also be furnished by exhibitors, and exhibitors of alternating systems will be asked to contribute to the expense of constructing the transformer vault.

The building will be equipped for 500 horse power for the operation of motors, 500 horse power for arc lights, 500 horse power for incandescents and a reserve of 500 horse power for extra incandescents, applications for most of which are already in.

FIG 7. A TRIP UNDER WATER IN AN ELECTRICALLY DRIVEN SUBMARINE BOAT.

In order that the plant for this building may not be a source of expense to the exposition management, a charge will be made for any special arc lighting desired by exhibitors who do not participate in the equipment and electrical supply of the building; also against the same class of exhibitors who desire power for motors or who require incandescent lamps. These charges do not concern any who contribute to the expenses cited above.

In order that the above proposed system may be reduced to a definable quantity, the following blank is submitted:

Do you desire to participate in the electrical equipment of the electrical building on terms in accord with the accompanying circular?

Is your exhibit designed to include generators operated under load?

If so, how many, what capacity, what minimum steam power required, nature of current and character of work intended to be done? (Motors, incandescent or arc lighting.)

What floor space will generators and adjuncts occupy? (Send scale drawing and confine as much as possible.)

How many arc lamps will you exhibit?

How many incandescent lamps will you exhibit?

How many motors will you operate, of what [illegible] power for [illegible]

Do you desire to [illegible] the general [illegible] of [illegible] incandescent lighting? If not [illegible]

Do you desire to [illegible] the power [illegible] of [illegible] motors? If so, for what [illegible]

I am extremely [illegible] into the equipment of the [illegible] other posts, brackets, wire, etc. [illegible] operation, with date [illegible] to [illegible] The department [illegible] in service, and rates [illegible] nounced.

Exhibitors will, of course, remove [illegible] of the exposition.

Those exhibitors who do not [illegible] heating and power schemes, but [illegible] for motors, or who will require [illegible] addition to the general [illegible] cent lamps, will please state [illegible] details of their requirement.

Electric Tramway at the Chicago Stock Yards.

Armour & Co., Chicago, have just contracted with F B. Badt, manager of the western power and mining department of the Thomson-Houston Electric company, for an electric elevated tramway at the Union Stock Yards Chicago. This plant will be unique in that it will be the only electric elevated tramway in the United States.

One of the multipolar 135 horse power 500 volt generators will be erected to furnish the power for the electric locomotives. The plant is to be in operation within sixty days, and will probably form the nucleus of a large system of electric tramways at the Union Stock Yards.

California Water Power Project.

A large water utilization scheme will probably be put into operation on the American River, near Folsom, Cal., next year. At this point there is a fall of eighty-two feet in a short distance, and from this the Folsom Water Power company, by an elaborate system of dams and canals, now building, expects to obtain over 5,000 horse power. Much of this will be transmitted to the city of Sacramento by electricity, where it will be sold by the Sacramento Light & Power company for lighting, street car propulsion and manufacturing.

Lightning's Merry Pranks.

The lightning during the storm of Sunday night selected the water works building for a target, says the Chillicothe, Ill., *Bulletin* of May 6th. It struck the big smokestack, knocking the northeast corner of the coping off and cracking the stack down to the roof, it passed through the roof, leaving an opening about eight inches longer, then passed off down the conductor pipe. There were three large iron pokers, seven feet long, hanging on the wall that were so impregnated with the electric fluid that they started out on a grand old round through the boiler room. Isaiah Merritt quietly vacated the premises, and gave the merry pokers full sway. Ed. Lucas says the shock raised him two feet out of bed, but judging from the war-whoop that Ed. gave utterance, the electric current must have switched the way of his bare feet. No serious damage was done, excepting the smokestack, and that will be hard to estimate until a thorough examination is made.

FIG 9 A TRIP UNDER WATER IN AN ELECTRICALLY DRIVEN SUBMARINE BOAT.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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A LOS ANGELES, Cal, paper furnishes the information that "electricians are now considering the feasibility of transmitting electric power through ordinary manilla or hemp ropes."

Rope transmission of electricity is indeed a wonderful thing. It is to be hoped though, that the news of this application of ropes will not be noised upon 'Change, else what might be its effect upon the copper market!

THE general meeting of the American Institute of Electrical Engineers at Chicago next week will mark an important epoch in the history of that organization. The meeting will be attended by the most prominent scientists in the American electrical world to day, and promises to be of unusual interest. It is hardly necessary to say that Chicago will welcome its distinguished visitors and extend to them the hospitality for which the city and its people have been noted.

THE department of electricity and the bureau of construction of the World's Fair have agreed upon a plan of lighting the electrical building, as outlined in the circular presented on another page. The idea is to have the work done entirely by exhibitors, without expense to the Exposition company. Those exhibitors requiring lights and who do not participate in the operating plant will be charged at about the same rate paid by exhibitors in other buildings. The money thus obtained will be used to defray the cost of fuel for the steam plant and the expense of installing the engines. The plan appears to be a feasible one, and it is to be hoped that Chief Barrett's circular will meet with a prompt and generous response from intending exhibitors.

THE telephone has already proved a valuable factor in the work of life-saving crews, and now it is proposed to extend the scope of its operations in this country under government patronage.

The House of Representatives has passed a bill authorizing the construction of a telephone line on the coast of Virginia, from Cape Charles to Assateague Island, in aid of the preservation of life and property. The bill directs the secretary of the treasury to establish this line in order to provide communication between the life-saving stations upon that coast, connecting the lines with some locality that telegraphic communication may be had with the principal seaports of the Atlantic coast. The bill appropriates $15,000 for carrying out its provisions. There have been, since August 26th last, seventeen marine disasters on the coast referred to, and during the months of January and February five steamships were wrecked upon that coast. The measure was asked for by the boards of trade of New York, Boston, Philadelphia and Baltimore.

RAILROAD men are watching the development of the electric motor and its application to the requirements of freight and passenger traffic. The action of the Belt Railroad company of Baltimore in equipping its tunnel line with electric motors is one of the most advanced steps that has yet been recorded. The operation of heavy trains seems to be the problem which is engaging the engineers at the present time. It is reported that the engineers of the Wisconsin Central, the Illinois Central, the Pennsylvania and the Boston and Maine roads are making exhaustive investigations of electric systems with a view of recommending the adoption of the one best suited to the heavy work which will be required of it. Prof. Henry A. Rowland and Dr. Louis A. Duncan are quoted as saying that, upon a carefully constructed road, electric cars could attain with safety speeds which would not be possible with steam cars, the limit of safety being placed by them at 120 miles an hour. The practicability of using electricity for moving heavy freight trains will soon be satisfactorily demonstrated by the 22 ton electric locomotive which is being constructed at Whittinsville, Mass., and which is intended to haul six or eight freight cars of an aggregate capacity of 300 tons.

THE laying of the new Atlantic cable by the South American Cable company, an English corporation, has directed attention to the fact that Americans do not seem to fully realize the necessity of direct cable communication with the South American countries. Many prominent men have endeavored to impress upon Congress the importance of a project of this nature, but without success. Secretary Blaine, who has for several years been an earnest advocate of such a line and is even now negotiating with the Brazilian government for the establishment of an American enterprise, brought the project before the Senate committee on commerce last month, when he delivered an argument against giving the French-Brazilian Telegraph company the privilege of landing a cable on our southern seaboard. He assured the committee that the American project would be under way within a year if Congress refrained from legislation adverse to it, and that it would be executed by American capital and enterprise. The establishment of such a line would assuredly be advantageous to American trade with Brazil and other South American countries. There should be a direct cable line between this country and Brazil, and it should be controlled by Americans.

THE old scare that the current carried over street railway trolley wires might be dangerous to human life because it has occasionally caused the death of a horse was revived by a recent accident in Newark, N. J. There appears to be one sensible paper in that city, however, the *Times*, and in commenting on the incident it says:

A great many things which are not true can be established by expert testimony, but the plain, homely facts are much more satisfactory. There was never yet an authentic report of a human life being lost by contact with an electric street car current. The unfortunate accident last Sunday proves that the current, though fatal to a horse, was not dangerous to a man. The driver, probably, had as much of it as the horse did, and was terrified. There have been numerous cases where death resulted to animals, but horses, of all animals, are especially susceptible. They are more nervous, high strung, than mankind, and in tests have succumbed to a shock of 250 volts, while it has been debated whether 1,000 was necessarily fatal to a human being. Some persons certainly have taken much stronger currents without ill effects.

This is all quite true and the statement has been reiterated many times. The simple facts of the case appear to make little impression, however, on those who are blindly prejudiced against the trolley system. They will probably continue to ring the changes on the "deadly trolley wires" until their tribe becomes extinct. Meanwhile the system causing all the outcry is steadily and marvelously enlarging the field of its operations.

THERE has been a great deal of talk of late relative to a submarine boat that has been building at Detroit. Garbled descriptions of this vessel have appeared in a number of daily papers, as have, also, some very sensational and amusing accounts of its operation. Inasmuch as these descriptions, realistic though they were, originated in the fertile imagination of the correspondents, it is not at all surprising that they were inaccurate. For instance, the *New York Herald's* Detroit correspondent in a "special" dispatch dated April 9th complacently described his trip under water in this boat. The story of the reporter's alleged adventures and peculiar sensations while submerged in the Detroit river, was highly entertaining; but one marvels at his duplicity when it is considered that the correspondent did not make the trip at all and must, therefore, have been indulging in flights of fancy. Other correspondents have given out erroneous ideas as to the tests. Both classes have in a way been unjust to the designer, in that the extravagant claims of the first and the mistakes of the other might combine to make the public look upon the project as a "fake" enterprise—a conclusion wholly unjustifiable by the attitude of the builder of the boat.

The experiments and the results of Mr. Baker's work in this line cannot fail to interest electrical engineers. In this issue an accurate description of the boat and its operations is presented, together with illustrations showing the special features of the craft and views describing the first trip of the boat when it was left entirely to its own resources. This account, it is hoped, will place the readers of the WESTERN ELECTRICIAN in a position to see for themselves that a great problem has been attacked in a manner that entitles the builder of the novel craft to every encouragement.

POPULAR interest in the subject of rapid transit in cities is manifested by the attention directed by business men and capitalists, as well as engineers, to the discussion of this topic. Thomas Curtiss Clark, in an article in *Scribner's* for June, calls attention to the "hap-hazard sort of way," as he terms it, in which the street railway systems of the large cities of the country have grown up. The fact that the legislatures have, in a measure at least, controlled the situation and dealt out franchises, oftentimes in return for political favors, explains the present condition, according to Mr. Clark. He says that the effect of this policy has been to place "the ownership and control of street lines in the hands of persons eminent rather as politicians than as capitalists." A change, however, has been worked—a veritable revolution—in the commercial aspect of the case. This is due largely to the introduction of the electric systems. "Street railway shares," says Mr. Clark, "are now sought eagerly by investors, are quoted in the money markets of the world, and have attracted the attention of the most conservative bankers."

Some figures are presented in this article which show that these claims are not based solely on the writer's enthusiasm. Thus it is pointed out that, owing to the substitution of electricity on many lines formerly operated by animals, the number of horses used on street railways has diminished during the last year 26,181. After calling attention to the advantages cities reap through the rapid transit facilities afforded by street railways—surface, elevated and underground—Mr. Clark says: "The community, however, should not only be just, but generous in its dealings with the companies, and share with them the burden of rapid transit by furnishing the place to put the lines, either on the surface, or above, or below ground. That is to say, the city should condemn the damages caused by any of these forms of rapid transit, pay the abutting property owners before they are built, and charge the companies a rental for the same, based upon the rate at which the city can borrow money."

Electricity on the Farm.

By A. F. McKissick.

The recent application of the electric motor to ginning and pressing cotton, cutting up feed stuff, threshing grain, and other farming operations where mechanical power is called into play, is another of the many instances where power transmitted by electricity furnished from a central station has proved more convenient, more economical and safer than power furnished by a steam engine.

The location of the first plant of this kind is on the farm of the experimental station of the State Agricultural and Mechanical College of Alabama, at Auburn, Ala. The station is about three-quarters of a mile from the college, and is in every respect a typical southern farm. One of the necessities on a large farm like this is some source of mechanical power for performing the various operations such as ginning and pressing cotton, cutting up feed stuff and threshing grain. This power has heretofore been supplied by a 15 horse power engine and boiler, but it was decided to supplant this by the electric motor, which is furnished with current from a generator in the dynamo room of the college. This generator is a 12 kilowatt compound wound Edison machine of 125 volts, and is run by a 35 horse power Westinghouse Junior engine, furnished with steam from the steam plant which supplies the mechanical and electrical laboratories. The motor is a Thomson-Houston shunt wound 110 volt, 10 horse power machine. Owing to circumstances, the dynamo that furnishes the college building with lights had to be used as a generator, and the low voltage necessitated a greater loss than would otherwise have occurred. This defect it is proposed to remedy this summer by the installation of a 500 volt system. The generator and motor plants were installed, the poles put up, and the wires strung by the students in the electrical engineering department. A No. 0000 B. & S. wire is used for the main line, a number 6 grounded at each end and at intervals completing the return.

The motor, shown in Fig. 1, is belted to a countershaft, and from this belts run to the feed cutter, gin, screw press cotton seed crusher and thresher. The Edison generator

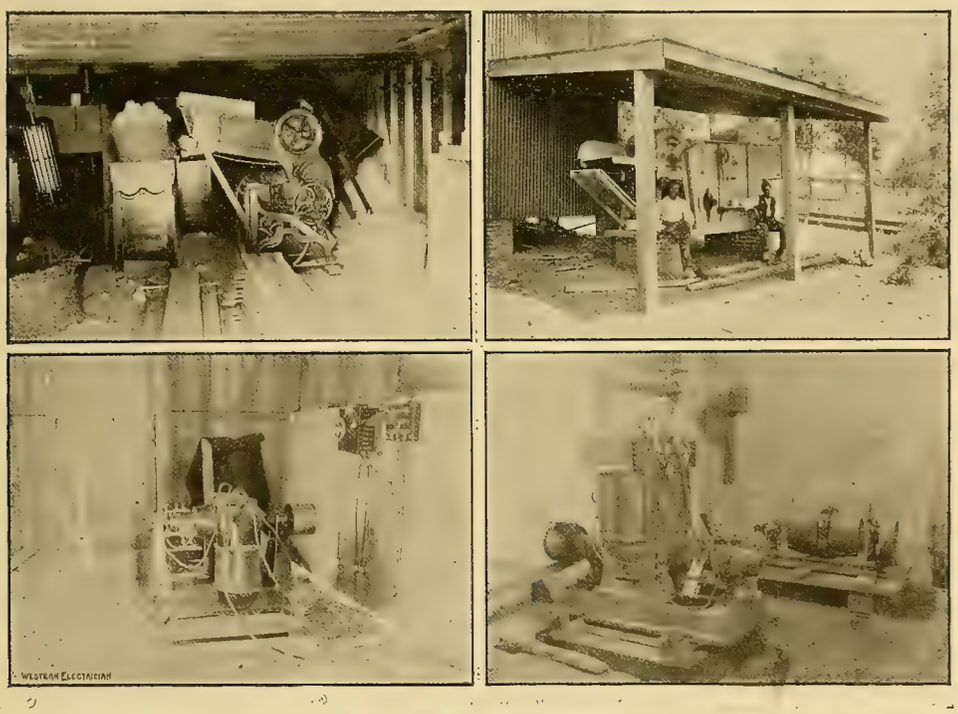


FIG. 1. ELECTRICITY ON THE FARM.

is also shown. The Brush arc dynamo in the rear is used for lighting up the campus. The feed cutter is used for grinding up oats, ears of corn, shelled corn, peas and all kinds of grain. The screw press is seen in the rear of the feed cutter. In the same room is located the cotton seed crusher. The gin and thresher are run also from the same countershaft. The silo cutter is used for preparing silo. The machine on the left is a corn sheller and separator. Fig. 2 shows a view of the line, the college appearing in the distance.

The steam plant is in operation the greater part of the day, so there is no delay in starting the motor at any time.

The advantages of this plant over the superseded one are its safety from danger to life and property, its safety from damage by fires, its convenience, economy, neatness and the advantages necessarily accompanying the centralization of small units into one large plant.

The installation is running successfully and has proven its adaptability to this class of work.

Duties of Telephone Companies.

An interesting case recently arose in the United States Circuit Court of Appeals at Philadelphia, involving the duties of telephone companies to the public. The Delaware & Atlantic Telegraph & Telephone company owned a telephone exchange in the city of Wilmington. One of its subscribers was the Western Union Telegraph company, for which the telephone company transmitted messages. The Postal Telegraph-Cable company desired similar facilities, but was refused, and brought an action to test the right of the telephone company to discriminate against it. The court holds that the telephone company is a common

FIG 2. ELECTRICITY ON THE FARM.

carrier of messages, and that while it might perhaps refuse to serve any customers except private individuals, it cannot favor one telegraph company and deny another.

The telephone company asserted, among other reasons, that as its instruments were patented, it had a monopoly of their use, and was not therefore required to let any, except such as it chose, have the benefit of them. But the court refused to admit this distinction. A patent, said Judge Butler, secures title to the thing patented and its use, and the owner need not employ it in the public service; but if he does so he will have to submit to all the rules against discrimination which apply to railroads, telegraphs and other public agencies.

In this particular case the telephone company was hampered by certain agreements with the Western Union by which the latter company, in consideration of having resigned some claims to a conflicting patent, had been granted the exclusive use of the same while operated by the telephone company. The court does not enter into the merits of these agreements, but says that if the telephone company imposed any such restrictions upon itself they were void as regards the public, no matter what the rights of the Western Union might be in the premises. A telephone company cannot, by rendering itself liable to one party, escape its duties to another.

It is proposed to establish the office of electrical wire inspector, in conjunction with the fire department, at Cleveland, O.

Cerebral Radiation.[1]

By Prof. Edwin J. Houston.

I have thought it possible that it might interest you to consider some rather wild speculations in which I have indulged for a number of years past, but which I have heretofore refrained from publishing. In these speculations, to which I was first led by a suggestion from a friend, I have endeavored to correlate, to some extent, the phenomena of thought with grosser physical phenomena. Although the suggestions I have to offer as a basis for a hypothesis of the mechanism of cerebration are confessedly incomplete, and perhaps improbable, yet I have concluded to place them on record as of possible interest to the scientific world.

I am, of course, aware of the fact that the psychical operations of the brain are by no means understood. It is generally believed, however, that the seat of psychical activity is the cerebrum. The manner in which the brain acts to produce, record, and reproduce thought is unknown, and will probably remain unknown.

On the single assumption, however, that cerebration or thought, whatever may be its exact mechanism, is accompanied by molecular or atomic vibrations of the gray or other matter of that part of the brain called the cerebrum, I would propose the following hypothesis to account for telepathy, mesmerism, thought transference, hypnotism and other cognate phenomena.

Postulating the existence of the universal or luminiferous ether, which is now generally accepted in scientific circles, and bearing in mind the fact that this ether passes through even the densest matter, as easily as water through a sieve, it follows that the brain atoms or molecules that are here assumed as the cause of cerebration are completely surrounded by the ether. Now, since the ether is a highly elastic, easily movable medium, it would follow that thought or cerebration, if attended by vibrations, must necessarily develop in the ether wave motions, which have the brain atoms or molecules for their centers. In other words, the act of thought or cerebration necessitates an expenditure of energy, because it necessitates the setting in motion of these assumed atomic or molecular brain particles.

The exact nature of the motions that are assumed to attend an active condition of the brain must necessarily remain unknown as long as we are ignorant of the exact nature of the mechanism that is moved. But, if an active brain evolves thought because something is set in motion, it, of course, follows that a brain absolutely free from producing thought must be at rest so far as that kind of motion is concerned. An absolute freedom from thought in a healthy brain is most probably a condition that seldom exists; relative rest, however, must be quite common.

That the brain cells of the gray or other matter involved in the production of thought can be caused to assume certain groupings or relations toward one another would appear to follow from the ease with which that curious function of the brain called memory permits it to readily recall past peculiarities in the to-and-fro motions. By continually repeating certain trains of thought, as in study or repeated observations, the peculiar motions required to produce such thought are probably given a set or tendency to form more or less permanent groupings. When, therefore, the brain is moved or played upon, so to speak, these motions recur and certain memories are awakened.

How may these motions be produced? The answer would certainly appear to be both from within and without. It is, perhaps, possible that the flow of blood to an active brain, which as is well known attends all active cerebration, is not only for the purpose of nourishing and rebuilding the organ, but also for affording the purely mechanical force that needs but to touch this marvelously attuned organ to awaken the thoughts already impressed thereon, or to sit in judgment on new combinations never before presented to it.

I will suggest an explanation later on as to how these impressions may possibly be excited from without.

Whatever be the origin of these vibrations, or, however excited, energy is required to be expended in producing them, and, as the brain-worker will readily acknowledge, the expenditure of such energy often calls for an enormous expenditure of nervous force.

Cerebral energy, or energy thus expended in producing thought, is dissipated by imparting wave motions to the surrounding ether, and such waves are sent out in all directions from the brain, possibly in greater amount, or of greater amplitude from some of the brain openings, as, for example, those of the eyes.

Although there are no absolute proofs of the existence of the molecular or atomic vibrations of the brain particles which I have assumed, such a movement, however, is far from being improbable, and, indeed, some facts known to the medical profession are far from being at variance with such an assumption. A certain amount of pressure on the brain arising from the pressure of the blood is necessary for its proper action. If this pressure increases beyond a certain value, as, for example, in cases of fractures of the skull, where a portion of the bone is depressed by the fracture, thereby producing a compression on the brain material, all thought or cerebration instantly ceases; but when this pressure is relieved by the act of trephining, cerebration not only begins, but, curiously enough, generally goes on from the point where the patient left off, when the injury occurred.

Let us assume, then, that cerebral radiations or waves are given off from every sentient or active brain, and that these waves pass into the space around the brain something like the waves that are imparted to the air around a sounding tuning fork.

The cerebral radiations are not so gross as those of sound. Their wave lengths are almost certainly much shorter. They are imparted to the universal ether.

If such waves, which I would call thought waves or

1. Read before the Electrical Section, Franklin Institute, March 1, 1892.

cerebral waves, be present in ether that fills all space, it will be interesting to inquire what phenomena they might be expected to produce.

It being assumed that these vibrations take place in the ether itself, there need be no doubt or speculation as to the general nature of the waves themselves. They would presumably partake either of the nature of transverse or torsional vibrations.

The commonest character of the vibrations which occur in the universal ether are the vibrations which are now generally recognized as transmitting the phenomena of heat, light, electric or magnetic radiations, viz., of transverse or torsional vibrations.

An active brain may, therefore, be regarded as moulding the ether around it into thought waves, that are spreading outward from it in all directions. In this respect it is not unlike a conductor through which an oscillatory discharge is passing, producing those waves which Hertz has so beautifully demonstrated as resembling the vibrations that produce light.

Assume, then, that the cerebral radiations partake of the nature of thermal, luminous, electric or magnetic radiations, and the following explanation of telepathy, or thought transference, is, to say the least, not improbable.

I would explain the possibility of the transference of specific cerebral vibrations from an active brain to a passive or receptive brain by the simple action of what is known in science as sympathetic vibrations.

Take the case, for example, of a vibrating tuning fork that is sending off its waves across the space which separates it from a second tuning fork not as yet in motion, but tuned so as to be able to vibrate in exact unison with it. As is well known, the exact correspondence between the period of the active or the transmitting fork and the passive or the receptive fork, is such that the vibrations of one fork are gradually taken up by the other fork, so that the energy of the motion of the one is transferred or carried across the space existing between them, by means of pulses or waves, set up in the air which surrounds them.

As is well known, such sympathetically excited vibrations can be produced in a fork situated at a considerable distance from the exciting fork.

Or, similarly, take the case of the sympathetic vibrations excited by waves of light. Solar energy is radiated or transferred across the space existing between the sun and the earth by waves or oscillations in the luminiferous ether. These waves, falling on the delicate structure of a leaf, suffer a species of selective absorption, certain wavelengths being absorbed and others thrown off. The absorbed waves excite or produce sympathetic vibrations in the molecules of carbon dioxide present in the leaf, and cause the atoms of carbon and oxygen in such molecules to move towards and from one another in interatomic vibrations, which increase in amplitude or violence until their chemical affinity or atomic attraction is overcome and dissociation occurs. The oxygen is then thrown from the leaf into the air, and the carbon is retained in the structure of the plant.

Or, take the still more interesting case of what Hertz calls electric resonance. As already mentioned, it is now generally recognized by electricians that a conductor, which is the seat of an oscillatory electric discharge, is sending into the space around it electric waves or oscillations which travel with the velocity of light, and which are in fact of exactly the same nature as light itself. If these electric waves meet a circuit so tuned as regards the period of oscillation of the circuit in which they originally occurred, as to be in consonance with them, electric oscillations will be set up in this circuit, of exactly the same nature as those exciting it.

In view of these facts it does not seem improbable to me that a brain engaged in intense thought should act as a center of cerebral radiations, nor that these radiations proceeding outward in all directions from such a brain should affect other brains on which they fall, provided, of course, that such brains are tuned to vibrate in unison with them. In such cases the absorption of energy by the recipient brain may be either a species of selective absorption, in which its train of thought is only modified, or it may be absolute, in which case the recipent brain has excited in it an exact reproduction of the thoughts of the exciting brain.

Such a hypothesis is far from improbable; on the contrary, it would appear to be carried out by a variety of curious circumstances, which have only wanted some general hypothesis to properly correlate them.

If such a hypothesis be true, then these cerebreal vibrations or radiations must travel through space with exactly the velocity of light. This is of course on the assumption that the vibrating or oscillating brain molecules or atoms set up vibrations similar to those of light. Of course, this equality between the velocity of cerebral wave propagation and that of light is true only for free ether. In the ether which fills the interatomic of intermolecular spaces of gross matter, or, as it is technically called, combined ether, the velocity of wave propagation varies according to the particular character of the matter with which it is associated. A retardation or decrease in the velocity of the assumed cerebral waves would doubtless be experienced while passing through the materials of the skull and head.

If thought travels along waves in the ether similar to waves of light, it would be able to travel along any path by which rays of light can pass. It can therefore travel along rays of light, *i. e.*, along paths in the ether through which rays of light are moving.

There is a well-known experiment in hypnotism, in which the patient, placed in a state of semi or complete unconsciousness, has his brain called into a more or less active condition by the suggestions of the hypnotizer, which might seem to somewhat favor the hypothesis of cerebral radiation.

It might be interesting, in view of the above suggestions, to see whether a hypnotizer, placed in such a position as regards the hypnotized that flashes of light falling on his eyes shall afterward fall on the eyes of the patient, to observe whether or not acts of suggestion are more readily perceived by the brain of the hypnotized along such rays of light than without the aid of such rays.

If the preceding speculation be regarded as wild, and that this is true I have already granted, what may not be said as to the following.

If thought radiations partake of the nature of ether-waves, then there should presumably exist in the thought radiations of waves, phenomena corresponding to the various phenomena of thermal, luminous, electric or magnetic radiation; even the phenomena of reflection, refraction and possible even of dispersion of such waves, would appear to be a possibility. In this connection, it is of interest to imagine the analysis or separation of a complex wave of thought into its component or elementary waves, corresponding to the seperation of a beam of light, by means of a prism.

In this connection, there would be a new significance, in the phrases, "radiant with thought" or, "to concentrate one's thoughts on a subject."

If thought radiation or waves partake of the nature of light, then it would seem among the remote possibilities of science to obtain, say by means of a lens a photographic impression or such thought-waves on a suitably sensitized plate, somewhat after the manner of the ordinary photographic picture. Such a thought record, suitably employed, might be able to awaken at any subsequent time in the brain of a person submitting himself to its influences thoughts identical with those recorded.

Of course, I am aware of the improbability of such a record being obtained in the near future, and of the exceeding difficulties that would seem to stand in the way of ever obtaining it.

Until we know something more definite concerning the nature of these assumed cerebral vibrations and of their lengths, we must necessarily be seriously handicapped as how to best fix them permanently on a suitable record surface, and how afterward to cause such record surface to interpret its peculiarities to the brain. I merely throw it out as a possibility of what science may have in store for those who come after us. I would suggest in this connection that 100 years ago it would probably have been regarded as quite impossible that the telephone or phonograph could have been produced.

Such a thought record, however, if obtained, would not be an image of the thought itself, or of the particular groupings of the particles, whose to-and-fro movements attend or produce thought, any more then the tracings of the phonograph record form an image of the spoken words. They would merely represent the to-and-fro motions of the ether set in motion by the thought or cerebrations.

An eye looking at such an image would not be influenced thereby. If, however, ether waves similar to those recorded could be reproduced by causing light to pass through such photographic images of the to and-fro motions of thought waves, such waves might be caused to influence the brain and thereby awaken thoughts similar or identical to those recorded.

I have often amused myself by picturing a possible thought recording machine, whereby the thoughts of an active brain might be continously and permanently recorded on a moving sensitized film, the exposed surface of which was placed at the focus of a large lens placed in front of any one engaged in intense thought.

If, like the cylinder or plate of a phonograph or gramophone, such a record were afterward rotated at the same speed as that at which it received its impressions, under circumstances in which light passing through it is moulded into waves similar to those recorded on it, such waves when caused to act on a receptive brain, should, it would certainly seem, excite therein thoughts identical to those recorded as its record surface.

Of course, it is needless for me to say that such a machine has never been actually constructed and is still as unsubstantial as are the speculations which I have offered you. Indeed the probabilities against its being produced are so great that I have hesitated even to mention it,

Some experiments might be tried in a similar manner in thought transference, by holding large lenses in front of the eyes of a hypnotizer at such a distance as to converge the assumed cerebral radiations on the eyes of the hypnotized. These experiments might be tried either along with light, or independent of it.

I know that many points of the hypothesis which I have suggested are quite improbable, and that I may and probably will be misunderstood by some as putting forward facts rather than a bare hypothesis.

Probably one of the most serious objections to the hypothesis is to be found in the fact that the phenomena of telepathy and thought transference are not of more frequent occurrence. This I must frankly acknowledge to be a most serious objection. I would suggest, however, that the comparative infrequency of the phenomena may possibly be explained by the presence in the human body of a shield which protects the brain or the nerve centres from the effects of cerebral radiations. It is not impossible that the sheathes of the nerves act as screens to prevent the reception by the brain of these thought radiations.

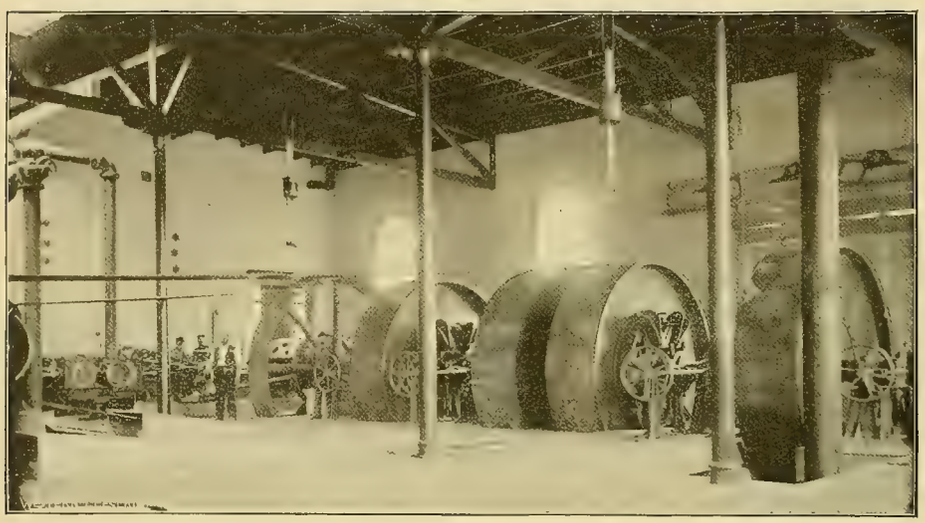
Prof. Tyndall, in his work on sound, alludes to the well known fact that when sympathetic vibrations are be-being excited by a sounding tuning fork in any body near it, that there is a greater rapidity of expenditure of energy of the fork's motion than when it was not exciting such waves. The analogue of this phenomena exists, perhaps, in the case of the assumed thought transference. Mental energy is presumably expended at a greater rate when it is exciting thought waves in this manner, than when such are not being excited.

There has often been experienced by me as a teacher a feeling of great exhaustion in taking charge of or watching a room in which a number of bright students were undergoing an examination. It is possible that the cause of this exhaustion is the rapid dissipation of energy by the cerebral radiations being absorbed by the receptive brains of the examinees. I am informed by certain physicians that a feeling of great exhaustion is experienced by them in the treatment of some cases.

If there be any truth in the hypothesis I have briefly outlined, there should be what I would term a kind of vital radiation going on and passing outward from the body of a healthy person, which may not improbably excite by sympathetic vibrations in the bodies of weaker persons around them, vibrations of a normal or more healthy type than those present in the sick person.

If this be true, the old belief of the efficacy of the laying on of hands, or of magnetic healing, may find some foundation in fact, apart from what is most probably the general explanation of such causes, viz., hysteria.

I have thrown out the above hypothesis of cerebral radiations with considerable doubt and hesitation as a suggestion only to those working in the field of telepathy or thought transference, in the hope that I may thereby call the attention of such investigators to some phenomena in this very obscure field of research.



GIANT CLUTCHES AT COLUMBUS.

Giant Clutches at Columbus.

At the power plant of the Consolidated road in Columbus, O., may be seen a very interesting arrangement of large clutches, which was built and installed by the Falls Rivet & Machine company, of Cuyahoga Falls, O. Four friction clutch pulleys, each twelve feet in diameter, with a 38 inch face, are carried on a single steel shaft 36 feet 6 inches long and 9½ in inches diameter. The clutches were built to drive 500 horse power, but tests have shown that they can transmit over 700 horse power each, on a single pulley at 120 revolutions, which was as great a surprise to the railway company as it was satisfactory to the builders. The pulleys are made of wood, with a steel rim on the outside, which makes them very desireable for large pulleys, being so much lighter than iron.

This line of shafting which is shown in the accompanying illustration is driven by two Buckeye engines of 1,000 horse power each, connected by clutches at each end of the line shaft. This arrangement of one engine at one end and another engine at the other end with a clutch from each engine, permits of either engine driving any generator, or when required, the second engine can be connected to service without reducing the speed of the

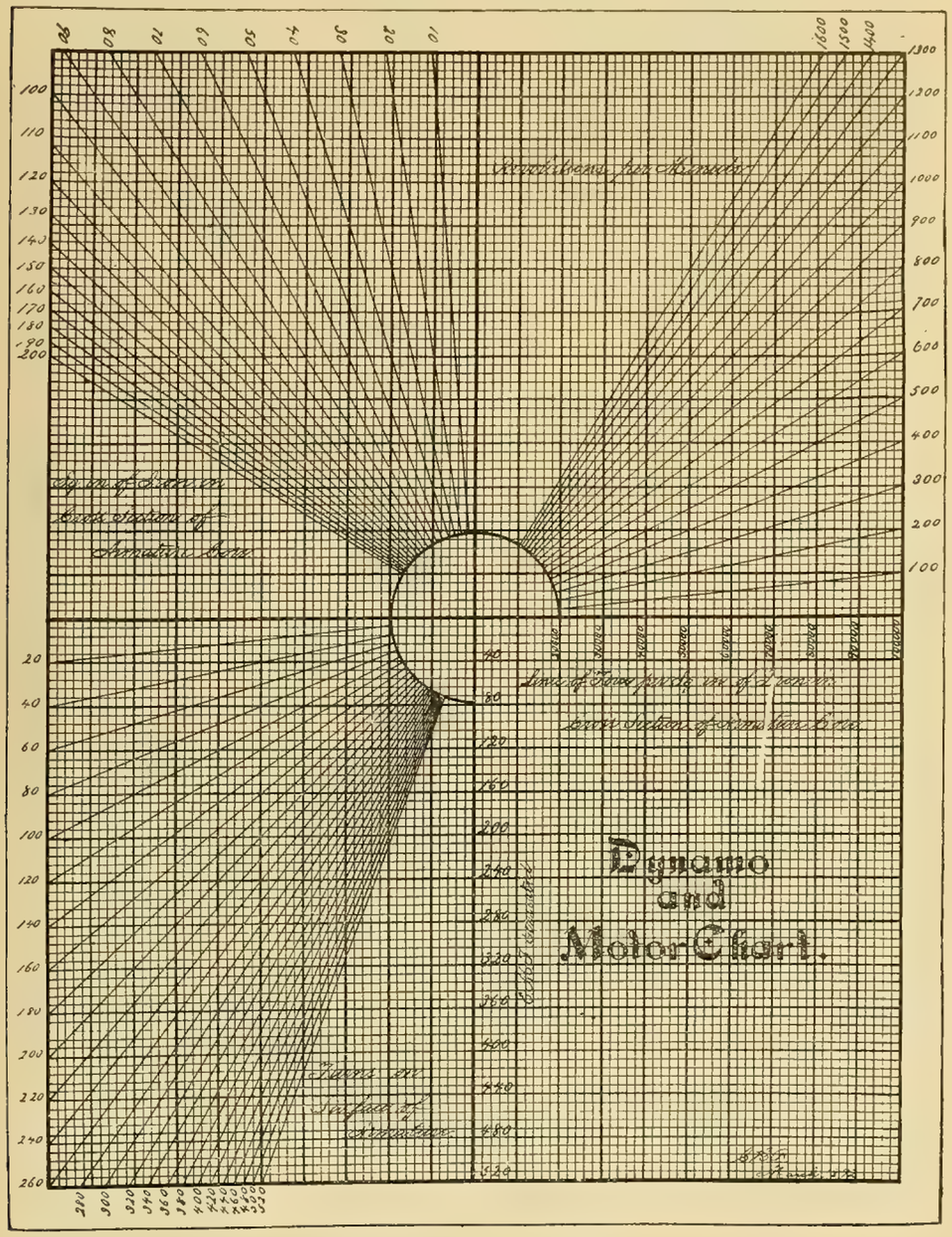
working engine in order to do so. The building was constructed before the contract for the machinery was placed, thus preventing the addition of a friction cut-off coupling in the center of the shaft, so that one half of the plant, including shafting and two pulleys as well as one engine, could stand idle if desired.

The Columbus company is highly pleased with the arrangement and working of the machinery.

Dynamo and Motor Calculation.[1]

By C. H. Bedell.

In the calculation of the different parts of a dynamo or motor, the work is of course divided into the calculation of the armature, and that of the field; but as the capacity and smooth operation depend principally upon the construction of the armature, it should be worked out first. This work is best divided into two parts; and since the dynamo is primarily a generator of electromotive force, the first consists of the calculation of those parts which effect the generation of the electromotive force, and the second consists of proportioning the parts, so that they will stand the currents which may be allowed to flow.



DYNAMO AND MOTOR CALCULATION.

The part of the work which I wish now to consider, is that of the generation of the electromotive force.

In order to calculate with certainty, one must know to what extent the proposed field will saturate the core of the armature, since the electromotive force is generated by the wires of the armature cutting the lines of force which the field causes to pass through the armature core.

One definition of a unit of electromotive force, is that electrical motor force generated by a conductor cutting one line of force once a second. Broadly the electromotive force generated = lines of force cut × number of times they are cut per second. The electromotive force is consequently proportional to the number of lines of force cut, and also the rate at which they are cut.

The rate at which the lines of force are cut is easily obtained for the total number of conductors on the surface of the armature T, multiplied by the revolutions per second R, gives the number of conductors which cut the lines of force in a second, or at the rate per second.

The number of lines of force cut, is obtained by multiplying the number of square inches of iron in the cross-section of the armature coil C, by the number of lines of force which is known will produce the desired degree of saturation L. Knowing the rate of cutting, and the number of lines of force, we have then the electromotive force (in absolute units) $= T \times R \times C \times L$,

or, $E.M.F. = \frac{T \times R \times C \times L}{10^8}$ volts.

This equation has only one factor about which there can be any uncertainty, which is the factor L; but as a very slight acquaintance with the form of dynamo to be constructed, or a careful calculation of the magnetic circuit will give the possible degree of saturation, there can be said to be very little uncertainity even in this factor.

The most satisfactory degree of saturation of the armature core, is with 90,000 to 100,000 lines of force per square inch of iron in the cross-sections of the armature core, which can be obtained with the usual percentage of watts used in the field.

The annexed chart will greatly facilitate this calculation. It is of the same general plan as Carl Hering's wiring charts published in his "Wiring Computer," and is used in the same manner. The interpolations for values between the diagonal lines are different in this chart, as the readings in the upper left-hand field should be along a horizontal line, and those in the upper right-hand, and in the lower left-hand field, should be along vertical lines.

It will be noticed that although the chart covers all the usual sizes of generators, yet calculations can be made with it far beyond its limits, as the different factors are so related to each other that where one is changed another can be changed proportionately, except in the case of lines of force per square inch. In the case of lines of force per square inch values cannot be obtained higher than 100,000 lines per square inch with economy, on account of the iron being saturated at about that point.

If higher values of electromotive force are desired than those given, the figures in the scale of electromotive force can be doubled, provided any one of the others, except the lines of force per square inch, is doubled also.

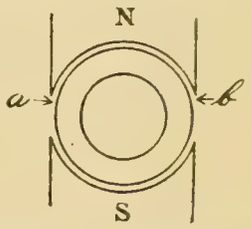
Or if very low values of electromotive force are desired, the scale of electromotive force can be divided by any factor, provided any one of the other scales be divided by the same factor.

As an illustration of the use of the chart, let us suppose we have a dynamo having 200 times on the surface of the armature sixty square inches of iron in the cross-section of the armature core, and we desire to know at what speed it will be necessary to run the armature to generate 200 volts. Starting at the 200 point in the column marked "E. M. F. generated," follow the line to the left until it intersects the line representing 200 turns; then follow the vertical line from that point until it intersects the line representing sixty square inches cross-section; then follow the line to the right until it intersects the line representing the probable degree of saturation, which in this case we will say is 100,000 lines of force per square inch. The speed line which also crosses at this point is the speed required, and is exactly 1,000 revolutions per minute. If only 90,000 lines of force per square inch could be obtained, the speed required would then be a little over 1,100 revolutions per minute. It will be noticed that the form of the armature, amount of active wire, or volts per foot of active wire, do not enter into the calculation. In this method the number of lines of force which pass from any one pole into the armature core and the rate which the wires cut these lines of force, form the basis of calculation.

The maximum $P_1 D_1$ is between two points on the armature wire which just include all the lines of force which pass through the armature, to or from any one pole, as at a and b in the figure, if we are working with lines which pass from the north pole.

As far as the electromotive force generated between a and b is concerned, it makes no difference in a ring armature what becomes of the lines of force after they pass those points, or what the other wires on the surface of the armature are doing. In a two pole field the other portion of the armature wire, passing under the south pole, cuts the same lines of force, and consequently the same number, and since the rate of cutting them is the same, the electromotive force generated is exactly the same as that generated under the north pole. But as these two electro-motive forces are in opposite directions no current flows around the armature, although the points of greatest $P_1 D_1$ are joined together by the parts of the armature wire not under the poles.

Since what becomes of the lines of force after passing



DYNAMO AND MOTOR CALCULATION.

the points a and b of a ring armature, or what the armature wires not between a and b are doing, makes no difference to the electromotive force generated between a and b, the lines of force may be divided so as to pass from the armature into different poles, and the armature wires not between a and b may pass under any odd number of poles, and may generate under those poles different electro-motive forces from those under the pole first considered. It is usual, however, to so build the different portions of a multipolar field, that the electromotive forces generated under the poles is the same in amount, in order that all the terminals of the same potential may be joined together, thus connecting the different portions of the armature in parallel.

The methods of calculation given above, either by formula or chart, deal with the generation of the electromotive force under one pole only, and consequently can be used for any direct current dynamo having a ring armature, whether for bipolar or multipolar fields.

In the case of drum armatures the conditions are a little different, as the return portion of a wire under the north pole passes under the south pole and generates an electromotor force which is added to that generated under the north pole, increasing the electromotive force between a and b. But the adjoining wire does not give its electromotive force to a and b, but to corresponding points adjacent to the south pole. Consequently, it may be considered that the one wire offsets the other, and the same formula and the chart hold good for drum armatures also.

In cases of multipolar machines having the electromotive forces generated under like poles in series, the electro motive forces either of formula or chart, should be increased in proportion to the number of such poles.

The square inch of iron in the cross-section mentioned above, has reference to the iron in the cross-section through which the lines of force pass from any one pole.

The electromotive force generated may be that of a dynamo, or that of a moter in the form of a counter electromotive force. In each case allowance should be made for the loss in voltage due to the resistance of the armature, and also to whatever loss of electromotive force there may be due to the lead of the brushes.

A report gained circulation in Columbus, O, a few evenings since that a new and very brilliant electric light had been sent up in a balloon from Chicago. Several hundred people watched it in the western sky, and agreed that it was exceedingly grand and beautiful. They were looking at the planet Venus.

1.—Read before the Electrical Section, Franklin Institute, April 5, 1892.

Constant Shunt Method for the Measurement of Large Continuous Currents.[1]

By Clayton W. Pike.

The constant, Vienna or Munich shunt method, as it is variously termed, is something which is by no means novel, and is, indeed, well known to some of the section, having been used by them at the electric exhibition of the institute in 1884. But I believe that the method is not so well known, or at least not so much in use as it should be, and I hope, by calling attention to some of its advantages and by pointing out and showing how to avoid certain errors incident to it, one or two of which are not generally known, to do something toward bringing it into more general use.

For the measurement of continuous currents we have the various forms of ammeter, the Siemens dynamometer, the Thomson platform galvanometers, and the Thomson balances, the tangent sine and cosine galvanometers. With the objections to the ammeters all are doubtless familiar. They are inaccuracy of graduated scale, errors due to residual magnetism or to loss of permanent magnetism, and lack of wide range. The Thomson platform galvanometer does not measure large currents without the use of the permanent magnet, which is objectionable if considerable accuracy is desired, and it requires a knowledge of the horizontal component of the earth's magnetism H. The Thomson balance is an instrument of much greater value than the above, being independent of H, having greater range and greater precision, but being even more costly.

The tangent galvanometer requires the value of H, and has only a limited range, while the sine and cosine, though better in this last respect, are tedious to use on account of the time required in setting the coils.

The great advantage of the shunt method over all these is that, by the aid of fairly simple and cheap apparatus, currents varying from 1 to 1,000 amperes or more may be measured with quickness and a very great degree of accuracy over the whole range.

The shunt method is really a comparison method, and depends upon Ohm's law that the potential difference between two ends of a resistance is proportional to the current flowing through the resistance.

Let $A\ B$ be a conductor whose temperature is kept constant; its resistance will therefore be constant, but need not be known. Pass the current C_1 which we desire to measure, through $A\ B$; there will then be a potential difference $P\ D$ between A and B.

Let G be a mirror galvanometer with telescope and scale, then the deflection d is proportional to the current through it, which is proportional to $P\ D$, as long as resistance of galvanometer and leads is constant, $d_1 \propto P\ D_1$ or $d_1 \propto C_1$.

Pass any other current C_2 through $A\ B$ then $d_2 \propto C_2$ and

$$C_1 = \frac{d_1\ C_2}{d_2}.$$

If the resistance of the galvanometer and leads be not constant, the algebraical result is less simple and, moreover if the deflections become very large, they are not strictly proportional to the current through the galvanometer, which we will call $C\ g$. Hence the comparison of large with small currents will be somewhat inaccurate. This leads us to a little different method. Place a resistance box R in the galvanometer circuit. Pass current C_1 through $A\ B$, causing a potential difference $P\ D_1$, and sending through G a current

$$C_1\ g = \frac{P\ D_1}{R_1 + g}$$

where g is the galvanometer resistance.

Then

$$d_1 \propto C_1\ g \propto \frac{P\ D_1}{R_1 + g}$$

or

$$C_1 \propto d_1\ (R_1 + g)$$

in the same way

$$C_2 \propto d_2\ (R_2 + g)$$

then

$$\frac{C_1}{C_2} = \frac{d_1\ (R_1 + g)}{d_2\ (R_2 + g)}$$

or

$$C_1 = \frac{d_1\ (R_1 + g)}{d_2\ (R_2 + g)} C_2$$

Now, if when C_2 were flowing we had accurately measured it by a tangent galvanometer or by the electrolytic cell, the quantity

$$\frac{C_2}{d_2\ (R_2 + g)}$$

would be known. Call it K the constant of the shunt. Then we have the general formula for the shunt that the current whose value we desire is equal to

$$d\ (R_1 + g)\ K$$

Now, by using the resistance box, and by adjusting it to give about the same deflections on the galvanometer in different measurements, we have secured two important advantages.

1. We have done away with the error of assuming that the currents through the galvanometer were strictly proportional to its deflections.

2. The resistances R being large in value with reference to galvanometer and leads, and being of platinoid or some metal with very low temperature coefficient, any change in temperature of galvanometer and leads will produce little effect on the result.

Like all other methods this one is liable to certain errors, some of which I will mention and briefly suggest their remedies. The way in which they affect the result will also be stated.

1. *Reading of Deflection.*—Suppose you could read to within ·01 cm. on the scale. If the deflection were 10 cm. the error would be

$$\frac{\cdot 01}{10} = 1 \text{ part in } 1{,}000.$$

The error is evidently diminished as we increase the deflection.

2. *Error Due to Temperature Change of Galvanometer and Leads.*—If these are of copper their resistance would change four-tenths per cent. per degree centigrade. This correction could be applied, but if the resistance in R is large with respect to g, this correction will be negligible; 2° then conflicts with 1°, and we must compromise. Suppose $R_1 = 20\ g = 2$, and temperature rise = 10° C., then true value of

$$R_1 + g = 20 + 2 + 2 \times \frac{4}{100} \times 10 = 22\ 08$$

and the error in neglecting the

$$\cdot 08 = \frac{\cdot 08}{22} = 1 \text{ in } 275$$

3. *Error Due to Temperature Change of Box.*—This is ·02 per cent. per degree centigrade for platinoid coils, and may be corrected or neglected, according to the desired precision of our results.

4. *Error Due to Determining Constant K.*—The constant is best determined in most cases by electrolytic cells, say three in series. If one has a tangent galvanometer of proper range, 1 to 5 amperes, and knows H to the desired accuracy this may be used. A Thomson deci-ampere balance would be very convenient for subsequent determinations of the constant, if its readings were known to be correct within the desired degree of accuracy. An error of ·1 per cent. in K causes an equal error in the subsequent measurements.

5. *Error Due to a Rise in Temperature of the Shunt.*—This may be due to two causes, a rise in the temperature of the room or the heating effect of the current. Both may be obviated by placing the shunt in liquid artificially cooled by cold water coils, and keeping constant the reading of a thermometer placed in the liquid close to the shunt.

Suppose the rise in temperature were 5° C. If the shunt were of German silver the change in its resistence would be ·04 per cent. × 5 = ·2 per cent. or two parts in 1,000, and the results of the measurement would be in error by this amount. If of platinoid the error would be but half as much.

6. *Error Due to Change of Value of H.*—This would be possible if the galvanometer had the earth's field for a resting force. If great accuracy be desired, obtain the value of the constant frequently, and see if it changes. As I have before said, a Thomson balance would be most desirable for this, and many laboratories can afford one Thomson balance. Also, if we had a galvanometer whose damping could be removed, we could determine whether H had changed by its time of vibration. The sources of error so far mentioned are well understood and looked out for, but the following are, I believe, not so well known. At least the amount of the effect is not so generally appreciated, and they have, so far as I know, received exhaustive study only at the hands of W. L. Puffer of the Massachusetts Institute of Technology. His results are to be found in the "Proceedings of the American Academy of Arts and Sciences," January, 1888.

7. *Error Due to Thermo-electric Effects.*—We are obliged to make the resistance of our shunt very low to prevent undue heating, hence the potential differences set up at its terminals are very low. In this case any thermal electromotive forces, which might be caused by differences of temperature at the junctions of the different metals, would be liable to affect the readings of the galvanometer. This trouble may be obviated by so making the shunt as to put the junctions under the surface of liquid whose temperature is maintained constant, and may be detected by running the galvanometer leads to a mercury cup commutator and testing with reversals.

8. *Error Due to Electro-chemical Action.*—The shunt is placed in liquid, and under the action of the potential differences set up at its terminals there is electrolytic decomposition (if the liquid be one which can be decomposed as water). This will cause the end having the higher potential to be darkened, owing to oxidization of the German silver by the oxygen set free, while the other end will become whiter or cleaner in appearance, owing to the reduction of the film of oxide on its surface by electrolytic hydrogen. These actions will evidently set up electromotive forces, and if the shunt resistance is very low, will cause considerable error in the result. This source of error could be avoided by placing the shunt in some liquid incapable of decomposition with low electromotive forces. Chemically pure water would do, but for the trouble of obtaining and keeping it so. Petroleum oils would act slightly on the bare piece of metal composing the shunt, thus producing a battery effect. We must either immerse the bar in some liquid incapable of acting on it or cover the shunt very carefully with some substance not acted upon by the liquid in which it is placed. Everything considered it seems to me that very carefully covering the shunt with several coats of shellac and afterwards with copal varnish and immersing it in distilled water would be the most satisfactory method.

Design and Construction of Apparatus.

Suppose we desire to measure currents of from one to 1,000 amperes. This would require a set of five tangent galvanometers of different sizes, the three largest of which would be impracticable. The diameter of the largest would be about seventy-five feet. With the sine or cosine galvanometers or Siemens dynamometer we could do better in this respect, but they are still out of the question.

With the Thomson platform or balance we should need three different instruments, which are exceedingly costly. Moreover, none of these could be used near dynamos, and this means that we must lead the whole of the current we wish to measure perhaps a considerable distance, thus entailing expense for wire and perhaps leakage.

Suppose we make one shunt of resistance ·001 w. If of German silver 9 inches wide, $\frac{1}{100}$ inch thick, two strips 24 inches long joined in parallel, will be nearly the required dimensions. The object of making them so thin is to offer large surface to the water so that they may quickly dissipate the heat produced by the current. The rate of production of heat with the maximum current, 1,000 amperes, will be ·24 $C_2 R$ = ·24 × 1,000² × ·001 = 240 calories, or enough per second to heat 240 grammes of water 1° C. if none of the heat be dissipated. We must now provide a containing vessel large enough to hold so much water that it will not be unduly raised in temperature, and large enough to admit of placing in it coils of pipe which shall carry cooling water if this be found necessary with the larger currents.

The two German silver strips should be joined thus by massive cast copper blocks, to which they are carefully soldered. To make the junction doubly secure, thin strips of copper 9 x 1 x ¼ inch are screwed and soldered on over the German silver, as shown. The vertical projecting copper bars D and F are for connecting the shunt into the circuit where we wish to measure the current.

The arrangement so far described would collapse, owing to the thinness of the German silver. So it is necessary to hold the copper blocks apart at the top and bottom by some arrangement which shall be insulated from the shunt.

This can be done by screwing on to both top and bottom of the copper blocks a piece of board 24 x 4 x 1 inch, as shown in drawing. The board on top should be pierced with a large number of holes, as shown, in order to facilitate the circulation of water. The ends of the boards touching the blocks should be soaked thoroughly in melted paraffine and coated with shellac. The screw holes in the blocks should be fitted with paraffine, the screw heads countersunk in the wood, as shown, and melted paraffine poured over them. The whole arrangement should then be coated with shellac and copal varnish thoroughly.

The containing vessel may be of wood, paper or galvanized iron, about 32 x 14 x 13 inches. Such a vessel will contain, besides the shunt, about 85,000 grammes of water. Now, the number of heat units, small calories, developed in one second by 1,000 amperes flowing through ·001 w is in one second, as before stated, such as would heat 240 grammes of water 1° C. Hence it would take to heat 85,000 grammes 1° a time $\frac{85000}{240}$ seconds, or about six minutes, if there were no radiation. But it is probable that this heat produced will not be instantly communicated to the entire mass of water, hence, for the large current measurements it will be advisable to lead coils carrying cold water close to the German silver strips, both inside and outside, if we desire great accuracy in our measurements.

Galvanometer.—Any form of sensitive reflecting galvanometer which is deadbeat and wound with coils of low resistance may be used. If the instrument has the earth's field alone for a restoring force, as is generally the case, (neglecting torsion) it would be convenient to have the damping copper mass easily removable. The following will illustrate the design:

Suppose the scale of telescope is divided into millimetres, and we can read with an error of ·1 mm. by eye estimation, then with a deflection 10 cm. the error in reading would be $\frac{1}{1000} = 1$ in 1,000. If our scale were distant from mirror of telescope by 1·5 metres, the deflection of the mirror for a reading 10 cm. would be about 2° for $\frac{10}{1500} = tan.\ 2a = 2\ tan.\ a$ approximately. $tan.\ a = \frac{10}{3000} = \cdot 033$ and a the deflection of mirror = 1° 54′.

When 1,000 amperes are flowing, the potential difference acting to send a current through the galvanometer is 100 × ·001 or one volt. Suppose we put in the galvanometer circuit 10,000 ohms, the maximum of an ordinary box, then the current through the galvanometer will be ·0001 ampere. With sufficient accuracy, we may apply the tangent galvanometer formula.

$$C = \frac{10\ H\ \gamma\ \tan.\ a}{2\ \pi\ n}$$

from which we have

$$n = \frac{10\ H\ \gamma\ tan\ a}{2\ \pi\ C} = \frac{10 \times \cdot 2 \times \gamma \times .033}{2 \times 3{\cdot}1416 \times .0001}$$

Assume a mean radius γ = 2.5 cm., then n the number of turns = 266 = 41·78 metres or about 136 feet of wire. If we take a copper wire whose diameter bare is ·036 inches the resistance will be about 1·1 a, and the wire will lie in a groove 1 × ⅝ inches, whose mean radius is 2·5 cm., or about one inch.

When one ampere goes through the shunt the potential difference will be 1 × ·001 = 1 volt. Then to give about 10 cm. deflection we should insert such a resistance that the galvanometer current would be ·0001, and this resistance would be about nine ohms Then should the temperature of the galvanometer coil rise 5° C., the resulting error would be but two parts in 1,000 from this cause alone.

A galvanometer of the D'Arsonval pattern might be used and would have the advantage of being independent of any changes in H, and of being very dead beat. It should be designed with as low resistance as is consistent with the condition that a current ·0001 amperes shall produce a deflection of 2°.

Two commutators are necessary. The larger receives the six coarse wire soldered into the copper lugs D F of the shunt. These wires should be No. 0000 B. & S. three in parallel, and the commutator of the mercury cup variety, so arranged that the shunt can be entirely disconnected from the dynamo circuit.

Into each of the holes at H and K should be soldered

1. Read before the Electrical Section, Franklin Institute, March 1, 1892.

carefully a No. 18 B. & S. copper wire thoroughly insulated, and the joint covered carefully with shellac and copal. These are lead out to the small mercury commutator for the galvanometer circuit arranged like the other so that the galvanometer can be isolated from shunt and main circuit. Then any thermo electric or electro chemical effects can be detected and studied. For instance, disconnect galvanometer entirely from commutator and note reading. Connect it to commutator with shunt unconnected and there should be, of course, no deflection even by reversing the commutator. Connect shunt (still with no current in it) to galvanometer commutator, and see if there is any deflection, reversing this time the connection from shunt to galvanometer. Finally, run current through shunt, and see whether changing the commutators produces any change in deflection, being sure that this current is maintained constant. Disconnect shunt from dynamo circuit, and see whether there is any appreciable deflection. The time occupied for these tests is very short, if the commutators are properly arranged; and if the tests show no appreciable thermo-electric or chemical effects, we may feel sure that our apparatus is satisfactory in this respect. Finally, provide a sensitive thermometer whose range is from about 60° F. to 80° F., or 15° C. to 27° C., and arrange so that it will be placed close to one of the German silver strips of the shunt. Read when no current is flowing, and then when the maximum current flows. Then if these readings differ 5° C. or 9° F., the error would be two per cent., as previously stated. If greater accuracy be required send cold water through the coils, and read the thermometer, then by sending the water through fast enough, the heating effect of the current may be nullified to the desired extent.

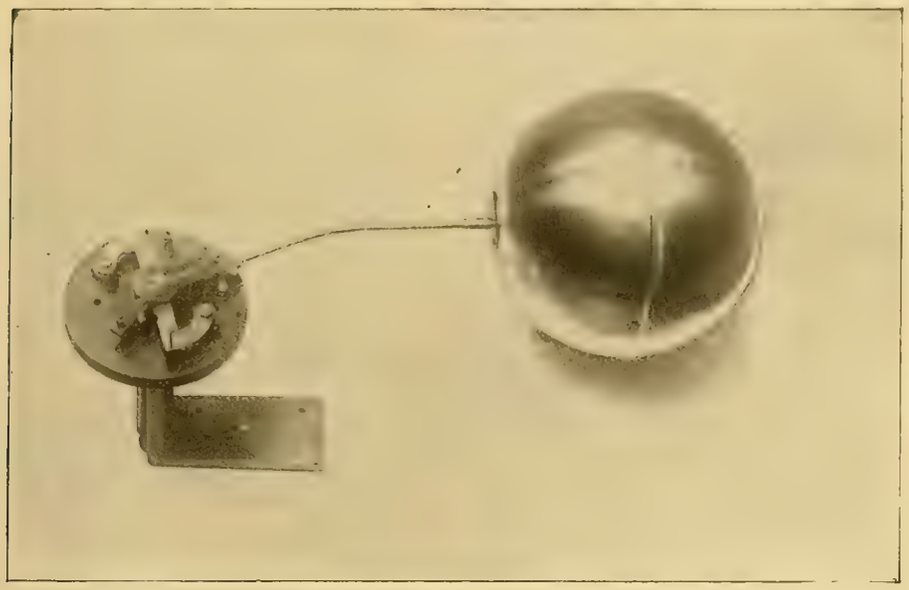
Recent researches of Prof. Ayrton on the D'Arsonval galvanometer indicate that such a type wound with platinoid with phosphor bronze strip suspensions would be most desirable, and, therefore, the following arrangement commends itself, more especially where the field around the galvanometer is subject to fluctuations. Use for the shunt bar a sheet of platinoid, to which the wires carrying the main current should be soldered. Preferably there should be several such wires soldered on the end edge of the sheet and distributed at equal distances along the edge so as to secure uniform distribution of current in the strip. If then a D'Arsonval, made as described and having its telescope and scale rigidly attached to itself, be provided, it may be used where the other arrangement would be out of the question, namely, near the dynamo room. Moreover, by making everything of platinoid, we have done away with temperature corrections, provided the platinum strip be of such dimensions that the maximum current doesn't heat it appreciably. The strip then may be kept in air, the only danger being a greater liability to thermo-electric effects due to differences in temperature at the junctions, and this can be tested by commutation.

Using the D'Arsonval, we can get a greater deflection for a given potential difference at its terminals, therefore, the resistance of the strip may be made lower and less energy be used up in the method of measurement, and in some cases this is an important advantage. On the other hand, since we measure with smaller potential differences, any thermo-electric effects will produce a greater error in our results.

Automatic Switch for Electrically Operated Pumps.

In the accompanying cut is shown an automatic switch for use with electrically operated pumps employed in filling water tanks.

The arrangement consists of a simple single pole switch with ebonite base, mounted upon an angle piece and operated by a ball float. As the water rises in the tank, the ball float rises with it until it reaches a point where the switch is opened by the operation of a spring. The motor consequently stops and no more water is pumped into the tank. As the water is drawn off, the ball falls with the water level, the switch is closed, the pump starts and continues working until the tank is again filled to the desired point. The ball and all parts coming in contact with the water are insulated from the switch connections and line terminals, so that no part of the circuit can be grounded through the tank. The switch may be screwed to a wall or partition by the side of the tank, or, if convenient, may be placed within and screwed directly to the side of the tank.



AUTOMATIC SWITCH FOR ELECTRICALLY OPERATED PUMPS.

The particular switch shown in the illustration is fitted with an arm seven inches long, and a ball seven and one-half inches in diameter, and will operate with a variation of six inches in the water level. It requires a cubic space of 11½ by 18½ by 20 inches, and can be used in any ordinary tank capable of holding more than thirty gallons.

Switches of this type can be used in connection with motors up to 2 kilowatt capacity, and can be arranged to operate upon any reasonable change in water level. The device was placed on the market by the Edison General Electric company.

Vertical Compound Engine.

The cut shows a sectional view through the low pressure cylinder of the vertical compound engine built by the Lake Erie Engineering Works of Buffalo, N. Y., represented in the West by W. B. Pearson & Co., Chicago.

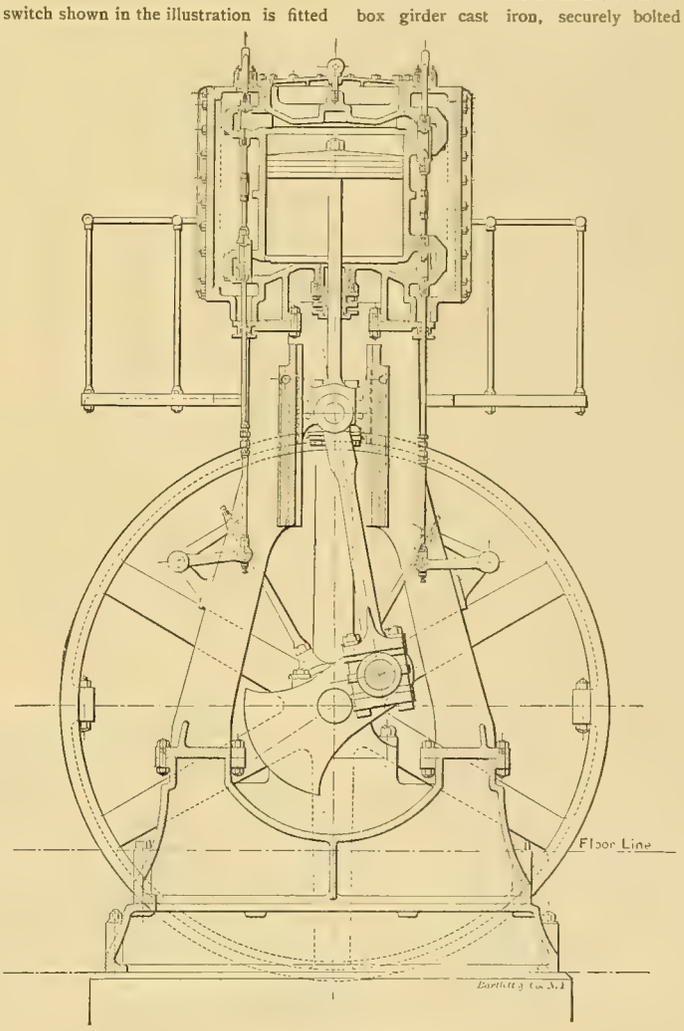
The cylinders are of the four-valve type, having two ports for steam and two ports for exhaust, with a steam chest at one side and an exhaust chest at the other side, at right angles with the crank shaft, thus allowing perfect freedom of access. It will be observed that the ports are very short and direct, and the clearances are consequently small, being from 2½ to 5 per cent., according to the diameter of piston.

The cylinders are substantially and neatly lagged with iron, and the space between the cylinders and lagging is filled with non-conducting material. The steam chest covers are provided with hoods, paneled and polished.

The valves are small, light and four-ported. The high pressure steam valves are well balanced, and the others are worked under light pressure on their sides, thus insuring tightness. The steam and exhaust valves are worked by independent gear, and the lap is adjustable, permitting of the most advantageous setting for condensing or non-condensing service. The governor and steam valves are constructed to carry the steam as far as seven-eighths of a stroke in the first cylinder should the demands of the load at any time require it. This system of valve gear and governor permits the engine to exert at least 30 per cent. more power in an emergency than any engine with releasing valve gear. This feature especially qualifies the engine for railway and other work requiring high powers through short periods of time.

The columns of the frame are of the "A" type of double box girder cast iron, securely bolted to the cylinder bottom and to the main pedestal, and carry the brackets for valve rockers, the guides being bolted on their inner faces. These guides are easily removed and renewed in case of accident.

The pistons are of the best marine design, having heavy



VERTICAL COMPOUND ENGINE.

cast iron rings, held firmly in position by intermediate spiral springs. The piston rods are of machinery steel, forged in one piece with the crosshead. Slippers are bolted to the sides of the cross head, and are of iron, babbitted. The connecting rod is forged, and of the forked pattern, with a wrist pin secured firmly to the ends of the fork, with a central bearing in the cross head. The crank pin has a two-part box, with its own bolts and independent of the rod forging.

Electric Power Transmission.

George Cutter's lecture before the technical students of the University of Illinois last week drew a large and appreciative audience. The subject, "Electric Transmission of Power," allowed the speaker to dwell on the recent developments in alternating current working which have thrown a new light on transmission problems. In the course of his talk, Mr. Cutter repeated the induction experiments of Prof. Elihu Thomson, and also showed a number of new ones illustrating the same principles. He also showed the bearing of the Frankfort-Lauffen tests on this subject and closed with a reference to the prospects for electric power transmission.

Thomson-Houston-Edison Consolidation in Chicago.

B. E. Sunny, who will have charge of the western office of the General Electric company, moved into the building of the Edison General Electric company on Adams street last week, and the Chicago business of the new company will henceforth be conducted at these fine offices. The lease of the building heretofore occupied by the Thomson-Houston company, at 148 Michigan avenue, will not expire until May 1st next, and until that time the building will be used as a warehouse and repair shop. All the heads of departments will transfer their offices to the Adams street building within a few days, and by July 1st it is expected that the Chicago office of the General Electric company will be in smooth running order. The consolidation of the two office forces will inevitably entail some changes, but the announcement of the new office staff has not yet been made.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 28.—Commissioners David McClure, Robert McClay and Benjamin Perkins, who were appointed by the Supreme court to hear arguments for and against the construction of the tunnel under Broadway as proposed by the Rapid Transit commissioners, continued their hearing on Tuesday afternoon. Objections to the tunnel scheme are numerous now. The opinion has been advanced that the building of such a road would tend to destroy or cripple the underground wire system under Broadway. It is believed, too, by some who have made a comparison of the proposed tunnel with the London system, that the proposed underground railroad in New York could not be built without disturbing the surface of the street. The statement was made that there were no subcellars in London along the route of the underground railroad, and the cellars were not nearly so deep as the cellars here. But even in London it was necessary to underpin all the buildings along the route. That would be much more difficult here because the basement walls are not continuous. In London the walls were continuous, while here the pillar system obtains. To underpin the buildings here would be much more difficult and involve shoring them up to the second or third story, and that could not be done without taking possession of the buildings and opening up the street.

On Tuesday the answer of the Sawyer-Man Electric Light company in the suit brought against it by the Edison Electric Light company was filed in the United States circuit court. It is a general denial of the claims of Edison as the inventor of the incandescent lamp. It is also claimed that the Edison patent, if such were granted, expired March 4, 1883.

While speaking of the Menlo Park inventor's trials and tribulations, I must not neglect to mention that a dispatch from London on Tuesday announced that Mr. Edison had been awarded the Society of Art's medal. This distinction had previously been awarded to Faraday, de Lesseps, and other distinguished men.

The Western Union building in New York will soon be equipped, on its southeast corner, with a new time ball which is to slide down a pole 100 feet high above the roof. The ball is 3 feet 6 inches in diameter, and will be let fall by an electric signal from Washington every day exactly at noon. A smaller one will also be put on the Broadway front, the old one having been destroyed in the fire of July 19, 1890.

Matters pertaining to society are rarely referred to in electrical correspondence, but a number of the readers of the WESTERN ELECTRICIAN will doubtless be interested to know that a farewell dinner party is to be given by Secretary of State and Mrs. Henry C. Kelsey at Trenton, N. J., to Mrs. F. W. Roebling, who sails for Europe next week with her daughters and Edward Grant Cook. The dinner will be at Sherry's in New York, and covers will be laid for nineteen.

The "dummy" trains that have held possession of Third avenue, Brooklyn, and rendered it one of the most dangerous thoroughfares in the city, were taken off on Monday and the electric cars took their place. Cars were run on five minutes' headway, and Superintendent Cameron reported that there were no hitches.

I must not neglect to mention that the first electric car on Third avenue, Brooklyn, began its pilgrimage on Monday. On Friday the Myrtle avenue extension will be opened with the dummies just taken off the Fort Hamilton branch.

Mayor Boody of Brooklyn has appointed Prof. George W. Plympton and Frederick R. Lee as the two members of the new Brooklyn Electrical Subway commission provided for in a bill signed by Gov. Flower recently. The measure was drawn by the local electrical companies, and the $3,000 a year to be paid to each commissioner, in addition to the running expenses of the commission, will be raised by these companies. Prof. Plympton was a member of the old Subway Commission, and has charge of the scientific department of the Polytechnic Institute. Mr. Lee is a lawyer.

A dispatch from Susquehanna, Pa., announces that a corps of Pittsburg surveyors is engaged in that vicinity surveying a route for a pipe and telegraph line between Pittsburg and New York.

The New York Electric club has completed arrangements to continue in its old quarters on Twenty-second street, and circulars have been issued urging the members to make up the deficiency in the club treasury. The announcement is made that nearly $5,000 has already been collected. It is the intention of the managers to resume the restaurant service on a self-sustainimg basis as early as possible. On May 27th an entertainment was given at the club house that proved a thoroughly enjoyable affair.

The Board of Managers of the New York Electric club elected the following named active members on May 19th: Mortimer M. Hayden, John F. Zebley, E. C. Brown. The following named associate members were also elected: Geo. Urban, Jr., C. H. McIntire, D. T. Everts, G. F. Wheeler, S. L. Phillips, F. P. Little, C. I. Hills, John E. McIntosh, J. A. Seymour, Howard H. Crowell, A. J. Belden, E. T. Pardee, Chas. J. Mayer, Samuel G. Booker, J. Calisch, Chas. R. Lloyd, R J. Getz, C. S. Knight, D. F. Urquhart.

Edward B. Hess has begun action against the Thomson-Houston Electric company, claiming a commission on the sale of the electrical equipment for the "Huckleberry Road." Mr. Hess claims that he got the Harlem Bridge, Morrisania & Fordham Railroad company, known as the "Huckleberry Road," to adopt electricity as a power in the place of horses, and brought the matter to the notice of the Thomson-Houston company, and through him the contract was made for the equipping of the road. The Thomson-Houston company refused, he asserts, to pay him his commission of 5 per cent. upon the purchase price, whereupon he began suit. W. F. O.

Pittsburg, Pa.

PITTSBURG, May 28.—Superintendent Morris Meade has completed the report of the Bureau of Electricity for 1891. It shows 581 regular and 200 still alarms of fire sent in during the year, and not a single failure in reception or distribution of the alarms. He recommends preparation for putting the city wires underground when the light and telegraph companies put theirs down; urges improvement of the sound-carrying mediums of the police telephone service, and says that he has prepared an ordinance, which he hopes will pass, providing for the appointment of an inspector to make a regular and rigid inspection of electric light wires to prevent accidents. There are 235 telephones in the electric bureau, and he also recommends the appointment of a man to keep them in good order.

At the annual meeting of the Westinghouse Electric & Manufacturing company the following named directors were elected: Charles Francis Adams, Lemuel Bannister, August Belmont, A. M. Byers, N. W. Bumstead, Marcellus Hartley, George W. Hebard, Henry B. Hyde, Brayton Ives and George Westinghouse, Jr. The only change was the election of Mr. Bumstead in place of Charles Fairchild. The president's report shows aggregate sales for the fourteen months ending March 1, 1892, $3,468,900.50, and during the months of March and April, under the reorganization, of $1,576,235.83." P.

PERSONAL.

C. A. Daigh of the National Electric Manufacturing company, Eau Claire, Wis., is in the city.

R. M. Stafford, one of the foremen of the Erie Electric Motor company, was recently presented a gold watch by the conductors and motor men of the line.

Walter C. McKinlock of the Enterprise Electric company, Chicago, returned on Monday from a successful business trip extending as far west as Denver, Colo.

Paul W. Bossart has recently been appointed special agent of the National Electric Manufacturing company, with headquarters in Chicago. Mr. Bossart is well known to the electrical fraternity, having been an old-time telegrapher, and later was prominently connected with the introduction of the telephone. For some time Mr. Bossart has been in Denver, in charge of a western agency for the Short Electric Railway company.

NEW INCORPORATIONS.

Falls City Electric company, Louisville, Ky.; capital stock, $10,000; manufacturing the Hanson primary battery, etc.

Union Electric company, Louisville, Ky.; capital stock, $50,000; manufacturing and dealing in electrical instruments and supplies.

North Manufacturing company, Denver, Colo.; capital stock, $100,000; to manufacture, buy and sell batteries and motors of all kinds.

People's Electric Light & Power company, Silver Creek, N. Y.; capital stock, $20,000; to manufacture and use electricity for light, heat and power.

Lowell Electric Light company, Lowell, Mich.; capital stock, $60,000; generating electricity for lighting purposes; Chas. A. Church, Lowell, Mich.

Norway Water Power & Electric Light company, Norway, Me.; capital stock, $50,000; to purchase and develop water power; H. L. Horne, Norway, Maine.

Chadron Electric Light & Power company, Chadron, Neb.; capital stock, $20,000; supplying the city of Chadron with electric light for public and private uses.

Glendale Electrical company, Glendale, W. Va.; capital stock, $50,000; furnishing light, heat and power by means of electricity; C. C. Newman, Moundsville, W. Va.

Johnston Motor & Electric company, Portland, Me.; capital stock, $250,000; to manufacture and deal in all kinds of electrical appliances; Chas. A. True, Portland, Me.

City Electric Railway company, Port Huron, Mich.; capital stock, $100,000; to operate a street railway from Port Huron to Fort Gratiot; F. J. Dixon, Port Huron, Mich.

Lewisburg Light, Heat & Power company, Lewisburg, Pa.; capital stock, $12 000; supplying light, heat and power or any of them in Lewisburg, Pa.; John F. Duncan, Lewisburg, Pa.

Home Electric Light & Power company, Muscatine, Ia; capital stock, $150,000; to furnish electric light and power at Muscatine, also power for a street railway; F. P. Sawyer, Muscatine, Ia.

Electrical Supply & Construction company, Pittsburg, Pa.; capital stock, $100,000; manufacturing electrical supplies and appliances.; W. M. Galbraith, 414 Grant street, Pittsburg, Pa.

Nutley Electric Light, Heat & Power company, Franklin, N. J.; capital stock, $100,000; manufacturing and supplying electricity, etc.; F. W. Ward, 810 Broad street, Newark, N. J.

Washington Park & Spring Grove Railway company, Sioux City, Ia.; capital stock, $150,000; to maintain and operate a street railway by motor or electricity; D. T. Hedges, Sioux City, Ia.

National Gas & Water company, Chicago, Ill.; capital stock, $500,000; building, leasing and operating gas, water and electric works, etc.; N. A. McClary, 218 La Salle street, Chicago, Ill.

Magnetic Electric company (incorporated in W. Va.), Boston, Mass.; capital stock, $5,000,000; manufacturing and dealing in electrical apparatus; Edward H. Brown, 252 Essex street, Salem, Mass.

McConnelsville-Malta Electric company, McConnelsville, O.; capital stock, $10,000; furnishing light and power to the residents of McConnelsville, Malta and vicinity; John S. Adair, McConnelsville, Ohio.

Katahdin Mining company, Spokane, Wash.; capital stock, $100,000; general mining and milling business; building and operating railways, electric light and water works; Kinnaird & Happy, Spokane, Wash.

Pierce & Miller Engineering company, New York, N. Y.; capital stock, $100,000; manufacturing, furnishing, buying and selling machinery and tools of all kinds, contracting for electric and manufacturing plants.

Belle Vernon Electric Light company, Belle Vernon, Pa; capital stock, $1,000; supplying light, heat and power by electricity to the borough of Belle Vernon, Fayette county, Pa.; Isaac S. VanVoorhis, 85 Diamond street, Pittsburg, Pa.

Gordon Electric company, Chicago, Ill.; capital stock,

$10,000; to manufacture, patent, sell, construct, erect and set in operation all kinds of electrical machines, equipments, materials, instruments, etc.; Francis W. Parker, 1007 Opera House block, Chicago, Ill.

ELECTRIC LIGHTING.

The Mobile, Ala., Electric Lighting company will increase its capital stock $100,000.

The Toledo Electric Light company uses on an average 100 barrels of crude oil a day for fuel.

The Madison, Wis., Electric Light company is building an addition to its station 30 by 70 feet.

The city of Rome, Italy, is to be lighted by electricity generated at the picturesque cascade of Tivoli.

The capital stock of the Lebanon, Mo., Light & Water company has been increased from $100,000 to $250,000.

The plant of the Wilkinsburg, Pa., Electric company was damaged by fire on May 20th to the extent of $6,000.

The stock of the People's Edison Illuminating & Power company of River Point, R. I., is to be increased from $30,000 to $50,000.

It is said that the Thomson-Houston company has secured control of the Syracuse, N. Y., Electric Light & Power company, and that it is also endeavoring to purchase the Onondaga Light & Power company of the same city.

The city clerk of Minneapolis is advertising for bids for furnishing electric street lights to the city. The specifications are on file in his office, and proposals will be received until June 17th. The company to whom the contract is awarded will be required to give the city of Minneapolis a bond in the sum of $100,000, with good and sufficient sureties, to save the city harmless from any claims for infringement of patents, and to insure the faithful fulfillment of the contract.

A new electric light company, to be controlled in the Westinghouse interests, is promised for San Francisco, says the *Examiner* of that city. The plant, it is said, will cost about $1,000,000, and the investment is to be made by the Westinghouse company of Pittsburg, James G. Fair and other capitalists. Mr. Fair is named for the presidency of the new company. J. M. Thompson, who represents the Westinghouse company, has been negotiating for the purchase of property on First street, near Howard, and an electric station may be located there.

Sealed proposals will be received at the clerk's office of the city of Holland, Mich., until 6 P. M., June 7th, for the construction of a complete electric arc light plant, comprising a brick building for one 50 horse power steel boiler, with heater, pump, injector, smoke stack and all necessary piping to make connection with engine, etc., one 100 horse power high speed automatic cut-off engine, one fifty high tension arc light dynamo, forty 2,000 candle power lamps, best insulated wire, poles, and all other necessaries to complete a first-class plant. The plant is to be operated thirty days before acceptance by the common council.

ELECTRIC RAILWAYS.

The Rome, Ga., Street Railroad company has purchased for $25,000 the Rome electric light works and will consolidate it with the power plant.

It is said that the syndicate that made an offer of $100,000 for the electric car franchise in Covington, Ky., is ready to increase the bid to $150,000.

The contract for the equipment of the entire system of the West End electric railway in Pittsburg has been let to the Westinghouse company.

The Ithaca, N. Y., electric light system has been purchased by the electric railway company, and both railway and electric lights will be run by the new company.

It cost the city of Toronto $1,200 to assure itself that the overhead trolley system is the only one in practical, operation at present for electric railway work on this continent.

The Macon City & Suburban and the Central City street railways of Macon, Ga., have been purchased by the Thomson-Houston Electric company of Boston, Mass., for $200,000. The new owner will, it is stated, equip all the lines with electricity and rebuild part of the system. The improvements are estimated to cost $100,000.

The proposed electric line between Spokane, Wash. and Coeur d' Alene, Idaho, will be 32 miles long, with a maximum grade of one per cent. It is proposed to make the trip either way in an hour. Water power will be utilized. The cars will be of special design, similar to the observation cars on the transcontinental lines, with a view to affording passengers every opportunity to view the beautiful scenery along the route. They will be provided with mail, express and freight compartments and will be heated and lighted by electricity. The cost of construction and equipment will exceed $600,000.

There was a short strike on the East Cleveland, O., Street Railroad company's lines on Sunday. This company operates thirty-five miles of electric road, comprising five of the principal lines in Cleveland. From 6 A. M. until 1 P. M. no cars were run. At that time a compromise was effected and business was resumed. By the terms of the compromise the men are to work but ten hours a day, motormen to receive 18 cents an hour and conductors 17 cents, and for overtime 20 and 19 cents an hour will be paid respectively. Three leaders in the strike who had been discharged are to be reinstated. The men regard it as a victory. There was no trouble whatever, and the public who had to walk took the inconvenience good-naturedly.

TRADE NEWS.

The capital stock of the Detroit Electrical Works has been reduced from $1,000,000.00 to $750,000.00, all of which has been paid in. The company has opened an office at 89 State street, Boston.

The Niagara Falls Street Railway company, Niagara Falls, N. Y., is erecting a power plant. The Ball Engine company, Erie, Pa., is furnishing the steam plant, consisting of two 130 horse power engines, two 130 horse power boilers, pump, heater, etc.

A fire occurred in the factory of the Crescent Insulated Wire & Cable company on May 26th, completely destroying the roof and fourth floor of the structure. The loss from the enforced stoppage, though for a brief period only, will be considerable, as the company has been for three months taxed to its utmost capacity. The managers hope to be able to resume running full time in about two weeks.

The Samson Cordage Works of Boston, Mass., have been increasing the plant for the manufacture of "Samson" arc light cord and trolley cord, and have reached the limit of their water power. They have, however, purchased a water power in the neighborhood of their factory and they are now preparing to put in an electric plant which will enable them to transmit the power to the present factory.

Thos. G. Grier, Chicago, representing the Bryant Electric company of Bridgeport, Conn., has moved his office and salesroom from "The Rookery" to room 1422 Monadnock building. Mr. Grier is general western agent for the Bryant company, and carries a full line of Paiste switches and other specialties which he handles. Mr. Grier will be very pleasantly located in his new office, which is being fitted up in good style.

So numerous are the orders received by the Williams Engine Works at Baltimore that they are compelled to work at night, and are contracting with another larger shop to take some of the work. This company is building yacht engines, standard steam engines and very high speed engines for direct connection to dynamos. These engines are growing in popularity. With modern tools, advanced ideas, and the experience of the past as a guide the builders of this engine are pushing to a leading position.

The Rose Polytechnic Institute, Terre Haute, Ind., is one of the few well-endowed and well-equipped schools of a college grade in the United States devoted exclusively to the professional education of mechanical, electrical and civil engineers and chemists. Special attention is devoted to electricity. It is the strongest possible evidence in favor of this school that for several years the number applying for admission has exceeded the limited number that can be admitted. Those intending to study engineering should address Rose Polytechnic Institute, Terre Haute, Ind., a for catalogue.

The Du Laney Clock company, with a factory at Valparaiso, Ind., has recently opened an office at 914 Unity Building, Chicago. By an ingenious arrangement of a number of electro-magnets, the main spring of the clock is kept at an even tension, making as nearly perfect a timekeeping mechanism as is possible to devise. When connected in series a pulsation sent over the line by the controlling clock makes all the clocks run synchronously. Several railway companies have already adopted the clock, and it is believed that it will go into very general use for this purpose, and for the ordinary house use as a detached timepiece.

The Standard Paint company still continues to receive testimonials regarding its valuable products. Recognizing the expense of having a man apply paint or compound to moulding with a hand brush, the company has placed in the market a small machine for painting moulding. A small revolving grooved roller to fit any sized moulding is placed over a pan filled with P. & B. compound. The moulding is run over this roller giving it a smooth even coat of the compound. The company recently received a letter from a construction company from which the following abstract is taken: "We take pleasure in stating that we have used a considerable quantity of your P. & B. compound, and have found it satisfactory in all respects. We use it in preference to any other insulating paint."

Referring to the use of graphite, a correspondent in a contemporary says: "In making pipe cement, or as I would term it, pipe smear, it is not necessary to use the best oil or grease, as it is the graphite, and not the body in which it is suspended, that makes the mixture valuable and the joint perfect. I use the drippings from line shaft bearings, caught in the ordinary way and mix them with the best Ticonderoga flake graphite so that the compound can be applied with an ordinary sash tool. During the past three years I have used about fifteen or twenty pounds of dry Ticonderoga flake graphite for pipe joints, cylinder heads, piston rod packing, etc. Bolts smeared with graphite mixed as above, I have unscrewed after having been in the dampest places for upward of two years, or more, proving the anti-rusting qualities of graphite. To cool hot bearings put it on as thick as it will mix with oil."

The demand for the Sunbeam Incandescent lamp is keeping up beyond all expectations. Heretofore the sale of lamps each year has steadily declined after April 1st, and the manufacturers have taken advantage of this condition of the trade, and have either rebuilt or enlarged their factory, or have increased their stock of lamps on hand. The sale of the Sunbeam lamp for April this year was in excess of that of any previous corresponding month, and the sales in May have been one-half more than in April. The large number of dark days during the month has probably had something to do with this very satisfactory demand, but it is apparent that users of incandescent lamps have about concluded their further experiments are not necessary, and that it is worth while to invested to buy a lamp that has an established reputation. The Sunbeam is probably as well known a any lamp in the United States, and is used by as many intelligent consumers, which is a sufficient guarantee as to its merits.

The establishment of a new electrical supply house in the Manhattan Building by Walter C. McKinlock and his associates was noted in a recent issue of the WESTERN ELECTRICIAN. Prominently associated with his two brothers in the organization and management of the Central Electric company, Chicago, and the Southern Electrical Supply company, St. Louis, Mr. McKinlock has, as a pioneer, come to be well and favorably known to the electrical trade. In the management of the new company he will be assisted by F. P. Hill who has until a recent date held a responsible position with the Southern company, St. Louis, and by W. F. Richardson who leaves the Central Electric company, Chicago, for this purpose. Mr. Hill has been elected secretary of the new company, and Mr. Richardson will serve as vice-president and manager. An opportunity was offered for the establishment of the new business in St. Louis but with the rapid growth in the different lines in prospect throughout this city and in the entire Northwest during the coming year it was deemed best to locate in the World's Fair city. Several very valuable agencies have been secured including the control of the sale of Kerite wire for Chicago. The Enterprise company will receive a full line of supplies direct from the manufacturers. It is apparent that another strong supply house has been added to the electric interests of Chicago.

BUSINESS.

Wm. Brookfield, of New York, manufacturer of battery jars and glass screw insulators, is "blowing out orders" of every description of green and amber glass.

General Manager F. D. Potter, of the Roy Valve company, of New York, reports that the company is getting out a number of new style valves, especially suited for the equipment of central electric light stations.

The Sawyer-Man Electric company, of New York, reports a good business in the manufacture of incandescent lamps. The company also reports large sales for switches and cut-outs which it is at present manufacturing in large quantities.

Russell & Co. of Massillon, O., announce the sale of a large number of engines to electric companies during the last three months. The engines made by this company are particularly adapted to electric light and power plants, and their merits are being recognized by central station managers. The company is making additions to its factory.

That slow-speed motors are being introduced in all branches of work where such machinery is used with success is shown by the fact that the Crocker-Wheeler company of New York, have been working nights for the last two weeks in order to supply the demand for its well-known apparatus which it is shipping to all parts of this country.

The Northern Car company will soon ship, equipped and ready to be transferred to the street car tracks, the first of the new car bodies ordered for the Duluth Street Railway company. This car is equipped with two 20 horse power short gearless motors, and will be placed on the line at the head of the incline and back of the city of Duluth. This line is 1½ miles long and overlooks the entire populated district at the head of lake Superior. It is 650 feet above the lake level, and the incline by which it is reached was built at a cost of $250,000. The maxium grade of the road on which these gearless moters will be operated is 4½%.

The Ball & Wood company of No. 15 Cortlandt street, New York, has just shipped the eighth 150 horse power engine within as many months to the Edison Electric Illuminating company of Paterson, N. J. In addition to this average of one engine per month, the company has furnished the Edison company an improved 300 horse power compound engine. Visitors to the Ball & Wood shops at Elizabeth will now see over thirty engines under construction, embracing types of their improved simple, tandem compound and cross compound engines all on contract and in preparation for early delivery.

The Railway Equipment company, Chicago, reports lively demands in all departments. The company has added largely to the established business of the Electrical Merchandise company, which it purchased a few weeks ago. Owing to the established reputation of the standard appliances of this company, a large number of contracts for equipment have been made with the understanding that such appliances will be used. The company reports a largely increased business over the last season, but having increased its manufacturing facilities, it is able to guarantee immediate shipments. The managers of the company, having devoted their entire time and attention to "electric railway supplies only" for several years, are prepared to furnish reliable and complete information on the equipment of electric street roads.

The Stearns Manufacturing company of Erie, Pa., manufacturer of the Woodbury automatic high speed engine, has been notified that the Franklin Institute has awarded the Edward Longstreth medal of merit to the Woodbury engine. The committee's report contains the following: "The sub-committee, after witnessing the operation of several of these engines, was impressed with the fact that the skill and intelligence displayed in the design and construction of the engine had resulted in a machine of handsome appearance, capable of close regulation, smooth in its action and well adapted for its pur-

poses. Recognizing the integrity and skill displayed, your committee recommends the award of the Edward Longstreth medal of merit." The recommendation of the subcommittee was adopted May 4th by the committee on science and the arts

The Ball Engine company of Erie, Pa., has recently filled the following orders: Schuylkill Electric Railway company, Pottsville, Pa., one 200 horse power engine; J. C. Hubinger Co., Keokuk, Ia., one 300 horse power cross compound condensing engine; Pittsburg Iron & Steel Engineering company, Pittsburg, one 50 and one 100 horse power engine; Moundsville Electrical company, Moundsville, W. Va., one 130 horse power engine; Oakland Light & Power company, Oakland, Md., one 80 horse power engine. Crook, Horner & Co., Baltimore, representatives of the Ball Engine company, Erie, Pa., have recently furnished two 150 horse power engines to the North Avenue Street Railway company, Baltimore, and two 150 horse power tandem compound condensing engines and complete steam plant to the Chesapeake Light & Power company, Hampton, Va.

The corner of Michigan Ave., and Randolph St., Chicago, presents a scene of varied activity. The street is in that condition of upheaval incident to the laying of a cable conduit. This will be the new loop of the South Side company, and will do much to relieve the conjestion of traffic along State St. Near by the construction of the great Wigwam is being completed for the democratic convention. Soundings are also being made for the fundation of Chicago's new Public Library building. Across the way; towering above all this is the building of the Electrical Supply company, which seems to felicitate itself upon the good companions which it will have by and by. Within is a scene of even greater bustle and work. They haven't much love for cable roads to be sure, but they do enjoy orders for electric railway supplies. That they succeed in getting their share seems evident from the good humor which pervades this department.

The immense new pulp and paper plant of the Cliff Paper company at Niagara Falls is to be supplied with late designs of the horizontal shaft double discharge James Leffel wheels, built by James Leffel & Co., Springfield, O. The contract for this work was signed by the Cliff Paper company and James Leffel & Co. on May 13th. Each of these turbines is to be 1,100 horse power capacity. These wheels will connect direcly to the pulp grinder shafts at each end of the wheel shafts without belts or gearing. This company has celebrated the thirtieth year of continuous business in this line of work. It has added many improvements to the James Leffel wheel in the past two years, and has designed a large number of new styles, incorporating in them the best ideas of its large experience. The manufacturing plant of this company has also been recently greatly extended, and various pieces of new, improved and heavy machinery added, all adapted to the heavy water-wheel work they are now manufacturing. They shipped some time since one James Leffel wheel and casing weighing forty-five tons; also filled one order for nineteen large wheels for one pulp and paper company.

James R. Chapman, general manager of the Consolidated Street Railway company, Grand Rapids, Mich., has long been an enthusiastic believer in the gearless street car motor. Several months ago he placed an order for these motors with the Short Electric Railway company of Cleveland, O., and on Sunday, May 22nd, the first gearless car was run over his lines. On the car, beside prominent Grand Rapids people, was a party of gentlemen from Chicago, Ill., among whom were C. R. Cummings, Mr. Odell and Mr. Bradberry. Two trips were made by the entire party, one in the morning taking that portion of the Grand Rapids lines having grades of from three to five per per cent. Later in the day the car was run over the steepest and most difficult sections of track in the system, where it was demonstrated to the satisfaction of every one that the "Gearless" is a first-rate hill climber. The car ascended one 9½ per cent. grade at a speed of nine miles an hour without the least difficulty. This run was made several times in succession, the car being stopped and started in the middle of the grade with as much ease as on level track. The speed attained on the level was surprising to those accustomed only to cable cars. The motors on this road are wound for slower speed than is generally desired, owing to the stiff grades on the road, but they will make twenty-five miles per hour easily on the level.

ELECTRICAL PATENTS.

Issued May 24, 1892.

475,289. Electric Arc Lamp. Lucienne Brianne, Paris, France. Filed July 28, 1891. Serial No 401,021. Patented in France July 12, 1890, No. 206,963; in Germany August 1, 1890, No. 56,345; in Austria-Hungary Nov. 14, 1890, No. 32,479 and No 56 900; in Belgium Jan. 3, 1891, No. 93.327; in England Jan. 5, 1891, No. 200; in Italy Jan. 28, 1891, LVI. 438, and in Spain Mar. 24, 1891, No. 11,661.

In this device a weight separates the carbons and the current brings them together.

475,300. Extension Transmitter for Telephones. Victor A. Cook, New York, N. Y.

While properly directing the sound waves from the mouth to the diaphragm, it is the intention in this arrangement to guard against metallic vibration.

475,334. Electric Signaling Apparatus. William C. Moore, Kansas City, Mo.

The signals transmitted are not only adapted to actuate all of the receiving apparatus at the several outlying stations, but to cause the mechanism located at those stations not wanted to assume their normal positions, while the mechanism at the station which is being called is caused to pass completely through its operative phase.

475,335. Manufacture of Electrodes for Secondary Batteries. James F. McLaughlin, Philadelphia, Pa.

Dry powdered active material is packed against a suitable conductor, supported in a non-conducting mold, and then solidified and joined to its support by subjecting it to the action of a current of electricity within an electrolytic bath.

475,340. Automatic Electric Heat Alarm. Fred S. Palmer, Boston, Mass.

The invention consists of a reservoir containing mercury connected to one pole of a battery, a channel through which the mercury rises when heated to close the circuit by coming in contact with a point connected to the other pole of the battery.

475,345 Incandescent Lamp Socket. Frederick C. Rockwell, Hartford, Conn.

475 360. Amalgamator. James M. Thompson, San Francisco, Cal.

475,378. Station Indicator. Reuben B. Ayres, New York, N. Y.

475,394. Incandescent Electric Lamp. Henry Green, Hartford, Conn.

This invention consists of a lamp made entirely of glass and a pair of circuit wires attached to the platinum wires in the usual manner and trained up the sides of a hollow recess in the neck of the lamp and secured to the same by the fusion of a small portion of glass; a number of bead-like projections around the neck of the lamp serve to hold the same in the socket.

475,399. Electric Actuator for Registering Mechanisms. Charles F. Holt, New London, Conn.

475,402. Process of Obtaining Metallic Zinc from Sulphite of Zinc by Electrolysis. Theodor Lange, Brieg, Germany.

475,410. Electric Mechanism for Reciprocating Motion. Henry S. McKay, Boston, Mass.

An armature forming the core of two electro magnets is reciprocated, and in its travel changes the course of the current alternately from one magnet to the other, thus causing the reciprocation of the armature without breaking the circuit and without the armature losing its magnetism.

475,411. Electric Meter. Alexander G. McKenna, Allegheny, Pa, and Henry T. Weed, Brooklyn, N. Y.

An electrolytic cell containing a mercury salt has suitable electrodes and a receptacle for catching the deposited mercury, which receptacle carries a graduated scale to indicate the amount of the deposit.

475,441. Telegraphic Relay. Charles Cuttriss, New York, N. Y.

A coil is moved by currents in the main line and a carbon strip wound spirally upon itself is distended or compressed by the moving coil and included in the local circuit for varying the resistance in the same, and thus controls the amount of current flowing through a suitable receiving instrument.

475,442. Sealing Device. Charles Cuttriss, New York, N. Y.

475 467. Trolley for Electric Railways. John W. Newhouse, Indianapolis, Ind.

475,468. Electrical Transmitting System. Frederick E. Now, Cleveland, O.

This device is intended for communication between a central telegraph station and a number of other stations at the same time.

475,482. Lightning Arrester. James E. Browne and Frederick H. Tidnam, Elizabeth, N. J.

The discharge passes from a swinging ball to a ground, and the shock accompanying the flash drives the swinging ball away from the ground terminal, thus extinguishing the flash.

475,491. Electric Locomotive. Thomas A. Edison Llewellyn Park, N. J.; assignor to the Edison Electric Light company, New York, N. Y.; Original application filed June 3, 1880, Serial No. 11 243. Divided and application filed May 20, 1882. Serial No. 61,955. Again divided and this application filed June 9 1891. Serial No. 395,701. (No model.) Patented in England Sept. 25, 1880, No. 3 894; in Canada Mar. 31, 1881, No. 12,568; in India May 3, 1881, No. 341; in Victoria May 12, 1881. No. 3,012; in France May 27, 1881, No. 141,752; in New South Wales June 25, 1881, No. 948; in Queensland June 30, 1881, No. 21—299, and in New Zealand Aug. 2, 1881, No. 542.

The principal claim reads:
"A stationary dynamo electric generator, a wheeled vehicle traveling upon rails, an electro dynamic motor mounted upon such wheeled vehicle, having its field and armature coils in separate circuits, electrical connections between the motor upon the vehicle and said generator, and controlling devices mounted upon said wheeled vehicle for starting, stopping, and reversing its movement, whereby the movement of the wheeled vehicle can be completely controlled by a person riding thereon."

475,492. Electric Locomotive. Thomas A. Edison, Llewellyn Park, N. J., as ignor to the Edison Electric Light company, New York, N. Y. Original application filed June 3, 1880. Serial No. 11,243. Divided and application filed May 20, 1882, Serial No. 61,955. Again divided and this application filed June 9, 1891. Serial No. 395,702 (No model.) Patented in England Sept. 25, 1880, No. 3,894, in Canada Mar. 31, 1881, No. 12,568; in India May 3, 1881, No. 341; in Victoria May 12, 1881, No. 3,012; in France May 27, 1881, No. 141,752; in New South Wales June 25, 1881, No. 948; in Queensland June 30, 1881, No. 21—299, and in New Zealand Aug. 2, 1881, No. 542.

The claim reads:
"The combination of a wheeled vehicle, an electric motor located thereon, mechanically connected with a wheel or axle thereof, a source of electricity, a circuit including said source of electricity and motor, a track composed of rails upon which the vehicle travels, and a supplemental grooved traction wheel upon said vehicle rotated by the same source of power as the motor, adapted to grasp or grip the track."

475,493. Electric Locomotive. Thomas A. Edison, Llewellyn Park, N. J., assignor to the Edison Electric Light company, New York, N. Y. Original application filed June 3, 1880, Serial No. 11,243. Divided and application filed May 20, 1882, Serial No. 61,955. Again divided and this application filed June 9, 1891. Serial No. 395,703. (No model.) Patented in England Sept. 25, 1880, No. 3,894; in Canada Mar. 31, 1881, No. 12,568; in India May 3, 1881, No. 341; in Victoria May 12, 1881, No. 3,012; in France May 27, 1881, No. 141,752; in New South Wales June 25, 1881, No. 948; in Queensland June 30, 1881, No. 21—299, and in New Zealand Aug. 2, 1881, 542.

In an electric railway having a suitable source of current and supply conductors, the combination, with a car of an electric motor mounted thereon, and two derived circuits, one including the rotating armature of the motor, the other including the coils of the field magnets.

475,494. Electric Railway. Thomas A. Edison, Llewellyn Park, N. J., assignor to Edison Electric Light company, New York, N. Y. Original application filed June 3, 1880, Serial No. 11,243. Divided and application filed May 20, 1882, Serial No. 61,955. Again divided and this application filed June 9, 1891, Serial No. 395,704. (No model.) Patented in England Sept. 25. 1880; No. 3,894; in Canada Mar. 31, 1881, No. 12,568; in India May 3, 1881, No. 341; in Victoria May 12 1881, No. 3,012; in France May 27, 1881, No. 141,752; in New South Wales June 25, 1881, No. 948; in Queensland June 30 1881, No. 21—299, and in New Zealand Aug. 2, 1881, No. 542.

The combination, in an electric railway system, of a stationary source of electricity, a moving vehicle, an electric motor on the vehicle, mechanical connections between the rotating part of the motor and a wheel or axle of the vehicle, a main line of conductors extending from the source of electricity to the vehicle having a section thereof isolated from adjacent sections in the same line, and traveling contacts connecting the circuit on the vehicle with said main line or circuit or a section thereof, whereby the variation due to the described arrangement of the main line is automatically imparted to the motor to produce a corresponding variation in the movement of the vehicle.

475,498. Process of Rendering Iron, Steel, and other Similar Metals Homogeneous. Joseph C. Fraley. Philadelphia, Pa.

475,504. Switch for Overhead Wires. Alphonzo O. White and Paul W. Leffler, Minneapolis, Minn.

475 514. Electric Car Lighting System. James F. McElroy, Albany, N. Y.

The currents required for the maintenance of the lights are generated by means of a dynamo operated by the motion of the train itself, and in connection therewith a storage battery is employed of sufficient capacity to maintain the lights during stoppages.

475,526. Bottle Alarm. Joseph A. Trottier, Valleyfield, Canada.

475,527. Coin Controlled Electrical Apparatus. Horace Wickham, Milwaukee, Wis.

475,528. Rheostat. Charles Willms, Baltimore, Md.

475,529. Rheostat. Charles Willms, Baltimore, Md..

475,538. System of Electric Lighting. Milo J. Cowgill, Omaha, Neb.

A high voltage dynamo carries a sleeve provided with a series of inlaid peripheral segments and a common return collar brushes bear upon said segments to carry currents over the several circuits successively, and during but a fractional part of the time of each revolution of the armature, thus making it possible to use a low voltage lamp on a high voltage circuit.

475,544. Electric Arc Lamp. Robert S. Dobbie, Brooklyn, N. Y.

The combination, with the electrodes of an arc lamp, of an inclosing device around the arc for conserving the heat and intensifying the light thereof, the body having an escape passage and a draft inducing device for diverting gases through said passage from the space in front of the arc.

475,555. Incandescent Lamp Socket. Cromwell A. B. Halvorson, Saugus, Mass.

475,566. Automatic Electric Time Check. Charles K. Jardine, Georgetown, British Guiana.

475,600. Cable Hanger. John J. Nate, Chicago, Ill.

The combination, with a hook, of a metallic base to which said hook is attached, said base being provided with four openings adapted to receive a wire or wires, and said wire or wires adapted to be fastened to said base and to surround and support the cable at two points.

475,645. Lightning Arrester. Addison G. Waterhouse, Hartford, Conn.

The invention consists of a lightning arrester and a means for temporarily short circuiting the field magnets or suspending the current producing capacity of the dynamo electric machine while the discharges are passing to earth.

475,648. Anti-Inductive Conductor. Bror H Wesslau, Charlottenburg.

The improvement consists of an anti-inductive conductor having an open net-work of threads of insulating material wound or plaited thereon, with air spaces between said threads and an outer envelop of insulating material wound around the exterior of said threads and inclosing said threads and air spaces.

475,651. Device for Heating Metal Rods. Alfred D. Williamson, London, Eng., assignor to the Siemens Bros. & Company, limited, same place.

475 667. Hoop Welding Apparatus. Charles L. Coffin, Detroit, Mich.

475,668. Commutator Brush. Charles L. Coffin, Detroit, Mich.

475,702. Electric Motor Car. William H. Patton, Chicago, Ill.

575,703. Electrically Heated Sand Box. Lewis E. Pease, Cambridge, Mass.

475,727. Electric Arc Lamp. James E. Gaston, Sparta, Ill.

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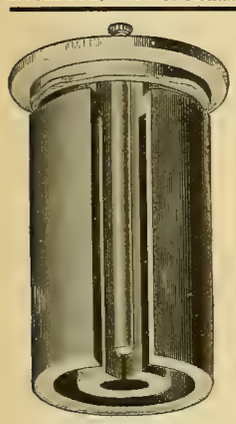

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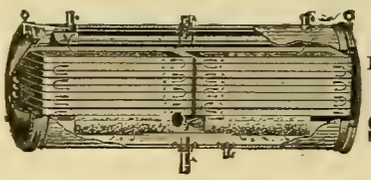

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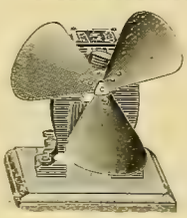

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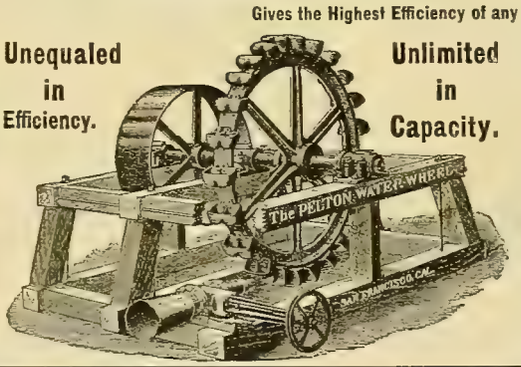

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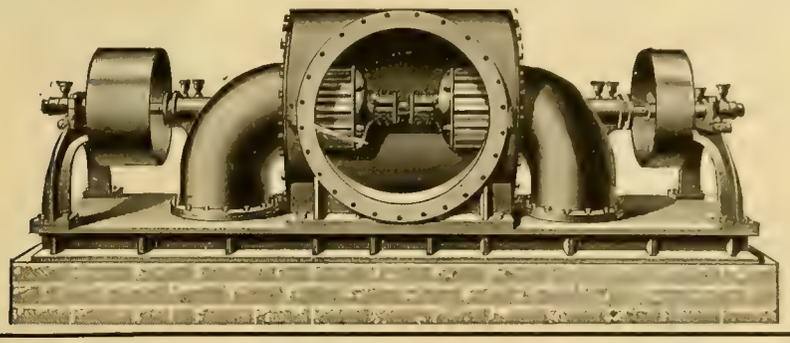

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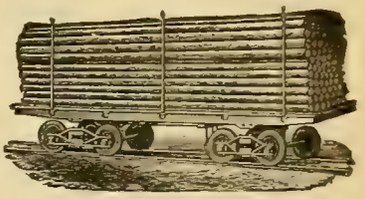

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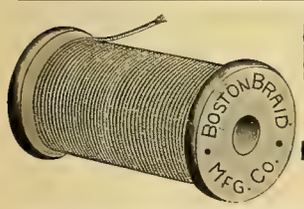

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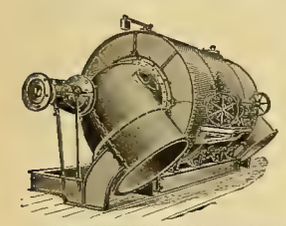

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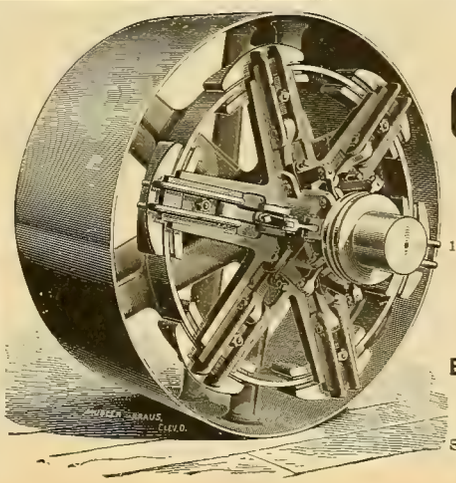

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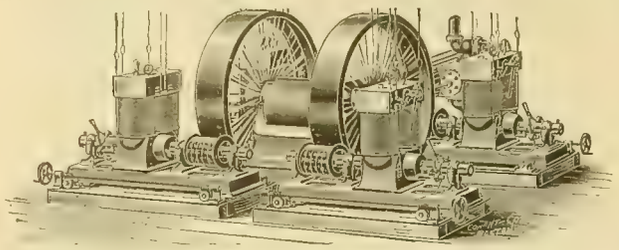

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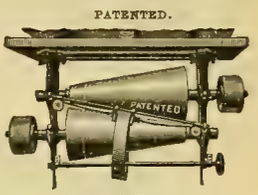

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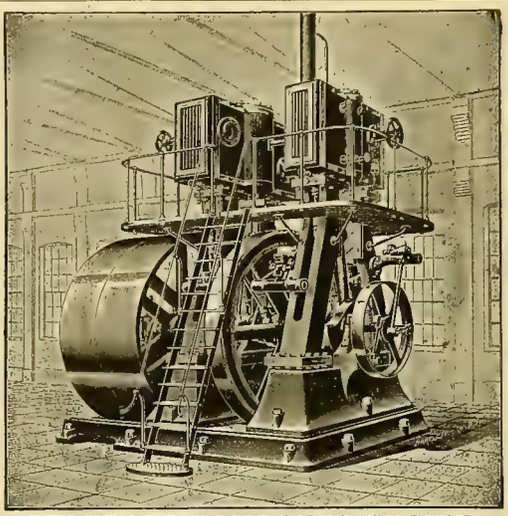

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B	5¾	6½	6	12	10	370	7	15	17	24	19	26	32	23	31	34	42	35	42	46	44	55	59	68	64	70	79	2.2
C	6⅜	7½	6½	13½	12	318	9	19	22	30	24	34	40	29	39	44	53	45	53	59	56	70	76	87	81	90	101	2.8
D	7¾	9	8¼	16½	14	277	14	28	32	45	36	50	60	43	58	65	79	67	79	87	83	104	112	129	121	133	159	4.16
E	9	10½	9½	19	16	246	18	37	42	59	47	65	78	57	76	85	103	87	103	114	109	136	147	169	158	174	196	5.44
F	10½	12	11	22½	18	222	26	53	61	84	68	94	112	81	109	122	148	125	148	164	156	195	210	242	226	249	281	7.80
G	12	13½	12½	25	20	185	32	65	75	103	84	115	139	100	135	150	183	154	183	202	192	241	260	298	279	308	346	9.62
H	13½	15½	14	28½	24	158	43	88	101	139	112	155	186	135	181	201	245	206	245	271	258	323	348	400	374	413	464	12.9
I	16	18½	17	33½	28	138	57	118	135	187	151	208	249	180	242	270	329	277	329	363	346	433	467	536	502	554	623	17.3
K	18	20½	19	38	32	120	74	152	174	241	104	268	321	232	312	348	424	357	424	468	446	558	602	691	647	714	803	22.3
L	20	22½	21	43	34	112	94	194	223	309	249	343	412	297	400	446	543	457	543	601	572	715	772	887	829	915	1030	28.6
M	24½	28½	26	52	42	93	138	275	327	452	365	503	603	436	587	654	796	670	796	880	838	1048	1131	1299	1215	1341	1508	41.9
N	28½	33	30	60	48	80	180	374	429	593	477	658	789	570	767	855	1041	877	1041	1151	1096	1370	1480	1699	1589	1754	1973	54.8
Mean Effective Pressure . . Lbs.							3.3	6.8	7.8	10.8	8.7	12.	14.4	10.4	14.0	15.6	19.	16.	19.	21.	20.	25.	27.	31.	29.	32.	36.	
Ratio of Expansion							13½		16¾		18¾			10¼		12¼		13¾			6¾		8¼		9¼			
Per Cent. of Cylinder Condensation							14	14	16	16	16	16	16	12	12	13	13	13	13	13	10	10	11	11	11	11	11	
Terminal Pressure (about) . Lbs.							7.3	7.7	7.7	8.3	7.9	8.5	9.	9.2	10.4	10	11.1	10.5	11.2	12.	14.	15.5	14.	16.3	14.6	15.6	17.8	
Per Cent. of loss from Expanding below Atmosphere . . .							34	15	13	8	17	8	3	5	0	0	0	0	0	0	■	0	0	0	0	0	0	
Steam per I. H. P. per hour . Lbs.							55.	42.	36.	27.7	47.	32.5	29.	33.3	27.7	25.7	24.8	28.7	27.0	25.4	30.	26.2	23.	22.	21.	20.5	20.	
Lbs. Coal at 8 lb. Evaporation . Lbs.							6.97	5.25	4.50	3 46	5.85	4.6	3.62	4.12	3.46	3.21	3.10	3.6	3.37	3.16	3.75	3.29	2.87	2.75	2.7	2.6	2.5	

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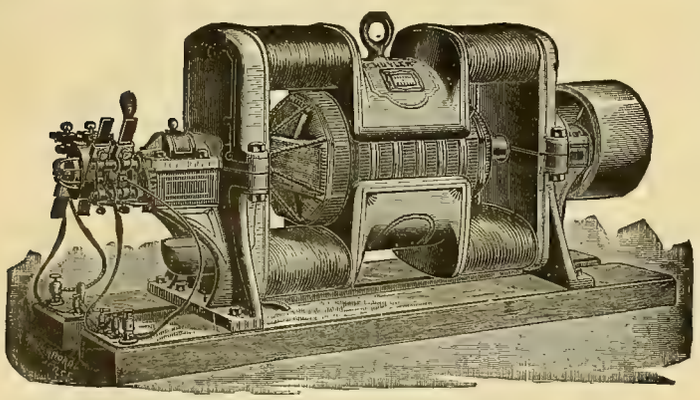

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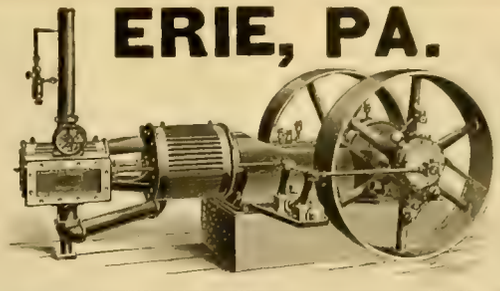

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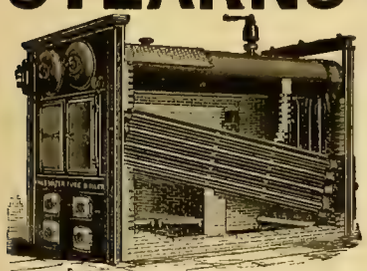

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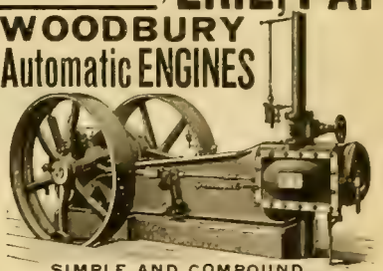

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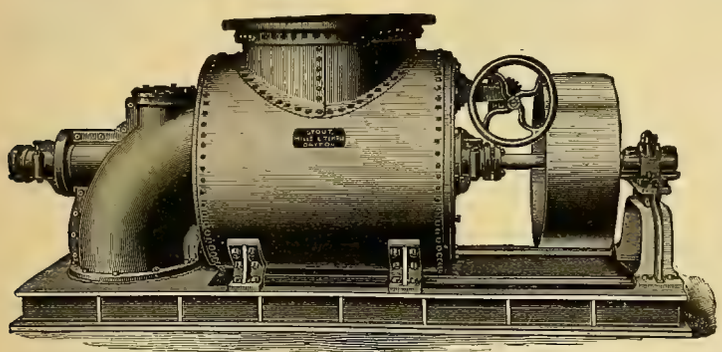

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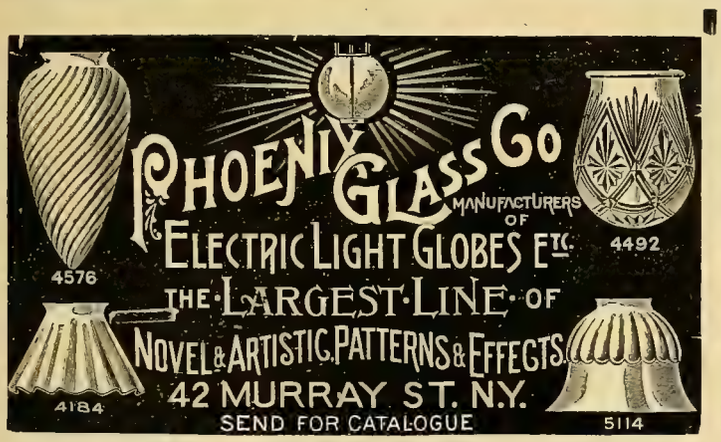

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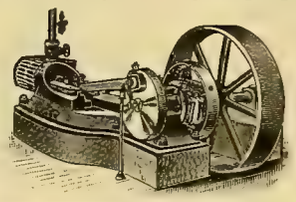

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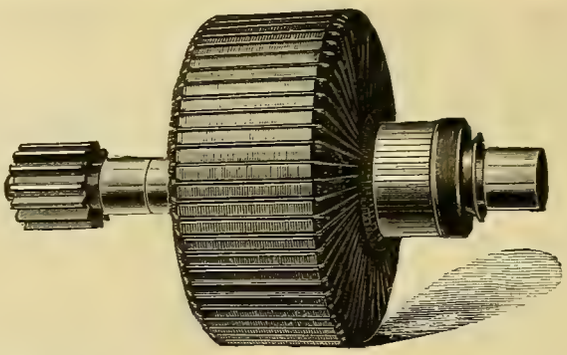

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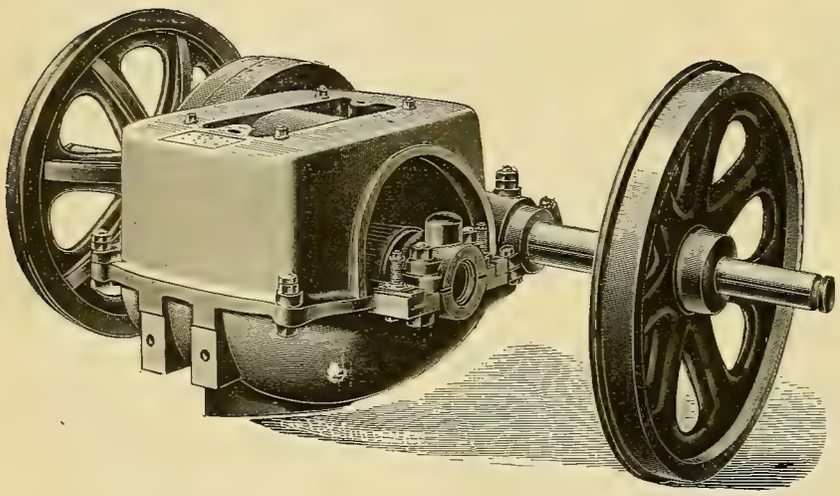

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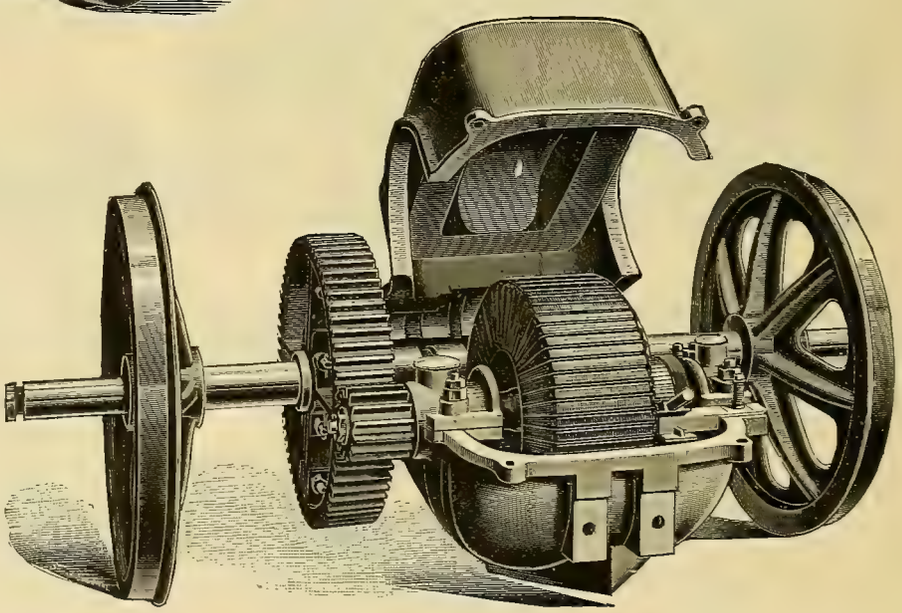

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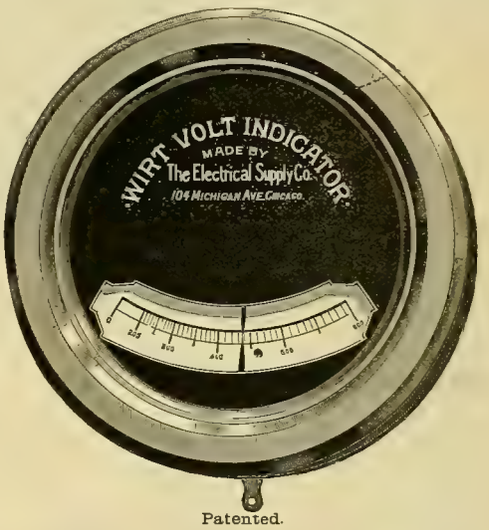

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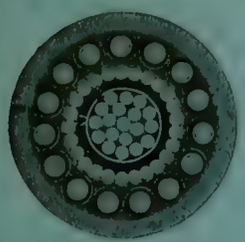
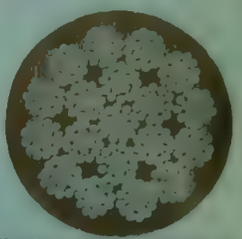
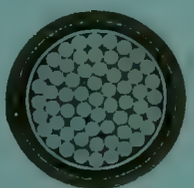
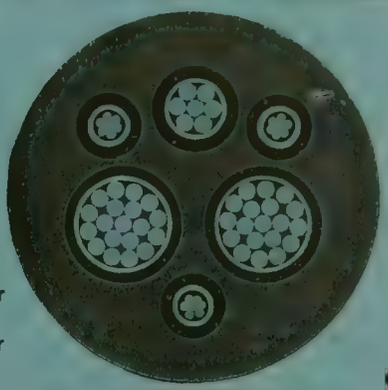
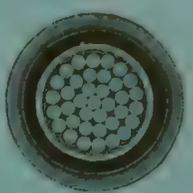

Underground Core.


Feeder Cable, Brooklyn Edison Electric Light Co.

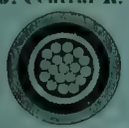
Underground Core, N. J. Central R. R.


Feeder Core, Broadway Theater.


Submarine Work, Edison Electric Light Co., Easton, Pa.


Naval Core, United States s. s. "Chicago."

Portable Cable, Broadway Theater.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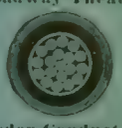
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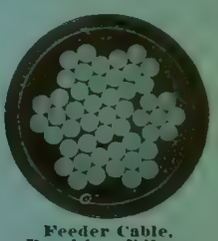
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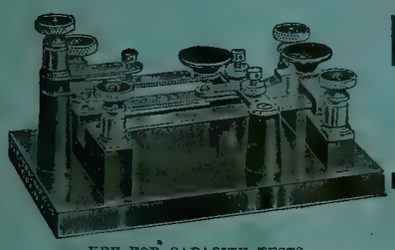

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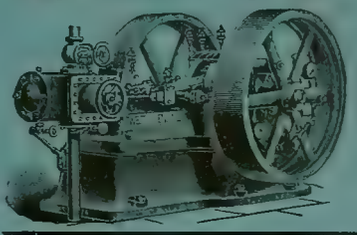

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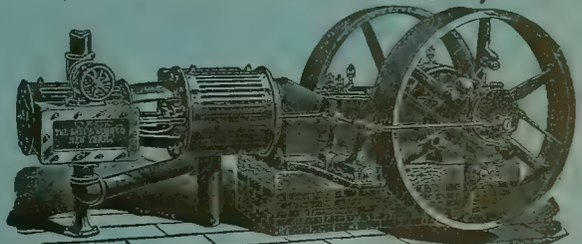

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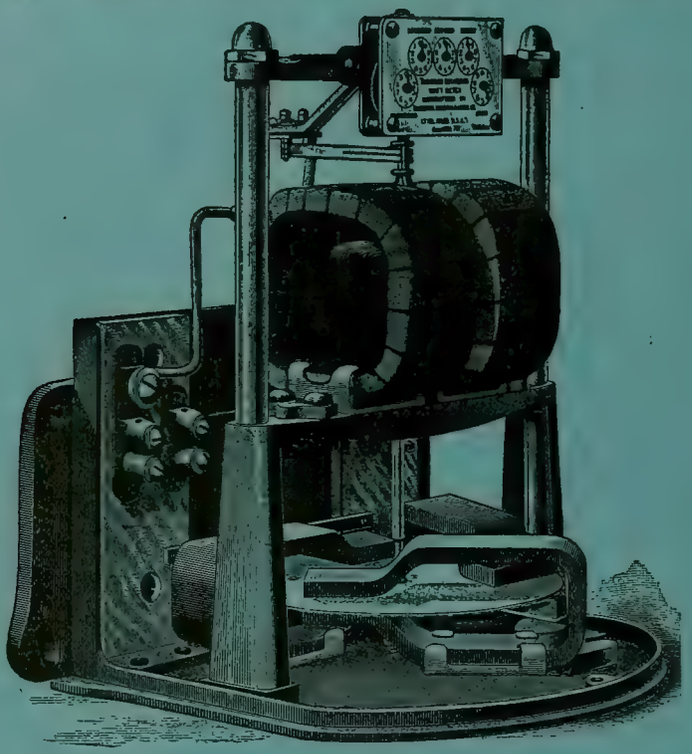
Thomson Recording Watt Meter.

For Lighting and Power Circuits.



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The ONLY Meter that Registers the Actual Power Consumed.

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GERMANTOWN, PA., April 29, 1892.

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GERMANTOWN ELECTRIC LIGHT CO.,

(Signed) Chas. M. Allen, Supt.

LANSING, MICH., April 6, 1892.

Thomson-Houston Electric Co.,
BOSTON, MASS.

GENTLEMEN:—Answering yours of the 31st regarding the THOMSON-HOUSTON RECORDING WATT METERS, would say that we are well pleased with them so far, and consider them better than anything else we have tried.

Yours truly,

LANSING ELECTRIC LIGHT & POWER CO.,

(Signed) E. F. Cooley, Supt.

Thomson-Houston Electric Co.,

PRINCIPAL OFFICE,
620 Atlantic Ave., Boston, Mass.

WESTERN OFFICE,
148 Michigan Ave., Chicago, Ill.

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Electrical Construction Co., The.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co., W. R.
Partrick & Carter Co.

Arc Lamps.
Beggs, J. E., Mchy. & Supply Co.
Brush Electric Co.
Duplex Electric Co., Ltd.
Easton Electric Co.
Electric Cons. & Supply Co.
Fort Wayne Electric Co.
Great Western Elec. Supply Co.
Rose Electric Light Supply Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Knapp Electrical Works.
Samson Cordage Works.

Batteries.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Law Telephone Co
Leclanche Battery Co., The.
Partrick & Carter Co.
Premier Electric Co., The.
Pumpelly, J. K.
Western Electric Co.

Battery Jars.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Law Telephone Co.
Leclanche Battery Co., The.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Detroit Electrical Works.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
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Central Electric Co.
Electrical Supply Co, The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
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Falls Rivet & Machine Co.
Hill Clutch Works.
Lake, J. H. & D.

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Samson Cordage Works.

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Electric Cons. & Supply Co.
Electrical Construction Co., The.
Knapp Electrical Works.
Rae, Frank B.
Smith, Thos. G. Jr.
Western Electric Co.

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Ball Engine Co.
Ball & Wood Co., The.
Bryan, W. H
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"C. & C." Electric Motor Co.
Detroit Electrical Works.
Diamond Electric Mfg. Co.
Edison General Electric Co.
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Electrical Eng. & Supply Co.
Falls Rivet & Machine Co.
Heisler Electric Co.
Keller & Degenhardt.
Lake Erie Engineering Works.
Lane & Bodley Co., The.
La Roche Electric Works.
Morse & Co., A. M.
Pearson & Co., W. B.
Racine Hardware Mfg. Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Short Electric Railway Co.
Sioux City Engine Works.
Smith, Thos. G. Jr.
Taylor Engine Co.
Thomson-Houston Electric Co.
Waddell-Entz Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Weston Engine Co.
Williams Engine Works.

Copper Wires and Tapes.
Central Electric Co.
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Edison General Electric Co.
Electrical Supply Co., The.
Enterprise Electric Co.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Roebling's Son's Co., J. A.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Detroit Electrical Works.
Electrical Supply Co., The.
Loud, H. M. & Sons Lumber Co.
Railway Equipment Co.
Schindel & Schindel.

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Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Electric Engineering & Supply Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Enterprise Electric Co.
Hart & Hegeman Mfg. Co., The.
Knapp Electrical Works.
Perkins Elec. Switch Mfg. Co.
Star Electrix Co.
Utica Elec. Mfg. & Supply Co.
Van Nuis, C. S.

Dynamos.
Brush Electric Co.
"C. & C." Electric Motor Co.
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Diamond Electric Mfg. Co.
Duplex Electric Co., Ltd.
Easton Electric Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Gregory, Chas. E.
Heisler Electric Co.
La Roche Electric Works.
Lovell Mfg. Co., Ltd.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Rose Electric Light Supply Co.
Royal Electric Co.
Schuyler Electric Co.
Waddell-Entz Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Lava Gas Tips.
Smith, A. T.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Rae, Frank B.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical and Mechanical Engineers.
Bryan, W. H.
Pierce, Josiah Jr.
Rae, Frank B.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Western Electric Co.

Electrical Intelligence.
Bryan W. H.
Keller & Degenhardt.
Rae, Frank B.

Electrical Specialties.
Andrae, Julius.
Bryant Electric Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Electric Engineering & Supply Co.
Enterprise Electric Co.
Hussey & Co.
Ries Electric Specialty Co, The.
Utica Elec. Mfg. & Supply Co.

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Baggot, E.
Electrical Supply Co., The.
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Electro-Plating Machines.
Brush Electric Co.
Detroit Electrical Works.
Edison General Electric Co.
Thomson-Houston Electric Co.

Elevators.
Link Belt Machinery Co.

Engines, Steam.
American Engine Co.
Ball Engine Co.
Ball & Wood Co., The.
Ide & Son, A. L.
Lake Erie Engineering Works.
Lane & Bodley Co., The
Morse & Co., A. M.
Pearson & Co., W. B.
Racine Hardware Mfg. Co.
Smith, Thos. G. Jr.
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Stearns Mfg. Co.
Taylor Engine Co.
Weston Engine Co.
Williams Engine Co.

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"C. & C." Electric Motor Co
Chicago Electric Motor Co.
Emerson Electric Mfg. Co.
Premier Electric Co., The.
Stanley Electric Mfg. Co.

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Kartavert Mfg. Co.
Vulcanized Fibre Co.

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Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Furnace Grate Bars.
Kelly Bros.

Fuse Wire.
Electrical Supply Co.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

Gas Lighting, Electric.
Detroit Electrical Works.
Knapp Electrical Works.
Partrick & Carter Co.

General Electrical Supplies.
Andrae, Julius.
Bryant Electric Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Cons. & Supply Co.
Electric Engineering & Supply Co.
Electrical Eng. & Supply Co.
Electrical Supply Co., The.
Enterprise Electric Co.
Hart & Hegeman Mfg. Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Queen & Co.
Utica Elec. Mfg. & Supply Co.
Western Electric Co.

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Brookfield, Wm.
Phœnix Glass Co.

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Dixon Crucible Co., Jos.

Hard Rubber Goods.
Butler Hard Rubber Co.

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Brookfield, Wm.
Bryant Electric Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Cushing, F. W.
Edison General Electric Co.
Electric Engineering & Supply Co.
Electrical Supply Co., The.
Enterprise Electric Co.
Great Western Elec. Supply Co.
Hart & Hegeman Mfg. Co.
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International Okonite Co., The.
Johns Mfg. Co, H. W.
Kartavert Mfg. Co.
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Standard Paint Co.
Utica Elec. Mfg. & Supply Co.
Vulcanized Fibre Co.
Wannopee Pottery Co.
Western Electric Co.

Insulated Wires and Cables.
Magnet Wire.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing, F. W.
Cutter, Geo.
Detroit Electrical Works.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Enterprise Electric Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
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New York Insulated Wire Co.
Roebling's Sons Co., J. A.
Sperry Elec. Mining Machine Co.
Waddell-Entz Electric Co.
Western Electric Co.

Lamps, Incandescent.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Cutter, Geo.
Cutter Electrical & Mfg. Co.
Edison General Electric Co
Electric Engineering & Supply Co.
Electrical Eng. & Supply Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Illinois Electric Lamp Co.
Knapp Electrical Works.
New York and Ohio Co.
Sawyer-Man Electric Co.
Somoff, J. L.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Mechanical Machinery.
Ferracute Machine Co.

Medical Batteries.
Detroit Electrical Works.
Partrick & Carter Co.

Mica.
Bowers Bros
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.
Schoonmaker, A. C.

Mine Signals, Electric.
Detroit Electrical Works.

Mining Apparatus, Electric.
Edison General Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

Motors.
Brush Electric Co.
"C. & C." Electric Motor Co
Crocker-Wheeler Electric Co.
Chicago Electric Motor Co.
Detroit Electrical Works.
Diamond Electric Mfg. Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Eng. & Supply Co.
Emerson Electric Mfg. Co.
La Roche Electric Works.
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Premier Electric Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Thomson-Houston Electric Co.
Waddell-Entz Electric Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Becker Mfg. Co., John.

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American Desk & Seating Co.
Andrews & Co., A. H.

Oil Cups.
Powell Co., The Wm.

Oil Purifiers.
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Pins and Brackets.
Central Electric Co.
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Loud, H. M. & Sons' Lumber Co.
Railway Equipment Co.
Schindel & Schindel.
Sterling, W. C.

Porcelain.
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Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Detroit Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Recording Pressure Gauges.
Bristols' Mfg. Co., The.

Regulating Sockets.
Ries Electric Specialty Co.

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Boston Braid Mfg. Co.

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Ostrander & Co., W. R.
Western Electric Co.

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Queen & Co.

Steam Pumps.
Worthington, Henry R.

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Detroit Electrical Works.
Johns Mfg. Co., H. W.
Railway Equipment Co.
Schindel & Schindel.

Tapes, Insulating.
Andrae, Julius.
Central Electric Co.
Cushing, F. W.
Crescent Ins. Wire & Cable Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Standard Paint Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Western Electric Co.

Telephones, Electric.
Detroit Electrical Works.
Western Electric Co.

Test Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.

Transformers.
Diamond Electric Mfg. Co.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Detroit Electrical Works.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

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Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Stilwell & Bierce Mfg. Co.

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Densmore Typewriter Co.

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Institute of Technology.
Rose Polytechnic Institute.

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Leffel & Co., The Jas.
Pelton Water Wheel Co.

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Central Electric Co.
Crescent Ins. Wire & Cable Co.
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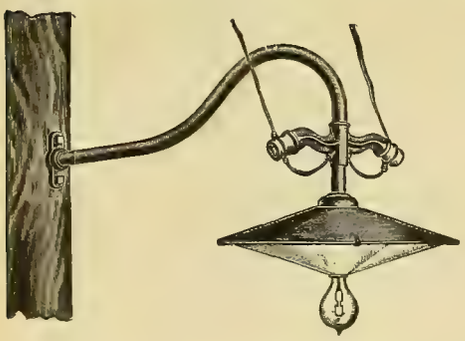

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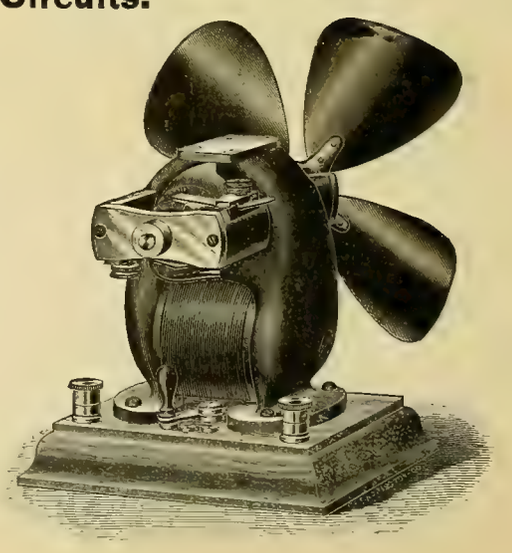

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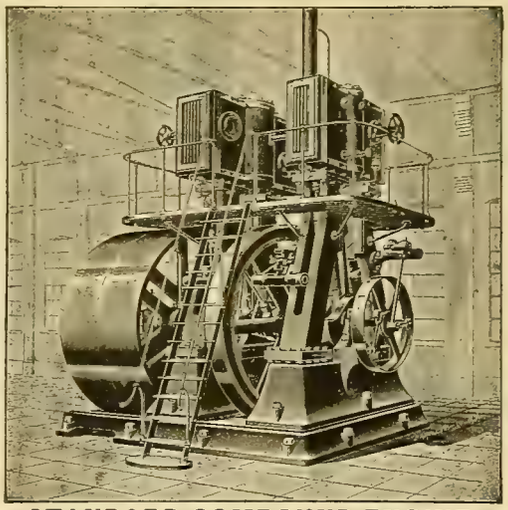

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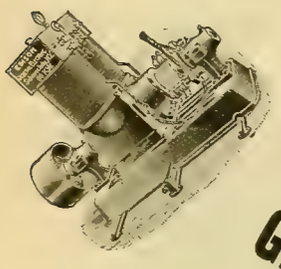
POWER AND ECONOMY TABLE FOR TRIPLE EXPANSION ENGINES—CONDENSING.

STEAM JACKETED.

Table No. 5.

Size of Engine	Diam. Cylinders inches H.P.	I.P.	L.P.	Stroke inches	Revolutions per minute	Horse-Power when cutting off at 1/4 stroke in first Cylinder 120lb	130lb	140lb	150lb	160lb	Horse-Power when cutting off at 1/3 stroke in first Cylinder 120lb	130lb	140lb	150lb	160lb	Horse-Power when cutting off at 1/2 stroke in first Cylinder 120lb	130lb	140lb	150lb	160lb	Horse-Power when cutting off at 3/4 stroke in first Cylinder 120lb	130lb	140lb	150lb	160lb	Horse-Power Constant at 1 lb M. E. P.
B	4¾	7½	12	10	370	35	37	42	44	48	44	48	53	55	59	57	64	72	79	84	81	88	97	103	110	2.2
C	5½	8½	13½	12	318	45	48	53	56	62	56	62	67	70	76	73	81	92	100	107	104	112	123	131	140	2.8
D	6½	10½	16½	14	277	67	71	79	83	92	83	92	100	104	112	108	121	137	150	159	154	166	183	196	208	4.16
E	7½	12	19	16	246	87	92	103	109	120	109	120	131	130	147	141	157	180	196	208	201	218	230	255	272	5.44
F	9	14½	22½	18	222	125	132	148	156	172	156	172	187	195	211	203	226	257	281	299	289	312	343	369	390	7.8
G	10	16	25	20	185	154	164	183	192	212	192	212	231	241	260	250	279	317	346	368	356	385	423	451	481	9.62
H	11½	18	28½	24	153	206	219	245	258	284	258	284	310	323	348	335	374	426	464	494	477	516	568	606	645	12.9
I	13	22	33½	28	138	277	294	329	349	381	346	381	415	433	467	450	502	571	623	663	640	692	761	813	865	17.3
K	15	24½	38	32	120	357	379	424	446	491	446	491	535	558	602	580	647	736	802	854	825	892	981	1048	1115	22.3
L	17	27	43	34	112	458	486	543	572	629	572	629	686	715	772	744	829	944	1030	1095	1058	1144	1258	1344	1430	28.6
M	20	33	52	42	93	670	713	796	838	922	838	922	1006	1048	1131	1089	1215	1383	1508	1605	1551	1676	1844	1970	2096	41.9
N	23½	38	60	48	80	877	932	1041	1096	1206	1096	1206	1316	1370	1480	1424	1583	1808	1973	2099	2028	2192	2411	2576	2740	54.8
Mean Effective Pressure . . Lbs.						16	17	19	20	22	20	22	24	25	27	26	29	33	36	38.3	37	40	44	47	50	
Number of Expansions						26.8					20.1					13.4					8.9					
Per Cent. of Cylinder Condensation						19	19	19	19	19	16	16	16	16	16	12	12	12	12	12	8	8	8	8	8	
Steam per I. H. P. per hour . . Lbs.						14.7	14.2	13.9	13.7	13.3	14.3	14.0	13.98	13.7	13.2	14.3	13.9	13.6	13.3	13.0	15.7	15.4	14.9	14.5	14.2	
Lbs. Coal at 8 lb. Evaporation . Lbs.						1.8	1.77	1.73	1.71	1.66	1.78	1.75	1.74	1.70	1.65	1.78	1.73	1.70	1.66	1.62	1.96	1.92	1.86	1.81	1.77	

LIGHT.



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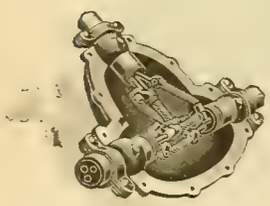

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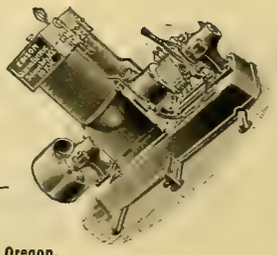

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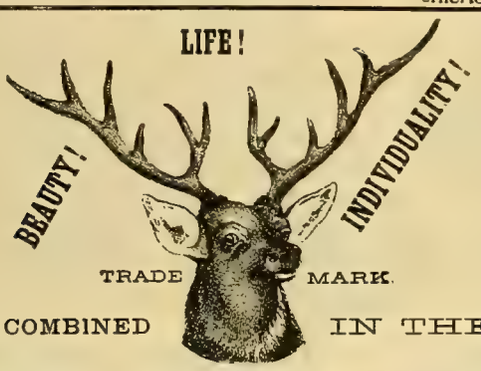

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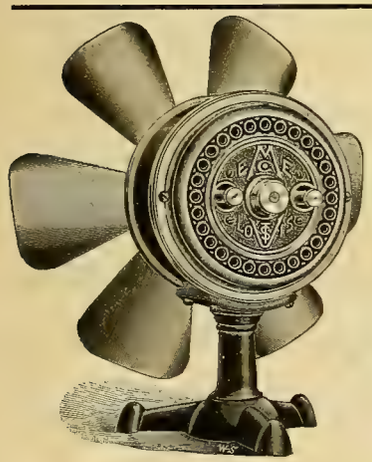

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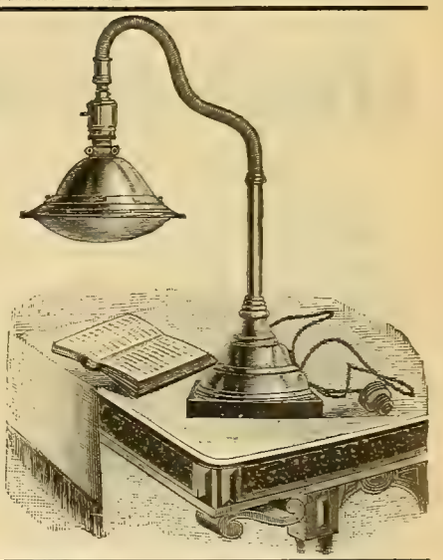

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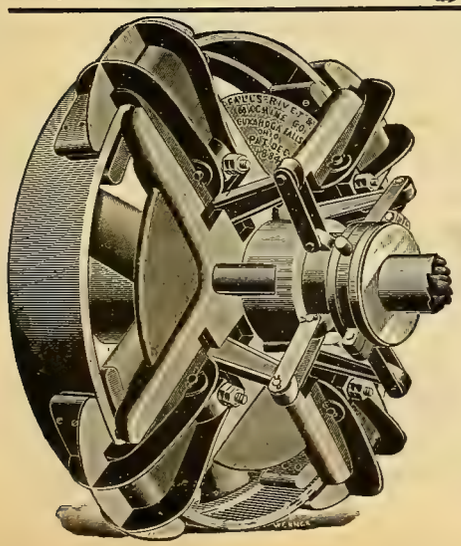

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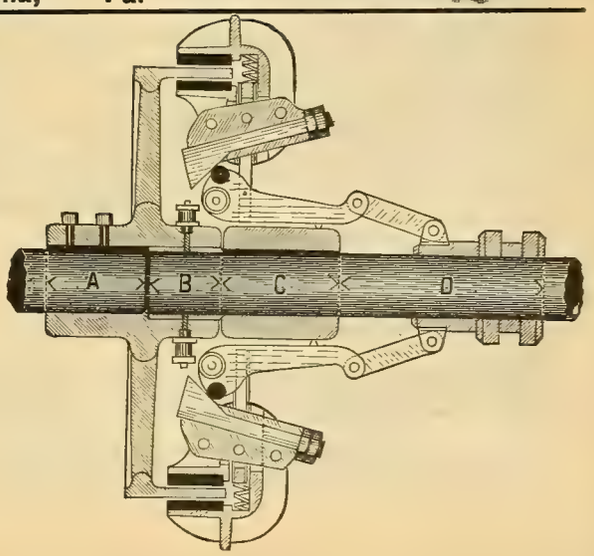

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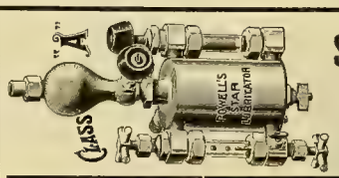

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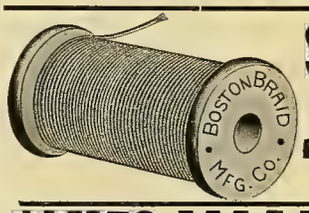

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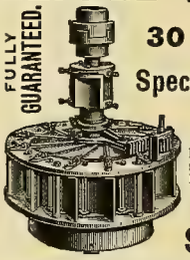

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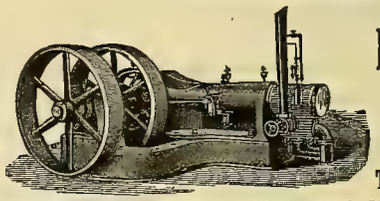

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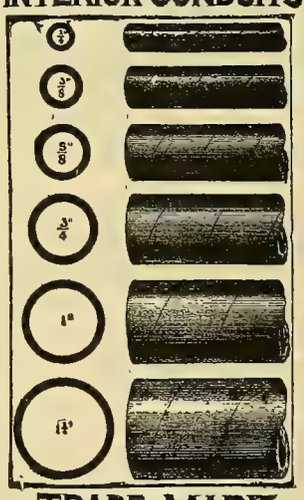

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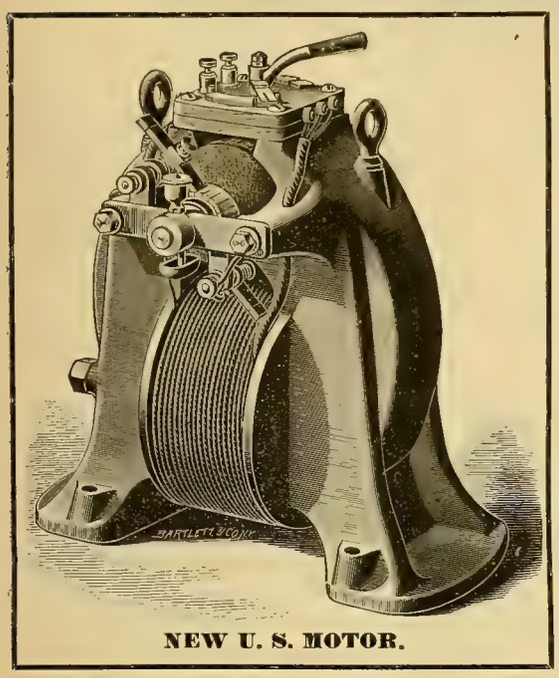

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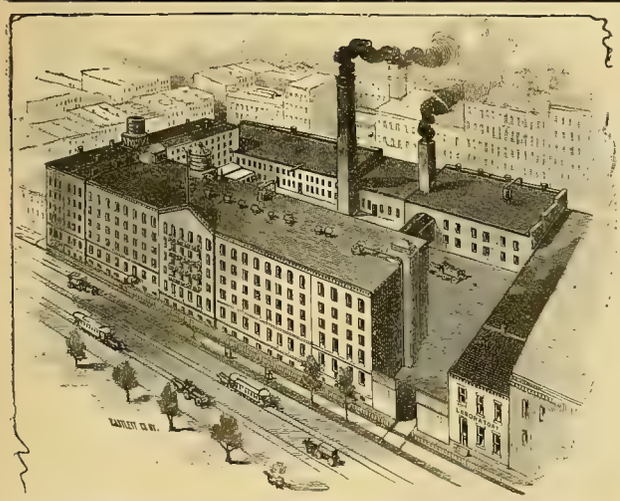

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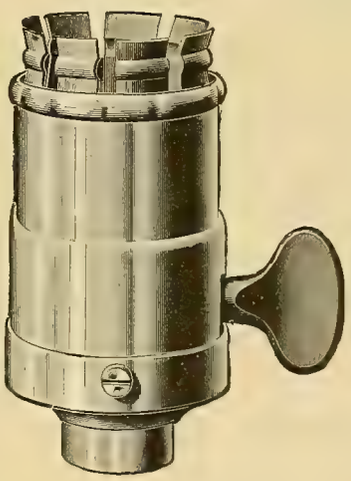

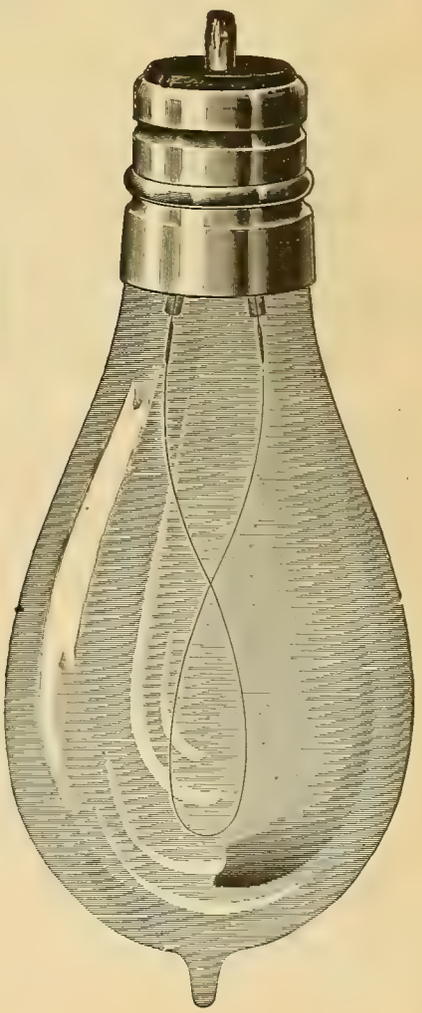

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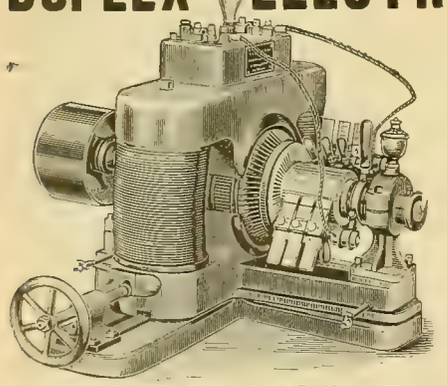

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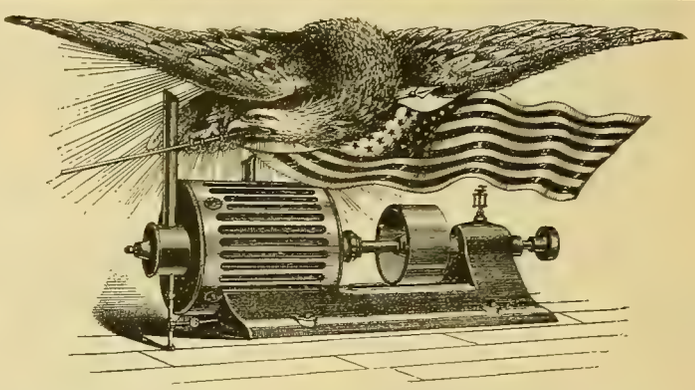

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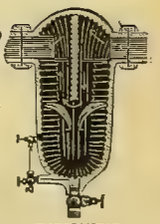

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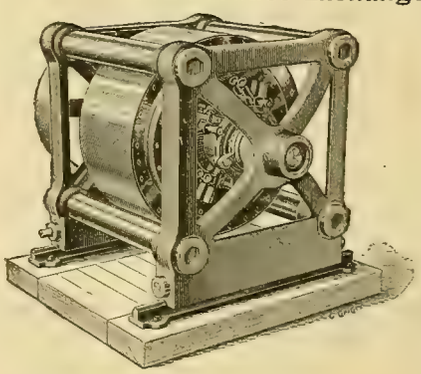

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Western Electrician.

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Vol. X. CHICAGO, JUNE 11, 1892. No. 24

First Electric Mill Tramway in Chicago.

Chicago is often charged with a boastful spirit that is far from becoming to its citizens, but it can be truthfully said that in the direction of utilizing new applications of electricity few cities are in advance of it. Within its borders or in immediate proximity to it can be found all systems of electric lighting and several electric railways. It has electric elevators, bridges that are turned by power transmitted by electricity, and great shops wherein electric traveling cranes form a prominent feature. In one respect, however, the manufacturers of this city have until now been behind their compeers in the East, and that is in the use of electric tramways in shops and yards. This backwardness, however, is now a thing of the past, as will be seen by the illustrations accompanying this article, which show the details of the first electric mill tramway plant in Chicago. Installations of this character have been found very useful in many eastern factories, where it is necessary to transport the raw material or the finished product considerable distances about the factory and yards. Much work of this character is necessary in clay-working establishments, such as brick and tile works and establishments for the production of terra cotta. To the last named class belongs the factory which has introduced the tramway plant forming the subject of this article.

The great and steadily increasing demand for building material in Chicago has brought with it a large use of terra cotta, which is now employed in large quantities on nearly all of the prominent new buildings in the city. Improved processes in the manufacture of this product have resulted in the production of a material that will stand all the variations of climate, and which can be fashioned in any shape and treated almost the same as stone. Consequently a great demand for it has sprung up within the last few years, and many large factories are now employed in its production. One of the most prominent of these is the Northwestern Terra Cotta company, which has just installed the tramway shown in the illustrations, to convey the raw materials to the kilns and to carry the terra cotta back to the drying sheds and yards. The company, whose works are located at Deering, on the Northwestern railroad, concluded to employ electricity as a motive power for its tramway, and contracted, through J. B. Wethrell of the Thomson-Houston Electric company, for the present installation.

In a general way, of course, the plant does not differ greatly from hundreds of others employed in street railway work, but, nevertheless, many difficulties were encountered and overcome that render the installation particularly interesting. As it was required that the cars should enter several sheds, the trolley wires are in many cases as low as eight feet from the track, while in one spot it was necessary to raise them to an elevation of eighteen feet, making a variation of ten feet. In addition to this it was necessary to provide for six curves, the radii in some cases being less than forty feet. Unfortunately these curves were at points where the trolley wires were the lowest. The plant also possesses a peculiar interest from the fact of its being the first of its kind to be installed in Chicago.

FIG. 1. FIRST ELECTRIC MILL TRAMWAY IN CHICAGO.

Current is furnished by a 300 light, 110 volt, incandescent dynamo, which had previously been used for lighting the buildings, and which is driven by an independent engine. The switch-board is so arranged that the generator can be used to run the cars on the tramway or thrown exclusively into the circuit for lighting the factory. Inasmuch as the same dynamo furnishes power for lighting and for the car motors, the earth return system was not deemed advisible, and so double trolleys were used, as will be seen by a reference to Fig. 1, in which a motor car and trailers are shown. The track is so arranged that it forms a loop and returns to the place of starting. In order that the trolleys could follow the entire length without handling, it was found necessary to cross the trolley wires, so that the negative conductor was connected with the positive. The manner in which this was accomplished will easily be understood by a reference to the diagram presented in Fig. 4. A sectional breaker was put in and the opposite terminals of each section were bound together by a cross-over wire, so that the current is fed continuously to the motors An instance of the curves that it was found necessary to employ, with the accompanying overhead construction, is shown in Fig. 2.

The track is about 1 700 feet long, of thirty pound T rail, laid on pine ties placed two feet apart. The gauge is three feet. The overhead construction consists of two No. 2 B. & S. gauge copper wires, varying in height, as has been before stated, from eight to eighteen feet above the track. The point where they are highest and also the loop switch is shown in Fig. 3. Considerable difficulty was experienced in making this switch, owing to the double wire construction. Immediately on taking the loop the line follows an S-shaped curve, Fig. 2, and descends with a continuous lateral curve into a store shed, where the distance from the track to the wires is ten feet. Two more curves of forty feet radius are encountered before the loop switch is again reached.

The motor car is equipped with two Thomson-Houston railway motors, each of 3 horse power capacity, wound for 110 volts, and geared directly to the axles and controlled by a standard railway-stand and switch. These motors have hauled on a level a load of ten tons or more at the rate of five miles an hour. Owing to the great variation in the height of the trolley wires it was necessary to design a special trolley stand for this work. The stand consists of a three inch iron pipe mounted on a flange to which the two trolley poles are attached by a fixture free to revolve and admitting of an independent adjustment of each trolley. The current is taken from the wires by sliding contacts, and is wholly insulated from the car.

The plant was installed by G. B. Seaman under the direction of Geo. P. Nichols, manager of the stationary motor department of the Chicago office of the Thomson-Houston Electric company. It has so far given complete satisfaction to the officers of the Terra Cotta company, and doubtless it will not be long before others of its kind are installed in Chicago.

The city of Ashtabula, O., now owns an electric lighting plant, which it purchased for $12,930. The Westinghouse system is used.

The Baker Submarine Boat.

The last issue of the WESTERN ELECTRICIAN contained a description of the new submarine boat that is now being experimented with in the Detroit river by its designer, George C. Baker of Chicago. The novel craft was given another trial on May 24th before Commodore Folger, chief of the ordnance bureau of the United States Navy, and although the trial was not satisfactory to the inventor of the vessel it indicated that progress is being made in the right direction. From several of the accounts published in the daily papers one would be led to believe that considerable trouble was experienced in keeping the boat submerged and propelling it under water. It is true that such a difficulty was enccountered; but it was expected by the designer, and each test of the boat brings him nearer to the solution of the very nice problems involved. In view, though, of these facts it is but just to Mr. Baker to present an explanation as to the line upon which his experiments are being made.

Those who have not experimented with submarine boats are illy fitted to criticize, and many there are, doubtless, who do not realize that all trials with such a craft, in one sense at least, must needs be successful. The submarine navigator's crowning ambition may be to go under water and stay there for a definite length of time, but as he goes down he carries with him a very natural desire that he may see the surface again. To sink the boat is one thing, to bring it up is another. It is just this delicate problem of how to manipulate quickly and with safety the boat's ballast, and thus increase or reduce the buoyancy without loss of time or great risk to the crew, that is now occupying Mr. Baker's attention.

As was stated in the WESTERN ELECTRICIAN's recent article, the boat was down completely out of sight a number of times, and was maneuvered enough and in a manner to convince even the skeptical that the stay was only a question of an expenditure of power and a careful reduction of buoyancy. The latter desideratum was, of course, to be gauged in that particular instance only by the risk Mr. Baker was willing to take in admitting water. In brief, the critical point in the buoyancy of the craft must be found by repeated experiments. These necessarily numerous trials, requiring not only the greatest care, but also no little nerve on the part of the pilot, take time, and, of course, lead many outsiders to suppose that serious difficulties have been encountered. It must also be remembered that with the boat in its present unfinished condition, and with the storage cells not braced or sealed to withstand pitching about, it is as yet not completely fitted for a thorough test in rough waters.

Improvements are now under way which, it may very reasonably be expected, will enable the pilot to easily and quickly control the water supply, the ballasting of the craft being, of course, the most important matter. As far as the prevention of the battery slipping or the electrolyte spilling is concerned, that is merely a question of detail.

It is worthy of note that Commodore Folger talks most favorably of Mr. Baker's work. In a dispatch from Washington to the *Chicago Herald* on May 29th the commodore is reported by that paper's correspondent as follows: "The trial of the Baker boat was very interesting. It is the first really encouraging thing in the way of submarine navigation we have had in this country, and justifies the hope that something may be done in that direction which shall materially increase the effectiveness of the United States naval force."

When asked whether he thought that the experiments at Detroit pointed to a new line of construction in the navy, he replied: "They certainly indicate that it is worth while forming that class of naval construction. I can tell better of the future possibilities after I have seen the Baker boat in its improved condition."

With reference to the description of the boat which appeared in this journal, a misstatement should be corrected. The 50 horse power motor in the boat which was referred to as having been constructed by C. D. Jenney of Fort Wayne, Ind., was built by the Jenney Electric Motor company of Indianapolis, Ind., as was also the special controlling rheostat and switch.

Electricity at the World's Fair.

Mr. Westinghouse was in Chicago last week endeavoring to induce the World's Fair authorities to reduce the amount of the bond required of him for the faithful performance of the incandescent lighting contract from $1,000,000 to $500,000. He contends that it is unjust to require a bond in an amount two and a half times as large as the total consideration for the work involved. Such a requirement, he thinks, is most unusual and quite unnecessary. The directors of the Exposition company, on the other hand, appear to think that an unusually large bond is demanded by the exigencies of the situation. Mr. Westinghouse was on hand at the meeting of the grounds and buildings committee on Thursday, but no action was taken on that day. On Friday, however, the committee passed a resolution allowing Mr. Westinghouse to furnish a bond of $500,000 in case each surety was liable for the full amount, or of $1,000,000 if each surety was only to be liable for the amount set opposite his name. On Saturday Mr. Westinghouse left for the East. The bond must be filed not later than Friday. In conversing with a representative of the WESTERN ELECTRICIAN the Pittsburg manufacturer said that it was the intention of the company to install dynamos of a greater capacity than any now in use in this country. These huge alternators will be driven by directly connected Westinghouse engines, as there is a constantly increasing tendency, Mr. Westinghouse said, toward the use of this style of engine and dynamo connection. Mr. Westinghouse also confirmed the report that his company intends to establish a large central station plant in Chicago after the World's Fair. He is of the opinion that there is room for another incandescent lighting company in Chicago and intimated that the station would be established some distance from the center of the city, thus obviating any risk of opposition by reason of the smoke nuisance.

In all likelihood the office of the department of elec-

FIG. 3 FIRST ELECTRIC MILL TRAMWAY IN CHICAGO.

tricity will soon be removed from the present quarters in the Rand-McNally building to Jackson Park. Director-general Davis has directed all department chiefs to make the change as soon as possible, as he thinks it necessary for the chiefs to be on the grounds so that they can advise with the construction department and facilitate the work. Department offices will be maintained at the Rand-McNally building for some time, but the intention is to concentrate all the national offices at the park as soon as possible. Chief Barrett and Secretary Hornsby will establish temporary headquarters in the horticultural building, which is practically completed. The change will probably be made in a week or so.

Chief Barrett returned from his western trip last week.

The names of the deceased electricians that are to adorn the electricity building are now being placed in position in all the prominence of bold lettering in staff. A curious error was made in preparing the mould for the name of Wheatstone. The "h" was left out, and it appears as "Weatstone" in the cast. This, however, will soon be rectified.

A curious idea has entered the heads of several Milwaukee people. The WESTERN ELECTRICIAN's correspondent at that city writes: "The Milwaukee exposition directors are considering the advisability of getting up a mammoth electrical exhibit as a World's Fair attraction in this city. No exposition will be held next year, and the plan, which was proposed by W. N. Stewart, is to have an electrical display that will eclipse the one at the Columbian Exposition, both in size and merit. It is stated that the electrical interests have not been allotted sufficient space at the World's Fair and that electricians are disappointed in consequence. The plan has caused considerable discussion among electricians. There does not seem to be much chance, however, that it will be carried out. The expense and the short time remaining are urged against it. It is argued, moreover, that the exhibit would have to be greatly superior to the one at the Columbian Exposition in order to draw any considerable number of people to Milwaukee."

Milwaukee manufacturers, who have been rather slow about arranging for exhibits at the World's Fair, will take a trip to Jackson Park in a few days. Special cars

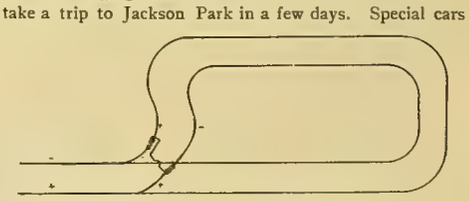


FIG. 4. FIRST ELECTRIC MILL TRAMWAY IN CHICAGO.

and reduced rates have been secured, and they will be transferred to the park without changing cars. C. C. Rogers, president of the Advancement association, is chairman of the committee that has the matter in charge.

FIG. 2. FIRST ELECTRIC MILL TRAMWAY IN CHICAGO

The annual financial statement of the Rocky Mountain Bell Telephone company shows that the paid-up capital stock amounts to $305,000 and places the value of its franchise at $195,000. The company's surplus is $64,904.38 and its reserve fund $36,992.95.

GENERAL MEETING

Of the American Institute of Electrical Engineers, Chicago, June 6, 7 and 8, 1892.

Prominent electrical engineers from all parts of the country assembled at the Grand Pacific Hotel, Chicago, June 6th, to participate in the ninth general meeting of the American Institute of Electrical Engineers. This is the first visit of the Institute to Chicago, or to the West, and, in fact, the second meeting of the Institute outside of New York city. The other occasion was the meeting at Boston two years ago. The action of the Institute in coming to Chicago is but another indication of the fact that electrical engineers throughout the country are looking to Chicago as the great center of future operations of electrical engineering.

The Institute's Executive Officers.

In the selection of executive officers for the present year the American Institute of Electrical Engineers has displayed excellent judgment, and it may be expected that, under the new president, the association will prosper and extend its influence. As has already been announced, Frank J. Sprague has been chosen president, while Ralph W. Pope and George M. Phelps have been retained as secretary and treasurer. Portraits of these gentlemen are presented in the accompanying illustration.

THE INSTITUTE'S EXECUTIVE OFFICERS.

2. Ralph W. Pope, Secretary. 1. Frank J. Sprague, President. 3. George M. Phelps, Treasurer.

Frank J. Sprague, the newly elected president, has earned this recognition at the hands of the Institute by the active interest he has always shown in its growth. He has gained distinction as an electrical engineer and inventor by his work in developing the electric railway and the application of electricity to the transmission and utilization of power. No man in the electrical field has worked harder and accomplished more in the face of what at times appeared to be insurmountable obstacles than Lieut. Sprague. Entering the field at an early day, Lieut. Sprague did not enjoy the advantage which the experience since gained has been to motor builders. He was obliged to secure his knowledge by experimental work at great expense, and not without many great disappointments and failures. His early experience, however, had fitted him for the work he had engaged in, and repeated failures only increased his determination to secure an ultimate victory.

Lieut. Sprague is still a young man, having been born at Milford, Conn., July 25, 1857. His ambition and energy led him to engage in a competitive examination for appointment at the Annapolis Naval Academy in 1874, and he was successful. During his four years' course he applied himself diligently, and was graduated with distinction. He served for several years in the navy, improving his opportunities, and devoting considerable attention to electrical subjects. In 1882 he was commissioned by the government to visit the Crystal Palace electrical exhibition. He was made the only American member of the jury, and was also made secretary of his section. His report to the navy department was an excellent piece of work in every way, and even now is highly valued. It need hardly be said that the exhibition afforded him many opportunities for renewed experiment, especially in the field of electrical power. Mr. Sprague was confirmed more than ever in his belief as to the possibilities of the electrical transmission of power, and he resolved to devote himself entirely to the problems awaiting solution in that field. At the Philadelphia electrical exhibition he displayed several motors bearing his name. The work done by the motors, and the ingenious principles involved, created so favorable an impression that the formation of the Sprague Electric Railway & Motor company followed at once, and, in fact, the company was barely formed before it was overwhelmed with business. But here was another difficulty. The first important contract that the company assumed, the equipment of the Richmond street railway with electric motors, might have proved the death blow to the new enterprise had it not been for the energy and perseverance which Mr. Sprague displayed in his management of this project. Mr. Sprague has given a very interesting account of his experience at Richmond in an address before the National Electric Light Association convention at Providence, R. I., in February, 1891, from which the following is taken: "Few of you are familiar, perhaps, with the inside difficulties with which we had to deal in the history of the electric railway, and the amount which it was necessary to conceal from the general public. The contract for the road in Richmond was taken in 1887. I had never seen the road. I remember to this day the impression that came over me subsequently when I went to Richmond and saw a grade of 10 per cent. My heart fell within me, and I said it is utterly impossible for any car to climb that hill. I returned to New York for consultation. Is it possible for any car to mount a 10 per cent grade? was the first question. Everybody said it was not, and I confess that I myself was of the same opinion. Shall we use a cable on that 10 per cent. grade and trust to electricity for the balance, or shall we change the gearing of the machine? was the next query. We were advised to find if we could get up the grade at all. Back to Richmond I posted. I started out one night when there had been an election, and when the streets were filled with a crowd of drunken men. We went down in great shape, and then just before us was this grade. I said to the superintendent, 'We cannot mount it.' 'Well,' he said, 'it will go up, and I will bet you $5 I will take you up.' We started and we mounted the hill. When we got to the top it had settled the question of traction on a 10 per cent. grade. It had settled likewise that the motors we had were altogether too small and too light, because they were hotter perhaps than the furnace in an electric welding apparatus. On getting to the top we thought the best thing we could do was to stand still a little while. I remember one of my assistants, Mr. Greene, was with me. I said to him: 'Greene, I think we had better send for some instruments. I think a little accident has happened to one of the machines.' So we lay down in the bottom of the car until he brought those instruments. They were four strong mules, for it was necessary to get that car back into the car shed that night."

HEADQUARTERS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

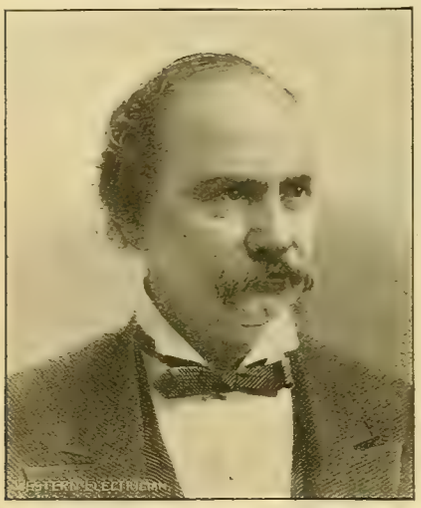
This was but one of many incidents related by Mr. Sprague, which shows how much energy was required on the part of the projectors of the electric railway; but all these troubles and many others were finally overcome. The electric system, greatly improved through the experience gained by Sprague and his associates in these early days, has greatly extended its field, and the reputation and fortune which the exploiters of the great enterprise have gained have been fairly won and are well deserved.

Mr. Sprague has not been content, however, with the accumulation of a fortune. He has gone on experimenting and investigating in practically new fields. He is greatly interested in the problem of rapid transit for New York, which is now engaging many of the leading minds in the electrical world. He has already submitted plans for a system of underground railways, and has, of course, advocated the adoption of the electric motor. That he believes in the electric railway, and that his mind is still occupied with great public questions, will readily be understood by all who listened to his able inaugural at the Chicago Electric club last Monday evening.

The secretary of the Institute, Ralph W. Pope, has been identified with the association from its earliest days, and was one of the first men to recognize the good to come from such an organization. He has served successfully for several years; in fact, since May, 1885, he has held the position, and has discharged the duties of the office satisfactorily to all. He has made a constant study of the workings of other associations, and has endeavored to profit by

their experience, as well as introducing new features of his own. The results speak for themselves. Although his work as secretary of the Institute has occupied a large part of his time, Mr. Pope has contributed largely to the electrical literature of the day, and is now publishing *Electric Power*.

George M. Phelps, who in 1885 was elected one of the managers of the Institute, was made treasurer in 1887, and has held the same office continuously since that date, having been re-elected each year. His careful attention to the duties of the office, together with his extended business experience, have been of great value in the financial administration of the affairs of the Institute. Mr. Phelps is well known in the electrical field, first in the shop of the American Telegraph company, of which his father was superintendent from the organization of the company till



DR. NORVIN GREEN, PAST PRESIDENT AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

its absorption by the Western Union Telegraph company in 1866. When the latter gave up manufacturing in 1879 and disposed of its factory to the Western Electric company, Mr. Phelps was appointed superintendent of the factory, which position he held until December, 1885. Early in 1886 he joined Franklin L. Pope in conducting the monthly *Electrician and Electrical Engineer*, acquiring a proprietary interest therein soon after. When the *Electrical Engineer* was expanded to a weekly and its business incorporated, he became, and now remains, president of the corporation.

History of the Institute.

Readers of electrical journals during the last four years are, of course, familiar with the fact that many important electrical investigations have been brought to public notice through the proceedings of the American Institute of Electrical Engineers. It is impossible to determine just what bearing and influence these publications have had upon general electrical progress, but it is certain that the active minds of many inventors were thereby stimulated to new efforts, and the march of improvement accelerated accordingly.

The first visit of the Institute to Chicago as an organized body may be looked upon as an indication that this city has become a great electrical center. When the Institute, two years ago, held its general meeting in Boston, the fact that the greatest electric railway system in the country was then being constructed in that city was influential in determining the choice. To-day the active preparations for the Columbian Exposition in Chicago have led to the choice of this city for the general meeting of 1892.

The meetings of the Institute are devoid of the bustle and excitement of the electric light and street railway conventions. There is no conflict in which the supply men are on one side and the active members on the other. The overhead lamb and the underground lion repose peacefully side by side, and neither one is yet inside the other. Occasionally the continuous and alternating current disputants have grappled in the arena, and the double reduction and the gearless motor advocates have met in verbal strife, but the motto always seems to have been: "There is good in everything."

It was in 1884 that the keel of the Institute was laid, and the great and dignified American Society of Civil Engineers lent a helping hand to steady the frail craft until it was sufficiently seaworthy to pursue its own course. Eight years is not a long period of time as history is made, yet it has seen a vast electrical development, as one may realize by glancing through the columns of the Western Electrician, for instance, and noting what enterprises have sprung into existence since 1884. There were prophets in those days, however, and the dynamo had even then become a machine of marvelous efficiency. Its companion, the electric motor, had not been recognized as worthy of association with the dignified Corliss engine or the speedy and powerful steam locomotive. The arc lamp and the incandescent had forged their way to the front through pure merit. But there had been no era of smooth sailing. One weak point after another had been eradicated; with the removal of one obstacle another arose in its place; and out of these trials and tribulations the electrical engineer was evolved. He was, perhaps, sneered at by the mechanical engineer, for many of his devices were crude; but what he lacked in skill he made up in perseverance and enthusiasm. Progress had been such that an electrical exhibition was proposed to be held in Philadelphia in the autumn of 1884, under the auspices of the Franklin Institute. At the same time, an electrical conference was organized under government authority. The one thing lacking, the want of which was immediately apparent, was a national society of electrical engineering. Unfortunately the American Electrical society, which had been organized in 1874 for a similar purpose, had passed out of existence at the very dawn of the new electrical era. At one of the last meetings of its Chicago branch the Edison system of incandescent lighting had been described by George H. Bliss. Like many other equally promising movements, this society was launched too soon. When the organization papers of the Institute were circulated in 1884, the project was received with enthusiasm. Every man interested in electricity was willing to sign his name to the call, and out of 279 there were 155 who subsequently proved their faith by their works, and paid their entrance fee and first year's dues. The Institute started off with a boom, and really accomplished more in its first year's existence than most societies which are organized upon similar lines. In the eyes of the worldly minded, however, it had not given to each member the value of the money he had invested, and there were many who, seeing neither fun nor profit in the future, did not respond with the advent of the new year.

Portraits of past presidents of the Institute are herewith presented. These gentlemen are all actively engaged in electrical matters, and their faces are familiar to many. Some of them, through their valuable discoveries and inventions, are known the world over, and all are known to those who have been familiar with electrical progress in this country. Each has contributed largely in his own special line to the advancement of electrical interests, and

FRANKLIN L. POPE, PAST PRESIDENT AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

in every case it may be said that the honors and distinction gained have been merited.

Dr. Norvin Green, president of the Western Union Telegraph company, had been elected as the first president of the Institute. Nathaniel S. Keith, its founder, was chosen secretary, and Col. Rowland R. Hazard treasurer. Other officers elected at that time were as follows: Vice-presidents, Prof. Alexander Graham Bell, Prof. Charles R. Cross, Thomas A. Edison, George A. Hamilton, C. H. Haskins and Franklin L. Pope; managers, Charles F. Brush, W. H. Eckert, S. D. Field, Prof. Elisha Gray, Prof. E. J. Houston, M. L. Hellings, F. W. Jones, George B. Prescott, W. W. Smith, Prof. William P. Trowbridge, Theodore N. Vail and Edward Weston. Just after the first general meeting of the Institute was held in Philadelphia, Secretary Keith secured a position in California, and practically abandoned his post as secretary, T. C. Martin, as acting secretary, filling out his term of office. In May, 1885, Ralph W. Pope was elected secretary, President Green and Treasurer Hazard being re-elected. The vacancies occurring which, under the rules, could not be filled by re-election, led to the choice of D. H. Bates, A. E. Dolbear, F. W. Jones as vice-presidents; C. L. Buckingham, David Brooks, T. C. Martin, Geo. M. Phelps, Jr., Prof. B. F. Thomas and W. D. Sargent as managers.

It had become evident that nothing was to be gained by the selection of officers who should represent the whole country geographically. They were either too busy to give attention to the Institute, or deemed it of trivial importance. There was a small minority which continued its faithful watch over affairs, but in an attempt to secure

T. COMMERFORD MARTIN, PAST PRESIDENT AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

a national representation, the council was so weakened in available working force that there was imminent danger of its succumbing to the fate of its predecessor, the American Electrical society. The only offset to the element of scattered members of council was felt to be in securing officers nearer headquarters who could and would take an interest in building up the Institute. Among those who showed themselves to be in earnest and strong in their determination that the Institute must succeed, were such men as the late Major Otho E. Michaelis, the late Sidney F. Shelbourne, C. O. Mailloux, Dr. Schuyler S. Wheeler, Francis B. Crocker, T. Commerford Martin, Joseph Wetzler, Franklin L. Pope, George M. Phelps, F. W. Jones; also many others who, by the example thus set, subsequently became members, and added the weight of their influence to that forward movement begun in 1887 under the presidency of T. C. Martin, and which has never since faltered.

It was at the May meeting of 1886 that the idea of a "workingman's ticket" was suggested, and candidates for council were nominated with the object of securing men who could be depended upon to assist in making the Institute a recognized national organization of electrical engineers. Franklin L. Pope was elected president; Norvin Green, Thos. D. Lockwood, Geo. C. Maynard and Prof. W. A. Anthony, vice-presidents; C. O. Mailloux, Sidney F. Shelbourne, Capt. O. E. Michaelis, and Prof. C. F. Brackett, managers. It was believed that in New York and vicinity there was sufficient material to give character to the meetings, which was alluded to in the secretary's report at the annual meeting in 1886 as follows:

> The importance of the various electrical problems which are continually being brought to public notice points to the advisability of holding monthly meetings for the discussion of current topics. There are in New York and vicinity a sufficient number of members to make such meetings successful, especially if those who are capable and have had ample electrical experience will perform their duty in the preparation of suitable papers for presentation on such occasions. I can see no reason why such a gathering might not be held monthly in conjunction with the regular meetings of the council under existing arrangements. A suggestion of this kind was made by my immediate predecessor, but not having been acted upon, I feel it my duty to state that I consider something of this kind absolutely essential to the future prosperity of the Institute and earnestly recommend that the matter be taken up at this meeting.

This recommendation was subsequently acted upon, a special meeting being held in June of the same year in order to determine the practicability of the plan before it was forgotten. As the Institute at that time had no per-

manent quarters of its own, and there was some doubt about gathering a respectable audience, it was arranged that the members should meet for dinner at 6:30 P. M., after which a paper should be read and discussed. The first of these meetings was held during the presidential term of Franklin L. Pope in 1886, and they became so successful that they have been continued ever since. While these meetings have been held in New York all members in the country are notified of their occurrence, and at nearly every meeting members are present from various parts of the United States. As soon as it became evident that these monthly meetings would be a permanent feature of the Institute another innovation was introduced. New developments in electrical practice followed in such rapid succession that it became evident that the yearly publication of the "Transactions" would not suffice. It was therefore determined to issue them monthly. This involved an additional outlay, but the rapid increase in membership permitted it, and it was believed that every possible method should be adopted consistent with prudent management in order to increase the value of membership. No restriction was placed upon the publication in the electrical press of the papers and discussions, excepting such regulations as were subsequently found necessary in order to prevent their premature circulation.

Owing to the constitutional law by which one-half the vice-presidents and one-third of the managers retired each year, no sudden change in the personnel of the council could be effected, but the good results arising from the infusion of new blood had already manifested themselves, and at the annual meeting, in May, 1887, T. Commerford Martin was elected president, with Franklin L. Pope, Col. Rowland R. Hazard and Prof. W. A. Anthony vice-presidents, and Dr. S. S. Wheeler, Joseph Wetzler, A. C. Fowler, and Wm. Lee Church as managers, and Geo. M. Phelps, Jr., treasurer.

When Volume 5 of the "Transactions" was completed, covering the meetings of 1887-8, it was decided by the council that if it was permanently bound in cloth it would be far more acceptable to the members. This was accordingly done, and each member in good standing received for that year a handsome volume, containing as a frontispiece a portrait of Past President Franklin L. Pope. Since that time the monthly parts issued regularly have formed a yearly volume of about 600 pages, and complete sets of the entire eight volumes have become exceedingly scarce, and are much sought for by the public

PROF. W. A. ANTHONY, PAST PRESIDENT AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

libraries of the country, which are now experiencing a remarkable demand for electrical literature.

The administration of President Martin is notable as being the turning point in the history of the Institute. Since its organization much valuable work had been done, but few people were aware of it. The Institute had lost prestige because it had no permanent abiding place. A very promising movement was undertaken to secure funds to buy a house, but another similar effort on the part of the New York Electric club conflicted with it, and it was decided by the council that it would be best to suspend all efforts in that direction until the mission of the Institute was better understood. The work of increasing the membership was vigorously pursued. A circular was prepared showing what had already been done and containing a list of members, then numbering about 170. A copy of this, with an application blank, was sent to every electrical engineer whose name could be obtained. This work, following, as it did, immediately after the general meeting of 1887, at which Prof. Elihu Thomson read his celebrated paper on "Novel Phenomena of Alternating Currents," attracted attention to the Institute as being an organization well worthy of general support, and the effect was marvelous, as may be seen by the record of elections for that year. During the year 1886 24 new associate members were elected. In 1887 there were 171 elected. This activity so encroached upon the time of the secretary, that it became necessary for him to devote his attention almost exclusively to the work of the Institute and on May 1, 1886, a business office was leased and furnished in Temple Court, which also became the eastern headquarters of the WESTERN ELECTRICIAN during the two years it was so occupied.

At this time Edward Weston was elected president, and Prof. Elihu Thomson, Francis R. Upton and T. C.

PROF. ELIHU THOMSON, PAST PRESIDENT AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Martin vice presidents; Charles Cuttriss, Geo. B. Prescott, Jr., Thos. D. Lockwood and William Maver, Jr., managers. At the general meeting the same year another important event attracted world-wide attention. This was the first public announcement of Nikola Tesla's "new system of alternating current motors and transformers." The Institute had now fairly attained that standing which had been the ambition of its supporters. It was the recognized channel through which the results of electrical researches should be given to the public. Heretofore they had frequently been read before other societies which were not always competent to handle them. There had been a gradual improvement in the quality of the papers, and latterly every year has witnessed the production of at least one of such importance as to make a lasting impression upon its page in the electrical history of the world.

In 1889 Professor Elihu Thomson was elected president, Edward Weston, Major O. E. Michaelis and Prof. Edward L. Nichols vice presidents; Dr. F. Benedict Herzog Dr. William E. Geyer, H. C. Townsend and Henry Van Hoevenbergh managers. While it was not expected that President Thomson could give personal attention to the duties of the office, the pains he had taken to bring before the Institute the results of his investigations and experiments had been exceedingly beneficial in attracting attention to its work. It had also been shown that the growth of the Institute was now steady and natural, and with a permanent secretary, whose attention was almost entirely devoted to its affairs, it need not be expected that the president should be present at all of its meetings. On April 2d, however, President Thomson delivered an exceedingly interesting experimental lecture at Columbia College on "Phenomena of Alternating Current Induction," which was attended by about 700 ladies and gentlemen. The choice of president for the year was especially fortunate, for this was the date of the Paris Exposition, and President Thomson was one of the few electricians in the party of engineers which visited Europe in 1889. As president of the American Institute of Electrical Engineers he responded to the toast of The American Electrical Engineers" at the Lord Mayor's banquet at Guild Hall. The same year an official delegation representing the Institute was in attendance at the Paris Electrical Congress, and it was there that the Institute extended an invitation to the participants to hold the next Congress in America on the occasion of the World's Fair, which it was then expected would be held in 1892.

At the annual meeting in May, 1890, Prof. William A. Anthony of Manchester, Conn., was elected president, Francis R. Upton, Frank J. Sprague and Joseph Wetzler, vice-presidents, and [illegible] managers. It was decided to hold the general meeting in Boston for various reasons, one being that both the retiring president and the president elect were from New England and that the membership in Boston and vicinity was about 50, so that a sufficient attendance could be depended upon to insure a successful meeting. One day was devoted to the reading and discussion of papers and the second to an inspection of the West End street railway system and the Thomson-Houston factory at Lynn. The meeting was a most successful one in every respect, and a very pleasant feature was a banquet in honor of the Institute given by the Boston Electric club.

On June 1, 1890, the headquarters of the Institute were removed to the house of the American Society of Mechanical Engineers, 12 West Thirty-first street, where they are still located. The building is admirably suited for the purpose, and the arrangement has proved entirely satisfactory to both societies. Under the terms of the lease the Institute has a fine office for the secretary, in which the monthly meetings of council are held, also joint use of the library, and of the auditorium, which is equipped with an electric focusing lamp for exhibition purposes.

In September the Institute took up the question of the adoption of American names for electrical units, recommending that the names of Franklin and Henry be commemorated in this manner. It was a noteworthy feature of the administration of President Anthony that, although living a hundred miles away from New York city, he never failed to be present at the meetings, of which ten were held during the year. As a compliment to his fidelity, one of his admirers, at the close of his term, presented the Institute a fine crayon portrait of the retiring president, which now graces the walls of the auditorium.

The annual and general meetings of 1891 were held in New York city. Professor Alexander Graham Bell was elected president; Thos. D. Lockwood, Carl Hering and Wm. J. Hammer, vice-presidents; and Dr. Louis Bell, Herbert Laws Webb, Prof. A. G. Compton and James Hamblet, managers. Vice-president Lockwood presided at nearly all of the meetings during the year, it having been understood that President Bell, in accepting the office, would be unable to be present on account of his absence from the country and his time being fully occupied in other

ALEXANDER GRAHAM BELL, PAST PRESIDENT AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

fields. It is needless to say that the affairs of the Institute have been faithfully administered at the hands of its active vice-president, who has made many trips between Boston and New York for this sole purpose, and he is by no means a gentleman of leisure excepting as he fairly earns an occasional holiday by his exceedingly methodical business habits.

Until the present year it has been the practice to hold the general meeting immediately after the annual meeting and election, which is fixed by the rules for the third Tuesday of May. This year, on account of the later date appointed for the general meeting at Chicago, the annual meeting was made a distinct event, and devoted strictly to the business affairs of the Institute. It was called at 4 P. M., May 17th, and the annual reports of the council, secretary and treasurer were read, audited and accepted. The total membership was shown to be 615, the net increase during the year having

been 74. The net receipts were $5,960.43, and the net expenses $5,952.10. By direction of the last annual meeting $500 was added to the building fund, which, together with the current balances of secretary and treasurer, amount to $1,121.09. At the same meeting Frank J. Sprague was elected president; A. E. Kennelly, Nikola Tesla and Oscar T. Crosby, vice-presidents; and Charles Wirt, Dr. Michael I. Pupin, Angus S. Hibbard and Charles P. Steinmetz, managers. George M. Phelps was re-elected treasurer, and Ralph W. Pope, secretary. After adjournment the members re-assembled at "The Arena," 41 West Thirty-first street, where the first annual dinner was served to sixty members and guests, among whom was Prof. George Forbes of London. President F. J. Sprague presided, and the speakers of the evening were Thos. D. Lockwood, Oscar T. Crosby, Dr. Louis Duncan, Dr. Charles E. Emery, Franklin L. Pope, T. C. Martin, and Oberlin Smith. It was the first purely social gathering of the Institute, and was so thoroughly enjoyed that it was voted that it be made hereafter a regular yearly practice.

The prestige of the Institute is now such that there can be no question as to its future prosperity. Its interests and policy are so carefully watched and guarded by the council that it does not seem possible for disaster to overtake it. One of the needed reforms, however, has been the devising of a different plan for conducting its elections, and a special committee has been appointed for this work, which will report at the Chicago meeting. The American Institute of Electrical Engineers is not only a national, but an international society. Every branch of electrical science is represented in its ranks. It aims to stand abreast of the great engineering societies of the country, of which it is the fourth in respect to age and total membership. The present year is looked forward to

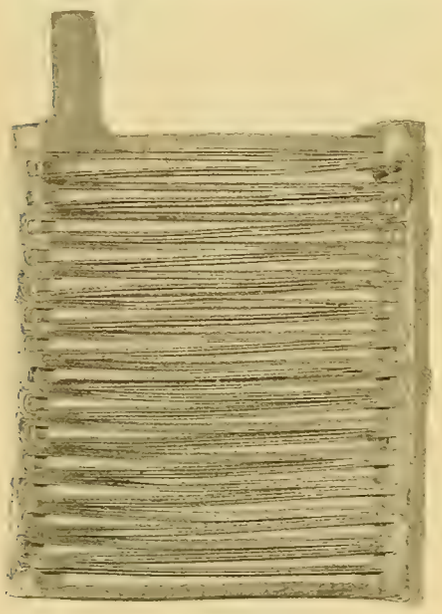


FIG. 1. STORAGE BATTERY FOR LAUNCHES AT THE WORLD'S FAIR.

as the one which will surpass all others, not only in growth of membership, but in the importance of its transactions, and it is gratifying to note that in the programme for the Chicago meeting the great West is so generally and ably represented.

Institute Members Entertained.

Members of the Institute and invited guests visited Pullman and the World's Fair site Monday afternoon. They were given every facility for examining both points and found much to interest them. In the evening, upon invitation of the Chicago Electric club, the Institute members gathered at the new home of the Electric club, and took part in the formal opening of the rooms. B. E. Sunny, president of the club, presided at the meeting, and introduced Lieut. Frank J. Sprague, the newly-elected president of the Institute, who delivered his inaugural address. There were quite a number of prominent visitors present in addition to the members of the Institute, and the new club rooms were taxed to their utmost capacity. The management had prepared a lunch for the occasion, and after the meeting the members and guests passed several hours in exchanging views.

The use of electric cars for funerals, in cases where the lines are available, is increasing in Pennsylvania and Ohio.

Storage Battery for Launches at the World's Fair.

In all probability it will not be long before the question is decided as to whether the launches to ply in the lagoons at the World's Fair grounds shall be operated by electric power. The official test was to have been made June 1st but only one electric boat was ready—that of the Columbian Launch company. On Wednesday, June 1st, the Columbian company's boat was run on the lake from the river out to the fair grounds. The trip was made on a rough sea but from all accounts the little vessel behaved admirably and both the builders and the storage battery people were enthusiastic in praise of the manner in which the electrical apparatus operated.

As the success of any electric launch as a bidder for favor with the management of the exposition must necessarily depend mainly on the efficient working of its source of power, there has been a great deal of interest displayed in the batteries with which the vessels will be equipped. Through the courtesy of the American Battery company, Chicago, the WESTERN ELECTRICIAN is enabled to present a description of the cell that is employed in the boat that has been prepared for the competitive test by the Columbian Launch company. This battery was invented by William Morrison of Des Moines, Ia., and is manufactured by the American Battery company.

This secondary cell, although one of the latest on the market, is in reality in form one of the oldest storage batteries known. It is strictly a Plante cell, no applied active material being used in its construction. The peculiar feature of the cell lies in the fact that the active material is formed out of the pure lead plates by the Plante process in a remarkably short space of time.

The plates are made of pure strip lead, Fig. 1, three-eighths of an inch in width, being bent at the ends so as to form parallel layers. A slot is cut in the two edges of the plates, into which a strip is inserted and the two edges of the plates are then firmly soldered together. The positive and negative plates are made exactly the same. In manufacturing the plates are put through the forming process, taking only about ten hours. About one-half of the lead is turned into an oxide, forming the active material, leaving the other half as a conductor or support, Fig. 2. This mode of construction allows great expansion and contraction, and therefore a very rapid charging and discharging is permissible without in the least injuring or to use the common expression, "buckling the plates." As the capacity of any plate depends to a large extent on the amount of surface exposed, the capacity of this plate is very considerable. The plates are 6 by 7 inches and nine plates are used in each cell, Fig. 3. Each plate contains, it is figured, about four square feet of surface. The cells when filled with electrolyte, and ready for use, weigh 37 pounds, with a capacity, it is claimed, of over 200 ampere hours.

The electrical equipment of the Columbian Launch company's boat consists of a five horse power Jenney motor, placed under the aft deck. The armature of the motor is connected directly to the shaft of the 24 inch screw. The power is supplied from 104 of the American Battery company's storage cells placed under the deck of the boat. The cells are coupled in series of fifty-two each, and by means of a very ingenious switch in the bow, thirteen, twenty-six or fifty-two cells can be thrown in, giving the boat three rates of speed. The screw can also be reversed at the three speeds mentioned. No rheostat is used.

Some Points for the Electrical Engineer.[1]

By Horatio A. Foster.

It has been the fortune of the writer during the last ten months to visit and inspect, both technically and financially, considerably more than a hundred central lighting stations.

Taken as a whole, it really seems as if much of the ordinary commercial common sense and the usual keen judgment of self-interest had been on a vacation when these plants were erected. In many cases this traces back first to the wiles of that slickest of all individuals, the agent, who is always willing to assure the buyers that his system of lighting will virtually run itself, and then to the fact that people were formerly so doubtful of the prospective profits that on going into the business they invested the smallest amount that would start the work. The consequence was bad construction, bad machinery, bad lines, and of course, an entirely unreliable service. Oftentimes the man put in charge was a novice, and that worst of all novices for the business, the local amateur electrician; and is it any wonder that the business was a failure for the first few years?

There is probably no business extant which has been built over so many times, and that has had the same quality and quantity of brains applied to it that is in such chaos as to the proper design of building and arrangement of machinery. In cotton or any other weaving industry, machine shops, foundries and similar establishments, it has long been determined which is the best form of building to erect, and those put up in the last ten years or so of a similar industry are planned in the same lines, differing only in size to suit the special case. Now, this not only fails to be the case in electric lighting, but outside of the two prominent systems of connecting the dynamo to its power—that is by direct belting to fast running engines, or by countershaft to larger slow running engines, there are scarcely a half dozen stations in the state of New York built on the same or similar lines.

If some action could be taken by this Institute through a committee which should examine into proper station design and report on some few general plans and suggestions as to lines to be followed, it might go far toward establishing a better backing for our members who are in that branch. As it is, I think it will be acknowledged that far more electrical engineering skill is applied to the larger isolated plants, and that the central stations are enlarged or rebuilt under the management of the local superintendent or board of directors, who frequently lack technical knowledge or even familiarity with recent improvements elsewhere. Quite often this is owing to the fact that the only experience they have had with an electrician has been the generally young, inexperienced expert who was sent out to install the first plant, and they think they can make better use of their money by controlling it themselves.

The method of distribution should also have consideration, especially in reference to the amount and style of underground work which certain sizes of city will be able to stand.

This may seem a large question, but you can be assured it is one of the most vital importance to the future welfare of the industry. It may be said that it is not well to interfere in private business, and that electrical engineers can be trusted to remedy the evil. I assure you the electrical engineer individually "is not in it," to use a vulgar phrase, and sad to say, has never been in it to any extent. Quite often officials of the electric lighting companies take a jaunt through the country visiting different stations for models for a new one for themselves. This often results in a worse muddle than ever, as they seldom find two stations at all similar, and they return resolved to use their own judgment.

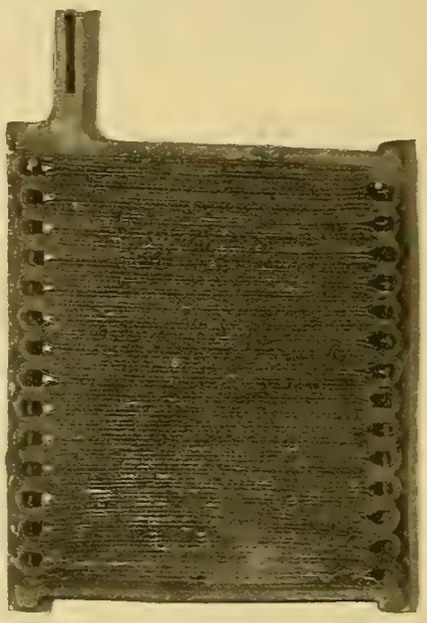


FIG. 2. STORAGE BATTERY FOR LAUNCHES AT THE WORLD'S FAIR.

This leaves the real electrical engineer out in the cold, at a point where if known he could by consultation do much good; but many of these company officials never heard of the American Institute of Electrical Engineers and need to have it brought to their notice in some way.

Some may think that in time the electrical engineer will be called in and consulted, as are engineers of other works, but at the present rate I am afraid many will be angels or worse before the majority of electrical central station companies come to that point.

Perhaps if instances be mentioned under the following heads a better understanding can be arrived at, viz.: Location; foundations; construction of station; motive power; arrangement of machinery, and location and construction of lines.

The location of plants is not now so generally bad as in the past, although we occasionally find a station in a location for which no excuse is apparent, as, for instance, one located in the basement of a carpenter shop at a long distance from fuel supplies, and only plenty of condensed water to recommend it; insurance rate, three per cent. or more. Another located nine miles away from a village of two thousand people to take advantage of water power never surely available all the year, and since destroyed entirely for the greater part of the year. Another place so low down in reference to its water power as to be flooded in freshets. Another located more than a mile from fuel supplies and the center of distribution at the top of a long, steep hill, with not even free water, to recommend it. Another so located in relation to a very intermitttent water power as to be unable to take advantage of the water for condensing purposes, and now running the poorest kind of

1. Abstract of a paper read at the general meeting of the American Institute of Electrical Engineers, Chicago, June 6, 7 and 8, 1892.

a slide-valve engine. Another located in a rickety, old, uncared-for part of a gas-house, where coke is scarce, and apparently plenty of water power available within a half mile.

Another located a long distance from center of distribution and coal supplies, to take advantage of cheap land and cheap fuel, the last of which has since proved very unreliable, when seemingly land could have been had much more central, with a much surer supply of cheap fuel, and to cap all, the value of that land has since increased enough to have paid the entire cost of the station at any moment it be desirable to sell.

One advantage of some of the older centrally located stations has since been learned in the increase in value of such real estate. One such station visited will enlarge and rebuild soon, and will sell its present real estate for enough advance to go far toward paying for the new station, and there are others which can, I think, tell the same story. In fact, in the present problematical growth of the future, a well-selected piece of ground may prove a very valuable part of the investment.

Foundations are now much better than in the past, and some of those now placed under dynamos would sustain almost anything that could be put on them. Poor foundations are occasionally seen, though, as for instance those under a large bank of boilers in a station which was erected and started in six weeks. The boilers have since lurched forward until the fronts are some two or three inches out of plumb. In fact too little attention seems to have been paid to boiler foundations as a general thing.

Engines have fared better and when the ground has been good the foundations are to be little criticised.

One station has very large Corliss engines and owing to water soaked ground and limited time in which to build the brick foundations, they were placed wholly above the floor level of the dynamo room, and belts run both ways from the flywheels to shafting on either side of the room.

Very few bad dynamo foundations are now met, but many unbalanced armatures are found, which no amount of foundation would hold steady.

In station construction there has been no settled design, therefore the promoters have generally built as they saw fit, occasionally following suggestions of the agent. Of course many plants are located in buildings already up, in which case the machinery had to be made to fit.

In many of those built especially for the work, no attention has been paid to designing for a low insurance rate, and brick stations are found sheathed all over the inside with pine, the one thing that insurance inspectors always criticise. A couple of coatings of whitewash or paint would have been much cheaper, safer and looked quite as well.

When stations have been remodeled, very little improvement has been made in the smaller ones, but those in large cities have generally taken advantage of all the improvements to date, if not too strongly attached to some one parent company.

The selection of motive power has of course been governed by local conditions; in the northern and northwestern part of New York state, water power is abundant and is largely used as motive power for stations, but almost invariably with steam reserve.

Water power alone has been found very difficult to govern for uniform speed, and some of the devices used for that purpose are to say the least ingenious.

When the load is large enough to use part steam there is no trouble whatever, as the wheel takes a steady load and the engine does the governing.

Plants are sometimes placed a long way from the work in order to take advantage of the water power and in some cases it seems as if all else had been sacrificed to that one point.

Of engines there is no end to the different designs, style and sizes used. Some use high speed, belted direct to dynamos, others slow speed belted to counter, some simple non-condensing where compound condensing would be decidedly best.

I know of at least three plants located in waterworks pumping stations, using high speed simple non-condensing engines on a practically steady load, all of which have been erected during the last three or four years.

Two stations I remember having an all night and every night load of arc lights and situated on a lake shore which run high speed simple non-condensing engines.

To offset this there is one station that deserves mention as it embodies many points of value. The building is substantial, of brick, two stories high, and on a river bank. The boilers are very efficient and well set, the engine is a moderate speed compound condensing, with shaft extended for three dynamo pulleys, and one for the power condenser. There is a heater between the exhaust and condenser and a power pump attached to one side of the condenser. The flow to the boilers is governed by a bypass valve, as the pump is of course in motion all the time the engine is running. This station has only an arc load and runs all night; it was built entirely under the supervision of a local mechanical engineer with the exception of connecting the lines and dynamo terminals to the switch-board, and would, I think, be hard to beat for results.

The arrangement of machinery is as diverse as the style of motive power. When direct belting is used the arrangement is generally simple and plain, but oftentimes so crowded as to be very inconvenient.

There seems no end to the arrangement of shafting. Some have a line shaft through the middle of the dynamo room and belt both ways to dynamos, others a shaft on either side of the room belting to the dynamos in the center, others the shaft under the floor belting up to dynamos and occasionally to engines also, others having the shafting overhead; in fact, there is no end to the styles, some good and some bad. In most cases friction clutches are used with shafting for stopping individual dynamos and some few may use loose pulleys on independent sleeve for the same purpose.

The length of belt centers varies greatly, some apparently thinking if long belts are better than short, very long ones must be much the best.

The improvement made in switch boards seems to me more marked than in any other one department, which is probably owing to the pressure of insurance men who look at the switch-board as the most dangerous fire risk of all.

In line construction I cannot see that any very marked improvement has been made, excepting in some cases, the substitution of larger and better poles for the older ones.

The use of black covered wire in place of white has perhaps made the lines a trifle less conspicuous, but that is about all. The lines still have the apparent aimlessness of direction mentioned by Prof. Thomson at Buffalo.

People in the larger interior cities are already agitating the question of underground wires and it seems probable that unless something is done soon by the companies themselves to rid the streets of the more conspicuous of these wires, there will be very costly trouble for them to contend with.

It can no longer be denied that wires are working well every day in subways and the only valid argument against them is extreme cost. Nevertheless, when the general public learns this fact, cost will have little to do with the argument.

In many places wires can be removed from the main streets to alleys back of the shops, and the extra cost will be decidedly cheaper than underground work. In such few places as have already done this, wires are inconspicuous and the underground question is never raised.

In street lighting the favorite method is the cable suspension across the street. Where the work is neatly done this serves very well, but it would be difficult to find a more unsightly thing than some of the lamps so suspended.

Considerable trouble is occasioned in the above method by breakage of the wires at the joint with the line, and at the cross bar over the hood. There is no apparent reason why twin or duplex wire should not be more used for this purpose, instead of the kinked and straggly single wires.

There are many other methods, some of them good in principle but bad in the application, and so it goes.

It seems to me that if some action were taken by a non-partisan association like the Institute, an advance toward better engineering might be made, if a few general laws could be suggested to be followed in laying out the different parts of a lighting station. Perhaps it may be said that much of the above work should more properly come before the National Electric Light Association, but as many of that society are members of the Institute, I feel sure they would individually appreciate its backing in the future when the time comes for enlargement, and they have need of combined expert opinion.

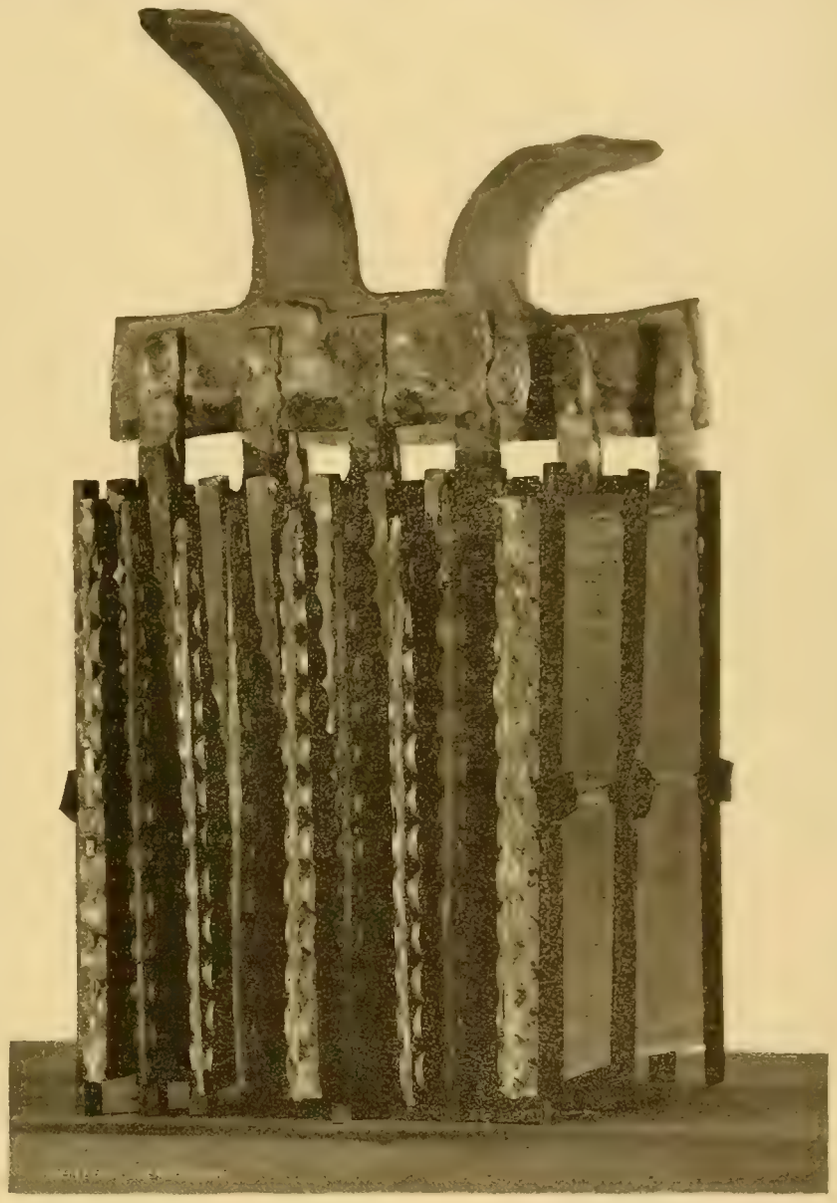


FIG. 3. STORAGE BATTERY FOR LAUNCHES AT THE WORLD'S FAIR.

Electricity and Horse Brushes.

"J. H. Dempsey, who manufactures and sells at wholesale horse brushes at Newark, N. J., passed through this city last night on the eastern express. He was complaining bitterly of the condition of trade in his line, and said: "Now you may laugh at the idea, but it is a fact that electric and cable car lines have hurt my business to a great extent. Yes, sir, the onward march of progress has caused a decrease of at least 20 per cent. in the horse brush trade in the past few years. You see not nearly so many people keep carriage horses as formerly, because they have rapid transit. Horse car lines, which used to make a big market for our brushes, have been transformed into electric lines and our trade is cut off."—*Pittsburg Post.*

Writing to the *Scientific American*, D. Egery of Grand Rapids, in alluding to the transformation of a cable to an electric road, says: "Exactly the same was done in this city last year. There was the same trouble from cables wearing out here on account of so many sharp corners, and nearly all of the expensive machinery and equipment was broken up and sold for old iron. The engines are being used, however, to drive the dynamos that furnish the current for the new system. The grip slots and rails are retained on the hill lines, and an auxiliary brake has been fitted on the cars to catch on these rails in case of an emergency. The increased amount of patronage, together with the better facilities for doing business, will doubtless repay the company for the great expense in making the change."

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IT is an encouraging sign that electrical mill tramways have been introduced in Chicago, as shown by the article printed on the first page of this issue. The city is rapidly acquiring a reputation for the diversity and extent of its electrical applications, and the latest step in local electrical progress is another confirmation of the assertion. Chicago is destined to be the electrical center of the United States.

THAT will be an interesting test of electric launches at Jackson Park this month. The trial will be made when Engineer Sargent returns from New York, and it is not doubted that one or more of the launches submitted by the competing companies will meet the requirements of the exposition authorities, with the result that a fleet of similar vessels will ply on the lagoons of the World's Fair grounds next year.

AN ARRANGEMENT has been made whereby Mr. Westinghouse will be allowed to furnish a bond of $500,000, instead of $1,000,000, for the faithful performance of the World's Fair incandescent lighting contract, provided each surety qualifies in the whole amount. The form of contract has been drawn up and agreed to by both sides, and it is altogether likely that the necessary bond will be forthcoming at the required time and that the papers will be signed.

THE general public will derive some satisfaction from the fact that the Bell Telephone company and the Western Union Telegraph company are engaged in a legal warfare over the disposition of profits of the former company. It seems to be the general impression that it is a good thing to get up a fight between these powerful corporations, even though the public is not directly benefited thereby. The idea of making one or both of these great corporations yield a part of the enormous revenues derived from the business has a peculiar charm for the average American.

CONSIDERABLE space is devoted in this issue to the American Institute of Electrical Engineers, its history and aims, the men who were instrumental in its formation and through whose direction and support it grew to the flourishing organization which held its general meeting in Chicago this week. This organization has a field particularly its own. Its meetings are devoted to technical discussions, rather than to commercial views. Many valuable papers have been presented before the Institute, and its proceedings have attracted attention throughout the country and abroad. Its membership includes the most prominent electrical engineers and inventors in this country, and it numbers among its supporters the men who have done most toward advancing the commercial success of electrical enterprises. The meeting of the Institute at Chicago at this time is particularly significant, as is also the prominence which the western members have taken in the proceedings. Several of the most interesting papers were contributed by members living in Chicago and other western cities. All of these signs are particularly pleasing to the friends of the association and electrical engineers generally throughout the West. It shows that the Institute is becoming in fact as well as in name a national organization, and the great West is being recognized as the field of future operations. The good work of the Institute and its members is recognized here and the organization will find everywhere in the West words of encouragement and willingness to co-operate with it in its work.

ACTING on the example of the electrical fraternity in this country, the Canadian representatives of the electrical companies have formed an association and issued a call for a convention, beginning June 14th, at Hamilton. An attractive programme has been prepared, and the presence of several prominent electrical engineers is assured. It is believed the new organization will be well supported, and at the present convention of course there will be a strenuous effort to get out a good attendance. Some Canadian electrical firms, however, have withheld encouragement from the project, claiming that it would be better policy to co-operate with the National Electric Light association in this country. They point out that the Canadians cannot hope to rival Americans for many years. The showing made at Montreal by the American association produced a profound impression on the minds of the Canadians who attended that convention, few of them realizing up to that time the degree to which electrical development had attained. Many influential Canadians desired to have a distinct organization, patterned after the American association, and their views prevailed. It is this organization thus formed that will meet at Hamilton next week. It will not be restricted to any particular line of electrical work, but will, on the contrary, endeavor to embrace all. There is really no reason why this should be a difficult matter. The several branches do not naturally conflict, though the policy of some companies in this country have caused controversies within the fraternity. The Canadian association has an excellent field, and if the men who have the direction of affairs will exert themselves in extending the scope of the organization it may do much toward advancing and protecting the electrical interests in the Dominion. It is to be hoped that the new organization will start out well and that its promotors will be men of judgment and ability. The Canadian Electrical association has the best wishes of the electrical interests of this country.

SEVERAL practical suggestions are embodied in Horatio A. Foster's paper before the Institute, and presented in another column. The paper is out of the general run, dealing as it does with station practice and management, rather than with abstruse problems. The suggestions contained in the paper are based upon Mr. Foster's experience and a personal inspection of central stations for light and power. It will be readily conceded that there is only too much truth in his assertion that far more electrical engineering skill is applied to the larger isolated plants than to central stations, and that the latter are enlarged or rebuilt under the management of the local superintendent or board of directors, who frequently lack technical knowledge or even familiarity with recent improvements elsewhere. Of course there are exceptions, but these are generally found in large cities where first-class electrical engineers can be obtained without much trouble, and where the extent of the investment required for the establishment and maintenance of a central station would not justify any other course. But there are hundreds of smaller stations that might be made good paying property if they had been properly constructed. Many of these were originally built without any knowledge of the requirements of the service and subsequent changes in the way of extensions and additions have only tended to complicate matters, until finally the company has found itself in an almost hopeless state of confusion.

It is this condition of affairs that has led Mr. Foster to suggest that "if some action could be taken by this Institute through a committee which should examine into proper station design, and report on some few general plans and suggestions as to lines to be followed, it might go far toward establishing a better backing for members who are in that branch." He would have the Institute determine general lines for location of plants, foundations, construction of station, motive power, arrangement of machinery, and location and construction of lines. It is of course understood that while every station may have some special requirements, yet a general plan might be adopted which would greatly help station managers to raise the standard of work.

UP IN Milwaukee there dwells an enterprising citizen bearing the name of Willis N. Stewart, who is described as "a local electrician." This gentleman appears to be endowed with a very vivid imagination, and he has been exercising his talents in drawing a picture for the directors of a local enterprise known as "the exposition," by which he makes it appear how easily Milwaukee can get up an electrical exhibition next year, compared to which the electrical display at the World's Fair will be as a sputtering tallow candle to an arc light. It seems that the idea obtains in Milwaukee that the electrical features of the Chicago Exposition will be of rather a picayune and insignificant order. Thus the *Sentinel* of that city, in describing Mr. Stewart's plan, says:

> Mr. Stewart proposes that the city arrange a mammoth electric exhibition to supplement that at the World's fair, which will be very small. There is general dissatisfaction in electric circles over the meager provision made at Chicago for so important an industry, so much so that several large electric companies had refused to exhibit at all. There was no possible chance to show electric locomotion there, and the result was that Milwaukee would have everything in its favor in its undertaking. As had been already successfully accomplished in Europe, electric power could be generated in this city and transmitted to Chicago in sufficient quantities to meet all demands, and the exposition building would make a grand place for a complete display of all manner of electrical devices, with tracks running out from the building for the experimenting of manufacturers of motors.

While this is not very clear, it is decidedly amusing. It is so preposterous that a serious refutation is almost out of place. Instead of being "very small," the electrical exhibition at Chicago will be by far the largest ever made. Instead of there being "no possible chance to show electric locomotion," plans are already under way for an intermural electric railway on elevated tracks nearly five miles long, and with a power station which will probably be as large as that of any electric railway company in this country. In addition, ample opportunity will be afforded for the display of all electric railway systems. The assertion that "several large electric companies" have refused to exhibit at all is also unfounded.

When the Milwaukee rainbow-chaser can show a beautiful building erected at a cost of $350,000 and containing 300,000 square feet of floor space, a lighting installation of 6,000 arc and 90,000 incandescent lamps, costing $520,000, a scheme of electrical power transmission comprising 2,500 horse power in electric motors, a five-mile electric railway, with trains running at the rate of thirty miles an hour and on one-minute headway, a fleet of forty or fifty electric launches carrying passengers, several great electric cranes, beautiful electric fountains and lighting effects, powerful search lights and all sorts of electrical machinery and instruments—when he can show such a display as this, at an outlay of considerably over a million dollars, backed by the enthusiastic determination of the electrical fraternity to make it the grandest of successes, as shown by the fact that the applications for room in the electrical building far exceed the supply of space; when he can give assurance that English and Continental practice will be well represented and that the leading electrical engineers of the world will gather in congress on the occasion of his exhibition—then, and not before, the Milwaukee dreamer can hope for a display that will rival the electrical features of the World's Fair.

To borrow a familiar slang expression, it may be said that Mr. Stewart is talking through his hat.

Selective or Individual Signals.[1]

By Thomas D. Lockwood.

Among the many subordinate branches of invention in auxiliary appliances which surround and form a suitable setting for that grand central figure, the electric speaking telephone, none represents more painstaking thought, has been more thoroughly ransacked, or has constituted a more attractive pursuit than the study of selective signaling.

The problem it presents is both electrical and mechanical, is sufficiently difficult to create the excitement always attending the pleasures of the chase, and sufficiently promising and hopeful of a practically successful issue to be retentively fascinating. Hence its solution has been attempted alike by prominent and capable electricians, by practiced electro-mechanicians and by amateurs; has, from the laboratory and workshop point of view, already many times been achieved in as many different ways, although commercially it yet hangs, like the fabled bundle of hay,

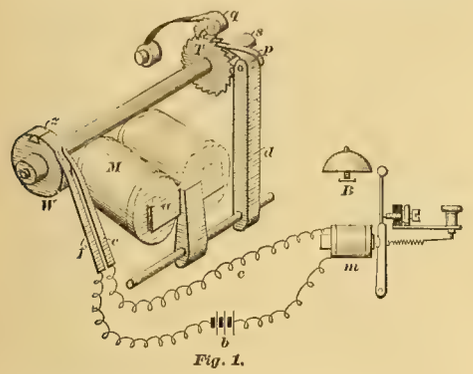


Fig. 1.

just a little in advance of the enthusiastic aspirant who strives to clutch it.

The Use or Function of Selective Signals in Telephony.

The business of the average user of the telephone keeps a line employed but for a very small part of the entire business day, and for the remainder of the time the line wire is idle and earning absolutely nothing. If by any means it could be made possible to place several sub stations in connection with the same circuit, without materially affecting the efficiency of the service rendered, it is obvious that the earning power of the circuit would be largely increased. But a call-bell or other signal is clearly necessary in order that the attention of the station may be attracted when some other station desires to communicate, and as we add stations to a circuit we also necessarily add call-bells; thus introducing two practical objections, viz :

1. A most incessant and annoying ringing, because a call sent to any station is heard at all stations.
2. The necessity of distinctive signals, whereby when the bell at any station is rung the attendant may know whether the call is for his or for some other station.

At this juncture the selective signal steps in, and its special work or function may be thus stated: That two or more stations being electrically connected with the same circuit, the call-bell at any predetermined or desired one of such stations may be operated, and the call given there, to the exclusion of the call-bells at other stations, which at

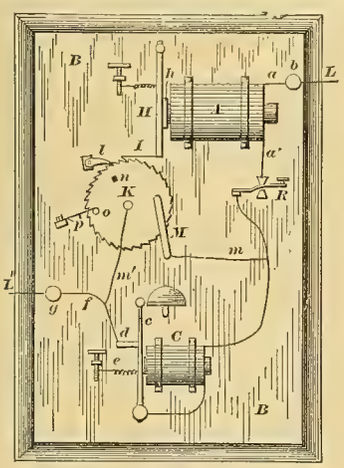


Fig. 2.

the same time remain quiescent, or are silent. We therefore see that the thing to be done is not merely to ring a bell over an electrical circuit; but to select and ring from a distant point a given bell on a circuit with which more than one are connected; and at the same time to ensure that the bells at the other stations which are not intended to be rung shall not be rung.

This statement of function justifies the term "selective signal" which I have adopted, and which I conceive to be more appropriate than the old term "individual signal" because more descriptive.

Historical Sketch of Selective Signals.

The idea of producing a practical selective signal is not (as might from the introductory remarks of this paper have been supposed) one which made its first appearance subsequent to the advent of the telephone.

Appliances possessing the same characteristic, appeared in England many years ago, and several forms have from time to time been patented in that country for use in connection with telegraphy which closely resemble some of the forms which within the last ten or twelve years have been re invented and patented here.

One of these[1] is based upon combinations of a plurality of line wires, two or more of which extend from a terminal to each two sub-stations.

A second[2] involves two wires together with the use of both directions and varying strengths of current; and states itself to be "for sounding any particular alarm in a set of telegraph stations."

The third[3] quoting from the published abstract, is for "transmitting secret intelligence to any one or more stations without the use of extra wires. At each station a metallic disk suitably inlaid with non-conducting portions, is brought to the required position in order to complete the circuit or not, by any electro-magnetic step-by-step movement, thus excluding or including the telegraph instrument at any particular station or set of stations as required."

Three other British patents prior to 1876 are of this class, one of which[4] speaks of "an apparatus comprising a main line, a series of independent branch or station lines at each end, and clocks at both ends working synchronously, which, by means of revolving cams, place the main wire in consecutive connection with corresponding branches at the two ends for definite times."

Another[5] speaks of "apparatus placed in a continuous circuit; the bell at any particular station being caused to ring by the simultaneous advance in all the line wire apparatus, of a cam disposed in a way peculiar to each station, which is instrumental in closing a local circuit by which the bell is sounded."

The final instance[6] of this series is a mechanism in which a disk slotted or perforated at but one point, the location of such point differing for each station, opposes itself to the forward motion of an armature lever at all times except when the slot or hole is immediately opposite a pin on the end of the lever. This occurs at no two stations at the same moment, but when it does occur at any station, the pin passes into the slot and the armature is thereby permitted to complete its advance and to close a local circuit and ring a bell.

Several of these suggestions will no doubt be recognized as being found also in some of the more modern selective signal appliances.

In France, too, in connection with railway telegraphy, this class of invention was formerly very popular; and as might be expected, is not neglected by that indefatigable chronicler, the late Count du Moncel, who devotes considerable space to the subject in the *Expose des Applications de L'Electricite.*[7]

It is unnecessary to recapitulate much of what he states, and it is perhaps sufficient to say that the plans of no less than thirteen different inventors are described, in which the achievement of selective signaling is at least aimed at; and that some of them evince as thorough an appreciation of the merits of the question as do many of the appliances patented for the same purpose in America since 1876, while one or two are actually based upon ideas which are found in comparatively recent patents also.

In the plan of Lamothe, for example, which is discussed by M. du Moncel, the gong which is to be struck is by one electro-magnet brought within range of a bell hammer, which then, by a second electro-magnet, is caused to strike the bell.

Another inventor, Bizot, has a plan for selectively ringing bells by means of pendulum hammers, placed at the different stations, and adjusted at each station to a different length.

An electro-magnet at each station in the main circuit controls the swing of the pendulums by its alternate magnetizations and demagnetizations, brought about by the makes and breaks of the main line current; these being effected by a vibratory circuit breaker at the transmitting station, operated by a similar electro-magnetic pendulum there, which can be adjusted, when desired, to the same length as the pendulum at any one of the other stations which it is desired to operate. Only that one to which it is adjusted will be operated, the others remaining inert. By so arranging all of the station pendulums that they can be adjusted, any station is enabled to selectively signal any other.

This apparatus I have described at considerable length, because it is founded on the harmonic principle, which later was introduced into telegraphy, and because it contemplates the use in selective signaling of that principle, subsequently more elaborately worked out by German and American inventors, and described in their several patents.[8]

Martorey's system, which likewise is described by M. du Moncel, also contains the elements of many subsequent forms. In it, by an electro-magnetic step-by-step motion, an escapement wheel having a number of teeth at least equal to the number of stations on the circuit, to give the signal, is brought to a given position by a given number of pulsations, differing for each station. All the teeth are metallic, and all, except one, are insulated. That one connects with the axis and mechanism, and is part of the alarm circuit. When brought into position, the ringing circuit, which,it appears,is open normally at two points, is closed at one of these points, and at this juncture a single impulse sent over a second wire closes the second break in the local circuit, causing the bell to ring.

In addition to the foregoing examples of the condition of the art, it is not, I conceive, out of order to point out that the principles that govern printing telegraphy are closely related also to selective signaling. Consider for example, the House, Hughes, and Phelps telegraphs, and the form of stock quotation recorders now so universally employed; in all of these a given letter or figure is brought to a suitable point and is then pressed by a final operation against the paper to make the impression.

Now a little careful thought will show that the two problems:

a. To bring a number of typewheels at different stations all to the same predetermined point, and then press the paper against them so that the same letter will be printed at all stations, and

b. To bring a number of wheels at different stations carrying local circuit closing devices (placed at a different point for each wheel) all to the same predetermined point, where any particular one of them will be in position to

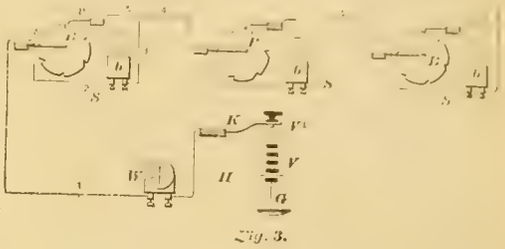


Fig. 3.

close its local, and ring its bell when the press movement is made—are not in principle by any means far distant from each other.

They are further related, in that both must have a unison, zero, or starting point, to which they can be brought periodically for a fresh start, to forestall a lack of harmony between the different stations, or to provide means for bringing back an errant wheel which has strayed away from the path of electro-mechanical rectitude.

A good stock of knowledge thus was at the disposal of those interested, even at as early a date as 1876, when the career of the telephone was only beginning. We had the electro-magnetic ratchet and pawl, step-by step, movement. We had electrically controlled clocktrains.

It was old to trip clockwork electrically; and also to use wheel circuit changers. The unison device in connection with step-by-step devices was old, and its use well known; the relay and its function of closing local alarm circuits was already a classic; wire combinations of various sorts were customarily employed; and the harmonic field had already been well threshed by Helmholtz, Bizot, La Cour, Varley, Gray, Bell, and others.

Why then was it not easy to make at once a thoroughly satisfactory and efficient selective call?

One reason is, that the average inventor or would-be inventor generally refuses, tacitly it is true, to recognize that there is any material of which he may make use. He

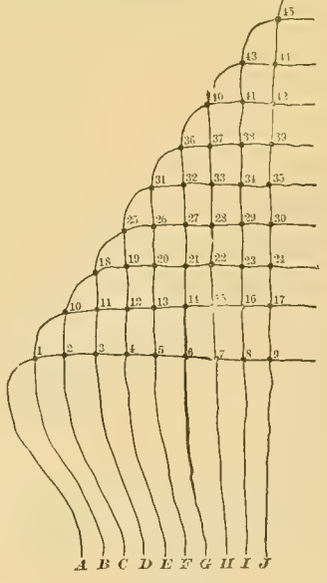


Fig. 4.

does not know the state of the art; does not want to know the prior art; does not care anything about the prior art, and often feels affronted when he is necessarily brought face to face with it; and then he gives utterance to the pathetic plaint that "the people of former times were a dishonest race; they have stolen all my new inventions."

It is however clear from what has been stated, that the principles which underlie the problem in its many phases had to a great extent been elucidated, and that much had been done in working out scores of electro-mechanical contrivances capable of being utilized in apparatus embodying such principles; and for these reasons there has in this branch of electro-mechanics been little scope for the

1. Read at the general meeting of the American Institute of Electrical Engineers, Chicago, June 6, 7 and 8, 1892.

1. Br. Patent 12030, January 25, 1848, H. and E. Highton.
2. Br. Patent 12959, February 7, 1850, E. Highton.
3. Br. Patent 13427, December 27, 1950, Dering.
4. Br. Patent No 3006, December 1, 1863, Wilde.
5. Br. Patent No. 910, March 31, 1865. De Bonneville.
6. Br Patent No. 1801, June 11, 1869, Lyttle.
7. Expose des Applications de L'Electricite. Vol. iii, 1874, pp. 510-528.
8. German Patent No. 941, Maron, Dec. 5, 1877.
   Br. Patent, No. 5078, Blake, December 11, 879.
   U. S. Patent No. 251,097, Currier, December 20, 1881, and others.

exercise of original broad invention, and consequently little reasonable expectation of substantial pecuniary reward, even for him who might produce a thorough practical success in selective signaling.

These considerations have without doubt had effect in preventing many inventors and mechanicians of the first rank, or of great experience, from vigorously grappling with what was left of the problem. Yet from January, 1879 to December, 1891, 161 U. S. patents were granted for forms of telephonic selective signaling appliances, all of which I have examined.

A careful analysis shows that quite a large number of general plans have been proposed, and that each of these has been developed in several ways with greater or less care, and to many degrees of perfection. Several sub methods can be utilized in many of the general plans, and in a number of cases attempt has been made to provide for several additional functions.

Though at one or two points selective signals embodying a few of these different plans are even yet employed, every telephone man knows that it cannot truly be asserted that success has attended such appliances.

One reason why has been detailed. Some other reasons may now be given.

1. Some forms of promising selective apparatus have been put into use before being mechanically perfected, and their faultiness has given a figurative black eye to the entire race.

2. Some have been inherently defective either in principle or construction.

3. Many, as soon as crudely devised, have been employed as beasts of burden on which to organize a heavily capitalized stock company, and it has therefore been the great object of the advocates of these to sell stock instead of to make a practically successful apparatus.

4. To be commercially successful a selective signal for a telephone system must be of low cost. In every form which has been put out and which has come under my observation, this requirement has been too prominently insisted upon, and the attempt has been made first of all to make not merely a low-priced, but a really cheap signal. This attempt, I may note, *en passant*, has met with uniform success.

5. Excellency has not been insisted upon.

6. In many instances the apparatus has been required to do too much, or to perform too many functions, and has therefore become complicated; and

7. Usually the places where such signals have been tried have also been places where intelligent supervision has been at a minimum.

Under the above circumstances, good results need not have been expected, and although they were expected, they did not arrive; and the user, after trying successively many of

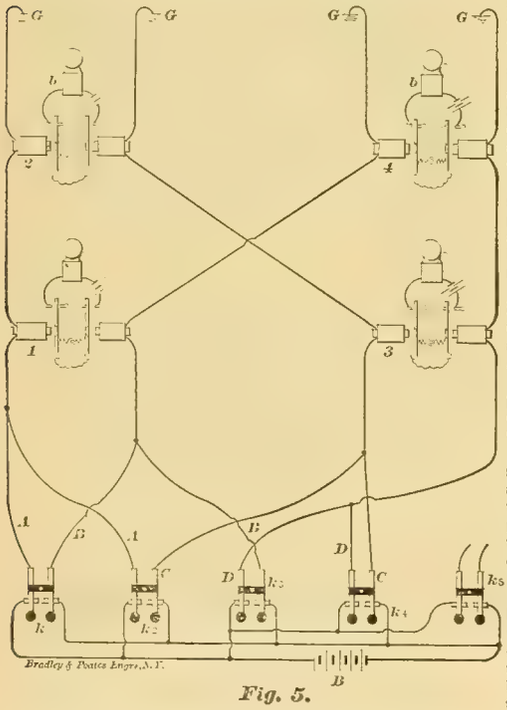


Fig. 5.

the different kinds of signals from time to time placed before him, has, with few exceptions already noted, discarded all; and for a long time now has refused to listen further to the voice of the charmer; alleging, and with some show of reason, that "the only trustworthy individual signal is an individual line."

Desirability of Selective Signals.

This epigrammatic saying is, however, in some sort losing its attractiveness, in face of the multitude of conductors which it implies; and to a keen observer of the signs of the telephonic times, it is evident that a very extensive return to party lines in some form will by and by be inevitable, at all events for residential districts, and from this point of view it appears that the demand for a simple and trustworthy, but not costly, selective signal is as great as ever, and that, if such a thing is made and its merits proved, many more party lines could and would be arranged and satisfactorily operated.

To reach practical success, by which is meant to devise a really trustworthy selective signal, economical, simple, and easily kept in order, invention is not so much needed—keeping the prior art in mind—as is electro-mechanical skill to mould a homogeneous and perfect apparatus from the immense amount of material we have to choose from; an apparatus, in fact, which will operate perfectly, not only when the several circuit signals are ranged up alongside each other on the testing-room wall, where a screw may be adjusted here, a spring tightened there, and a bell hammer rod bent in another place; but equally well when they are distributed over the circuit, and all at a distance from the operator.

And to aid the adventurer who intends to construct such an apparatus, I will outline the principles upon which this class of work in its several proposed plans has so far been founded, reference being made in brackets to a single U. S. patent exemplifying each of the several plans.

General Plans.

1. *To operate the several signals at each sub-station on a circuit with differing strengths of current.*

Bells depending for their proper operation on a margin

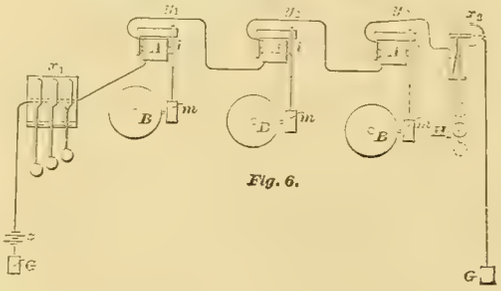


Fig. 6.

of current are, however, generally untrustworthy. [U. S. Patent—No. 221,512, Nov. 11, 1879, Buell.]

2. *Signals arranged to respond to currents of opposed direction.*

This implies, of course, polarized bells, and for a line with but two stations it is probably as good an arrangement as can be provided. [U. S. Patent—No. 218,153, August 5, 1879, Anders.]

3. *Signals involving changes both in strength and direction of currents.*

These are apt to be unreliable, for the same reason as are those of No. 1. [Patent No. 242,408, May 31, 1881, Anders and Vail.]

4. *Electro-magnetic step-by-step devices, acting to bring the sub station signals to a ringing point differing for each section, and then to close a local, branch, or shunt circuit, including the local bell, to operate ringing mechanism, or in some way to introduce the bell magnet into the circuit.*

Fig. 1, taken from a patent of E. N. Dickerson, Jr., illustrates a ratchet and pawl step-by step movement operating to close a local circuit in which is placed the bell. Successive pulsations sent from the central station, cause the electro magnet M in the main line circuit to attract its armature *a*, which after each pulsation is pulled back by a suitable spring (not shown).

The non-conducting wheel *w*, on which presses the two springs *e* and *f*, has at one point on its periphery an inlaid piece of metal *z*. When the wheel is rotated till the plate *z* comes under the two springs, the local circuit of the battery *b* is closed through the bell magnet *m*, and the bell B, which in practice would be vibratory, rings.

The wheel *w* can be adjusted on its shaft *s*, so as to be in a different position at each station, and is operated by the main magnet through its armature *a*, lever *d*, pawl *p*, and ratchet wheel *r*, the retaining pawl *q* holding the shaft *s* between the several forward impulses.

There are of course many other ways of utilizing these principles, one being shown in Fig. 2, which is one of the drawings of a patent taken out by Messrs. Curtis and Crocker.

In it, the main line L comes to the binding screw *b*, passes ses by the wire *a*, to the main electro-magnet A, which acts through its armature *h*, lever H, and pawl I on ratchet wheel K, held at any point by the retaining pawl *t*, and provided with a zero spring *p* and stop *o*. The ratchet wheels K are metal and at a point on their disk surfaces, differing for each station, have a non-conducting piece *n* et in, flush with the seat surface.

A contact spring *M* presses also on the conducting surface. After passing the magnet A, and continuing by wire *a'* to a key R, used to call the central station, the circuit divides, one branch passing through the magnet C of the call-bell and thence by way of the bell hammer lever *c*, back contact *d*, and point *f*, to the terminal *g* and thence to the outgoing line L'.

The second branch passes by wire *m* from the point of division to the contact spring M, thence to the ratchet wheel and through the mechanism and by the wire *m'* to the reuniting point *f*, binding screw *g*, and outgoing line. Thus as long as the contact spring M presses on the metal face of the ratchet wheel, the bell magnet is short-circuited; but when as the wheel is revolved, the end of the spring presses on the non-conducting piece *n*, the shunt circuit is broken and the bel introduced and rung.

This general plan No. 4 has been much favored by inventors, admits of almost indefinite variation, and is easily associated with auxiliary devices such as unisons, busy signals, and lockouts for apparatus at other stations. If mechanism properly designed and made be employed, there is no reason why satisfactory results might not be expected. Cheap apparatus has, however, invariably been tried and the system besides is slow. [No. 212,792, March 4, 1879, E. N. Dickerson, Jr. No. 230,530, July 27, 1880, Curtis and Crocker.]

5. *Clockwork bells.*

a. Those in which a constantly running clock train brings the bells at the different stations into circuit successively, or removes a mechanical holder from their hammers; when only they can be rung. These are not reliable; it being impossible to keep the clocks together; the clocks also require too frequent winding. [Patent 223,469, January 13, 1880, Bliss.]

b. Those in which at each station is a normally stopped clock train. All clocks are started by the same initial pulsation, and bring their signals to ringing points, or their bells into circuit at different times.

This idea is one of the most practical that has been advanced, and if the apparatus is well designed, and put together in a good mechanical form, it ought to do good work; unfortunately first-class apparatus is costly enough to remove the gilt from the economical side of the selective signal.

This plan is indicated by the diagram, Fig. 3, in which, however, the clockwork is not shown. In the diagram *H* is supposed to be the signal transmitting, and *s* the signal receiving station, at each of which is a metal circuit wheel B, by which in conjunction with the circuit springs *s* and *v*, the bells *b* are when at rest short-circuited. At the transmitting station is a circuit closing key K, a battery V having one pole united to earth or return *G*, and the other extended to the front contact V^1 of the key, and a duplicate W of the several sub-station instruments.

The first pressure of the key through suitable mechanism starts the clock-work at all stations, and introduces the bells at each station successively, as the wheels B bring their notches under the springs *v*. The wheels are in the present instance supposed to be slow moving, and to have six ringing notches for each complete revolution. They can by suitable mechanism be stopped on each notch to ring a given bell as long as may be desired; and they come to rest after one notch at all stations has passed under its spring.

Of course the notches are arranged to pass under the springs at different times for the several stations, and this is indicated in the figure, where the bell at the nearest station is introduced into the circuit; the springs *v* of the others being at different positions on the periphery of the wheel. [Patent 232,442, Sept. 21st, 1880, Blake.]

c. Those in which a normally quiescent clock-train is controlled by an electro-magnetic escapement, and permitted to move by successive beats, as a key at the central station alternately makes and breaks the circuit. [Patent 228,047, May 25th, 1880, Eaton.]

This could doubtless be made to work all right by putting excellent apparatus into it, but, like nearly all step-by-step devices, would generally be slow.[1]

6. *Bells in which all the hammers move forward to strike at the same time, but except the desired one are prevented from striking by an interposed mechanical obstacle, which in the bell of the wanted station is removed.*

This has been faithfully tried. It was operated by an electro magnetic ratchet and pawl, and was uncertain in

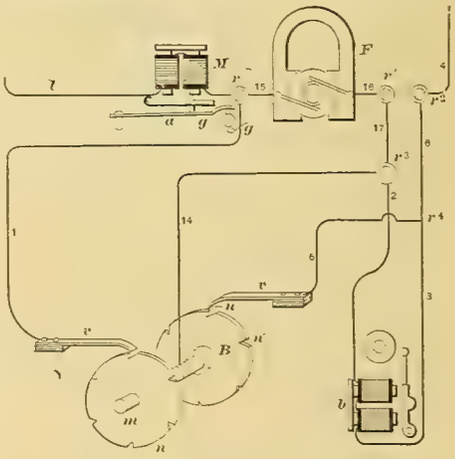


Fig. 7.

operation. It also developed another fault, viz., that even the bells which are not to respond make a considerable rattling. [Patent No. 219,059, Sept. 2nd, 1879, Anders.]

7. *Bells in which the ringing is done by circuit arrangement, or conductor combintaions. Two series of circuits may radiate from a central to a number of sub-stations, and one of each series caused to enter all stations. No two stations, however, have the same two circuits. Only when the current traverses both circuits does the bell ring at the station they enter.*

This is very promising. It can not, however, be applied to a multiple switch-board system. It requires relays and a local circuit bell, but no specially constructed apparatus.

It is also very speedy; the single pressure of a given key will always ring a given bell, and no mistake can be made.

This system is roughly illustrated by the diagram, Fig. 4, in which each outgoing conductor is shown to intersect each other conductor at some one sub-station, and thus afford facilities for producing a selective signal for 45 stations by using but 10 main lines.

For example, if it be desired to signal station 41, it will be necessary to manipulate the lines *G* and *J*.

The diagram Fig. 5 more fully illustrates one way in

1. All of the subdivisions of class 5 may either have the signaling device directly in the main circuit, or in a local circuit to be closed by the action of the main circuit.

which the idea is worked out, although there are several plans, all of which are more or less advantageous.

A battery B branches its two poles to each of a series of keys k, each of which controls the terminals of two lines; for example key k may control terminals of A and B, k^2 those of A and C, and so on.

At each sub-station two lines both enter and pass respectively through relays, and the concurrent action of the two relays at any station is required to ring the bell, since the bell circuit is led through the armature levers and the front contacts of both.

Taking the conductors in pairs, the number of possible combinations is represented by the expression $\frac{n^2-n}{2}$ and that number of separate stations can be selectively signaled by the use of n wires. [Patent No. 219,188, Sept. 2, 1879, Vail Patent No. 224,855, Feb. 24, 1880, Vail.]

8. *Bells working on the principles of harmonic telegraphy.* At each station the spring, pendulum or reed carrying the bell hammer is tuned to respond to a different note or rate of vibration.

The central station transmitting device is adjustable, and can have its rate made to correspond with that of any sub-station bell. When set in operation the coinciding bell only will ring.

Operated always by experts, and carefully constructed and adjusted, these might do well. They are, however, too sensitive; tend to become operative as their proper number of vibrations is approached, and in some degree become irregular with temperature changes.

Fig. 6 illustrates the idea, and shows a central and three sub-stations.

At the central station is a battery z, and three pendulum circuit breakers, formed into a single apparatus x'. Each breaks and makes the circuit at a different rate of speed.

The main circuit passes through the magnets A of the different sub stations successively, each magnet having a reed armature to which a pendulous bell hammer is attached, the normal rate of vibration thereof corresponding to that of some one of the transmitting circuit-breakers. At the end of the circuit is shown a second transmitter x^2, with which, if desired, the sub-stations may be provided.

It has an adjustable pendulum bob, H^3, which can be moved to correspond with that of any bell which it is desired to ring, and which, then being set in vibration, is responded to by such bell. [Patent No. 251,097, Dec. 20, 1881, Currier.]

9. *Sub-station signals in which galvanometers identically constructed and calibrated, make the same deflection with a given current; to ring the bells different currents are sent, which produce different deflections. Each, of course, has its ringing deflection at a different point, which may by a mercury cup close a local circuit.*

These signals ought to work fairly well, if sufficient care and cost be put into them. It would not be difficult to add several other classes to this list, but those which have been mentioned are the most important. [Patent No. 262,252, Aug. 8, 1882; Southworth.]

The plans of greatest promise are:

a. Those which by clockwork (as in 5 *b*) are brought to a ringing point differing for each, the clockwork being then stopped, and the ringing done by a different kind of current. This is virtually the same plan of operation as is employed in the stock quotation printing telegraphs; and is reliable, but when adapted to do the work well, costly.

b. Those which as in class 7, require the co-action of two circuits.

Either of these when adopted should be worked in connection with a local battery.

Probably in practice it will be found advantageous to have a separate circuit distinct from the telephone circuit, on which a great number of selective signals may be connected.

Many sub-methods and appliances have to be thought of in considering this subject; whether we will be content to ring sub-stations from the central station only, or on the other hand give each sub-station the power of signaling others on the same circuit.

If step-by-step apparatus be employed to successively bring the station appliances to their ringing points, some means is required to prevent the bells of intermediate stations from giving a signal as they are passed. Sometimes the time element may here be utilized. But a better way is to have the call-bell in a local circuit open at two points; to let the advance of the apparatus close one of these and then send a different kind of current to close the other.

We have to consider also whether the introduction of line in-use signals, unison apparatus, call sending appliances, and telephone lock out apparatus, are sufficiently important to be added.

The unison or zero device in some form may be considered as an essential auxiliary in all progressive signals, whether of the clockwork or step-by-step order. Even the most perfect mechanism slips occasionally, and as in stock printing systems where instruments "throw out" or get out of step with each other, a suitable zero at which all can periodically be brought to rest, and start even, must be certainly required. A "busy" signal which indicates at each station whether the line is in use at any other is useful, but not essential. And lock-out apparatus, usually provided by closing a shunt circuit round the call sending mechanism and telephones, at all stations on a circuit, except the one or two which are actually communicating, is also highly advisable in order that privacy and freedom from interruption may be maintained.

But, while some of these devices are necessary, and all useful if reliable, the contriver from this time forward must keep at all times before his eyes, the undoubted fact that selective signals where heretofore tried, have uniformly been handicapped by being too intimately associated with too many such auxiliary devices, and must be correspondingly cautious about the way in which they are added.

Some such mode as is depicted in Fig. 7 is best for this purpose.

In the figure, *M* is a clock tripping magnet, *I* the magneto generator for sending outgoing calls, *b* the station bell, and *m* and *n* two metallic wheel commutators mounted on, and electrically connected with the same shaft *B*. Arranged to press on the periphery of *m* is a contact spring v' and similarly placed with respect to *n*, is a spring *v*.

When the station mechanism is at rest, it is desirable to have the generators in the line circuit, but the bells out. Accordingly, the bell is short-circuited through the disk *n*, spring *v*, and wires 14 and 5; while a possible shunt circuit round the generator through disk *m*, spring v', and wires 1 and 14 is open, the spring v' being over the notch.

The notches of *m* are placed alike at all stations, but those of *n* differ at all stations; and therefore as soon as the shaft *B* begins to move, when the driving clock-train is tripped, the shunt circuit is established round all the station generators, and no station can interrupt by an attempt to send a call signal.

Such a device is well enough because it can generally be added without at all impeding the operation of the signal proper, and in any case constitutes a perfectly proper adjunct to the equipment of a party line. But when associated with selective signals the greatest care is necessary to provide that the arrangement is such that the auxiliary appliance may not prove a drag on the signaling mechanism.

Selective signals require a fair field and all the favor they can get.

Railway Train Lighting.[1]

By A. H. Bauer.

The first successful system of railway train lighting is that invented by Houghton, and adopted by the London, Brighton & South Coast railway of England, in 1881–2. Since then the many improvements suggested by other inventors have made it almost automatic.

The system consists of a Brush dynamo carried inside the baggage compartment and directly connected by link belting to pulleys on the axle of the car. Attached to the dynamo is a ball governor, rotating vertically, whose office is as follows:

1st. To control the movement of a switch, which, when the speed and therefore the electromotive force of the dynamo reaches a predetermined value, closes the circuit, and also opens it again when the electromotive force approximates that of the secondary battery.

2d. The adjustment of a resistance which maintains the current constant, and

3d. To shift the position of the brushes as the neutral point is changed by the varying speed of the armature.

But one set of brushes is used, carried in rectangular holders, at right angles to the commutator, and always in contact with it.

When the rotation of the armature is reversed by a change of direction of the train, the brushes are carried forward or backward by the friction on the commutator and a connection with the governor until the quadrant passes but a fraction beyond the vertical, when it is drawn to the proper position by a spring, the action being similar to that of a snap switch. Limiting stops are provided to prevent the quadrant going too far.

The same movement of the quadrant also changes the position of a switch controlling the connection of the field coils, and therefore the polarity of the dynamo. It therefore follows that the current is always in the same direction, no matter which direction the armature may rotate. One set of accumulators, consisting of 25 cells, is provided for each train, and placed in the baggage compartment. The maximum number of lamps in a train is 70, of 10 candle power each, at 50 volts.

No attendant is necessary, but at certain stations on the line an examination of the plant is made, and required repairs are attended to. I am informed the system is so reliable that since the year 1888 but two failures have occurred.

It will be noted that the key of this system is the convenience with which the connection between the armature pulley and that on the axle can be made.

Throughout Europe the rigid wheel base is universally employed under railway cars; consequently, by setting the dynamo across the car, the armature shaft will always be parallel with the axle, and the connecting belt runs in practically the same plane.

In this country the bogie truck is exclusively used. Several attempts have been made to drive the dynamos by connections with the axle of bogie trucks. All, however, have failed for the reason that no provision was made for maintaining the armature shaft and axle parallel at all angles of the truck, and because sand, dirt, etc., gathered by a moving truck will soon destroy any mechanism that may be used for the purpose under the car. The problem, however, has not been abandoned, and I am in hopes that within a very short time a solution will be found.

Numerous propositions have been made to use primary batteries for car lighting, but I am not informed of a successful installation of that character.

Secondary or storage batteries have been more or less employed for the purpose, with varying success. The first attempt in this direction was made in 1887–8 on two Pullman limited trains, of six cars each.

Each car was equipped with thirty cells of battery, having a capacity of 150 ampere hours, and weighing 50 lbs. per cell, or 1,500 lbs. per car. Duplicate sets were kept charged at each end of the line, and on arrival of the train, exchanged for those that had been exhausted while on the road. The average number of lamps per car was 26, of 16 candle power, at 60 volts, or a total of 156 in the train. After sixty days' trial it was clearly demonstrated that, under existing conditions, the system could not be made successful, and it was abandoned.

The reasons for its failure were: 1st, that the capacity of the battery was insufficient to maintain the number of lamps required for the proper lighting of Pullman cars on long runs.

For example, the current required for 26 60-volt, [illegible] ampere lamps, is about 20 amperes. Therefore $\frac{150}{20} = 7\frac{1}{2}$ hours, that is to say, 1,500 lbs. of battery was able to maintain 26 lamps but 7½ hours. These trains leave east-bound at 5 P. M., but the light is required at 4 P. M. for inspection, receiving passengers, etc. Consequently the battery would be exhausted at 11 P. M.; in fact it would be earlier, as will be explained. Therefore the oil lamps would have to be used when light was required during the remainder of the trip. West-bound the same reason held good, although not to the same extent, because the train leaves that end in the morning and passengers will, as a rule, after 12 hours' traveling, retire earlier than those going east, leaving at 5 P. M. Consequently less light is required, and a certain per cent of the charge is not used.

A second reason was the deterioration of the batteries themselves, which were of the pasted grid type. It was found that the constant agitation of the acid solutions in the jars, as well as the unavoidable rough usage to which they were subjected when changing, caused a loss of the paste or active material, proportionately reducing the capacity. In fact, close observation indicated the loss during one handling to be equal to if not more than that caused by 1,000 miles' travel on the car. The paste when separated from the grid accumulates in the bottom of the jar, or lodges between the plates, forming a circuit through which the cell is discharged, resulting in the buckling and sulphating of the plates, and the destruction of the positive elements within a short time. This was five years ago. Since then improved methods of manufacture as well as more intelligent care in handling have, to a great extent, overcome their objections and thereby increased the life of the battery. It may be asked—why not increase the size and therefore the capacity of the cell? The reply is—that to properly light a train of six Pullman cars, for instance, between Chicago and Jersey City, with the number and kind of lamps above stated, would require 30 cells, each weighing not less than 100 pounds—a total of 3,000 pounds per car, or 18,000 pounds for a six car train. The expense of handling and changing such a weight would make its use almost prohibitory, for each cell would have to be handled singly. The weight on the car would also be objectionable. Since these experiments were made, lighting for short distance, only, from storage batteries, has been made successful. For the past two years four cars, each equipped with 32 cells of 150 ampere hours capacity and 26 16 candle power 60-volt lamps, have been running between Chicago and Cincinnati, and Chicago and Indianapolis. Two of these cars are charged every day at Chicago for about nine hours with sufficient current for a round trip. The batteries, however, are not changed; the cars are always placed on the same side track to which wires from the dynamo are led, and the charging is done without removing them. The average length of time the light is required during a round trip is six hours; the cars leave each end of the line at 8 and 9 P. M. respectively. Repairs are made by removing the defective cell and substituting another if necessary.

The costs of repairs and renewals of all kinds from September, 1891, to January, 1892, inclusive, per month, was as follows:

September, 1891	$ 36 44
October, "	108 82
November, "	51 24
December, "	70 21
January, 1892	38 31
Total	$314 02

which divided by four is $78 50 per car per month or $2 61 per car per day, and this divided by 26 gives 10c. as the cost per lamp per day. As the engine and boiler are used for furnishing power for other purposes while running the charging dynamo, it is difficult to get the cost of the power for charging these batteries; that factor, therefore, is not included in the above statement.

In January, 1888, a solution of the problem of lighting six car trains for long distances was sought for in another direction. Two trains running between Jersey City and Jacksonville, Florida, a distance of 1,100 miles, were selected for the experiment. At first an attempt was made to utilize the power of the axle, but for reasons already stated did not prove successful.

The next step was the subtitution of a vertical single-stroke engine located in the baggage car, for the axle connection. This engine was belted to the dynamo, and was supplied with steam from the locomotive boiler.

While this plan seemed to be a step in the right direction, it still had its objections, due to the fact that the upward and downward movement of the driving-rod acted in the same manner as would a heavy blow on the car body, so that the latter would vibrate in unison with the stroke of the engine.

After a few trials the vertical engine was removed and a three-cylinder reciprocating engine, with three-inch cylinders and four-inch stroke, was substituted. It was connected direct by a flexible coupling to a 75 volt 60 ampere dynamo of the ordinary open frame type, and both run at 1,000 revolutions per minute.

The working of this combination clearly demonstrated that a solution of the problem was attainable, and it was now possible to guarantee a fairly successful lighting of the two trains. A fault soon developed, which could not be anticipated. It is well known that all railway trains, while running, gather more or less dust and dirt, but it was not known until train lighting was at-

1. Read at the general meeting of the American Institute of Electrical Engineers, Chicago, June 6, 7 and 8, 1892.

tempted that this dust and dirt contain certain quantities of carbon and metal which adhere to armature and field wires, and being conductive form short-circuits. So frequently did this occur, that it became necessary to carry an extra armature with each plant, and make changes while the train was in motion. Later in the year these dynamos were removed, and the Eickemeyer installed. The Eickemeyer dynamo seems to be perfectly adapted for train lighting. As both the armature and field coils are protected by the iron of the machine, the dust and dirt do not reach the wire, except in small quantities, and by removing it every six months, when the car is shopped for repairs, short-circuits have been prevented. Its strong construction is such that it will successfully withstand the general rough usage to which machinery of this character is subjected on railway trains.

The system which has been used for the past five years on all Pullman trains consists of a Brotherhood three-cylinder engine and Eickemeyer dynamo, bolted to a cast-iron bed plate, and located in the forward end of the baggage car, occupying an enclosed space of 6 feet 6 inches by 3 feet 3 inches. The engine and dynamo are connected by a flexible coupling which allows for the irregularity should they not be in perfect line. A two-gallon sight feed pressure lubricator bolted to the end of the car, furnishes oil to all wearing parts of the engine. The average consumption of oil is about one gallon every 20 hours of actual running of the engine.

Steam is taken from the locomotive boiler, a tap being made at the dome, the pipe passing under the tender and car, between which a flexible rubber hose makes connection. It has been found that with 1½ inch pipe between the boiler-head and car, there is a loss of 15 pounds' pressure due to friction und condensation; therefore, to run the engine at 50 pounds requires 65 pounds at the supply pipe on the locomotive. With 50 pounds' pressure, the dynamo will, at 900 revolutions, generate 80 amperes, at 72 volts, when all the lamps and batteries in a six car train are in circuit, and 50 to 75 amperes, at 80 to 85 volts, at the same speed when the batteries alone are connected, depending on the counter electromotive force of the batteries.

On the side of the car is placed an automatic switch, which will break the circuit when the electromotive force of the dynamo equals that of the batteries. A voltmeter and ammeter are kept constantly in circuit while the plant is in operation. A tachometer, belted to the armature shaft, is also provided for noting the speed of the engine and dynamo. This plant is inclosed by a tongue and groove partition surmounted by a wire screen.

The system of wiring adopted is the equi-potential, in which the pressure is practically equal at each lamp and battery. One wire leads from the positive pole of the dynamo to the rear end of the rear car, where it is coupled to a second that returns to the baggage car—but not to the dynamo—being tapped, however, by the positive pole of each battery and one side of each lamp. A third wire leads from the negative pole of the dynamo to the rear end of the rear car, where it ends. This third wire is tapped to the negative pole of each battery, and the remaining side of each lamp.

All the batteries and lamps are therefore in multiple arc. Double pole, fusible cut-outs are placed in each circuit, and, with the switches, are located in the closets of each car. The wires are always placed on the roof of a car. For this purpose, whitewood moulding, thickly coated with asphalt paint, is nailed from end to end as near the center as possible, usually one and three-quarter inches from the edge of the smoke-jack if the car is equipped with center oil lamps, and from six to twenty-four inches when gas lamps are applied. Branch mouldings extend to all points on the roof through which it is desired to run wires to the lamps, switches, etc., inside the car. For instance, the drops to the center lamps in the body of the car pass directly through the center of the roof into the air chamber of the oil lamp, from where they are suitably connected. Those leading to the switches, cut-outs and batteries pass through the panels between the ventilators and into the closets where the switches are located, the batteries continuing on through the floor to the boxes under the car. After being run in the moulding, the wires are covered with wooden capping and the whole tinned over, practically forming part of the roof. The grooves in the molding are made of such size as to hold the wire rigidly, so that its movement or abrasion is impossible. Wire so applied has, after five years' service, shown no deterioration whatever, and is apparently serviceable for at least five years more. As the tin covering of the moulding is cut and worn away by cinders and the action of the elements, it is found necessary to renew the moulding about once a year. The sizes of wire used are all of B. & S. gauge, and consist of No. 2 for those leading from the dynamo, Nos. 6 and 10 for the lamp mains and No. 14 for the lamp drops. The connection between cars is made by bringing the wires from the roof through the hood to the inside of the vestibule, where they terminate in square brass tubing called connectors, which are permanently attached to the vestibule frame. The connection between these connectors is made with three-conductor flexible cables, each conductor of No. 6 gauge. To the ends of each conductor brass springs are attached, which fit closely inside the tubing, giving about eight square inches contact. If cleaned occasionally this connection will carry 100 amperes without sensibly heating. As the connectors are placed horizontally, it is evident that, should the train from any cause be parted, the connection will be severed without damage to any part of the system, except to throw the load off the engine and cause it to race. Should this occur, which, in fact, is very seldom, the attendant is at hand to cut off steam and stop it until the connection can be replaced. With a No. 2 wire the average fall of potential in a six-car train is nine volts.

When the batteries alone are in circuit, the electromotive force of the dynamo will be from 67 to 83 volts, which, minus the loss, will overcome the counter electromotive force of the batteries, viz., 57.6 to 73.6 volts. When both lamps and batteries are in circuit the external resistance is, of course, reduced, and the electro-motive force of the dynamo falls in proportion, and that at the lamps will be from 60 to 66 volts.

It is unnecessary to use a resistance in the lamp circuit, as when the lamps are first turned on, the electro-motive force being say 66, a greater candle power is had just at the time when most needed, which, however, gradually falls and ordinarily reaches 60 to 61 volts in from two to four hours, depending upon the amount of charge in the batteries. It is true that this is at the expense of the life of the lamp, but as the handling of the switches is done by the porters and conductors, the use of rheostats or regulators, no matter how simple, would complicate the system and probably cause the total extinction of the light. Each car is provided with thirty-two cells of storage batteries, placed sixteen in each of two boxes, securely fastened under the center, and directly over the truss rod. The weight of batteries and boxes complete is about 2,000 pounds. As already stated, with the system of wiring adopted, the batteries and lamps are permanently connected in multiple arc, so that, should the train be parted and connection with the dynamo become broken the batteries will supply current necessary to maintain the light; or, should the batteries under one car become disconnected, its lamps will be supplied from batteries under other cars in the train.

The lamp equipment of a six-car Pullman train is as follows:

Combined smoking and baggage car	21 lamps.
Dining car	32 "
Three sleeping cars	90 "
Combined observation and sleeping car	29 "
Total	172 lamps.

Of this number 98 are 16 candle power and 74 are 8 candle power. The latter are placed in hallways, toilet-rooms and vestibules.

During six months of the year seven ⅛ horse power fan motors are added, viz., 3 in the dining, 2 in the smoking and 2 in the observation cars, each absorbing the current of four 16 candle power lamps, or a total of 28, which, added to the 172, makes the total 200 lamps in the train. To maintain the 200 lamps requires 144 amperes. As the dynamo will generate but 80, the batteries must supply 64 amperes, or 44 per cent. This is effected by charging the batteries during the day and part of the night *en route*, and while the train is standing in the yards.

The following, taken from the January records of a train, will give an idea of the number of lamp hours required:

CHICAGO TO JERSEY CITY.

Time.	Hours	No. of Lamps	Lamp Hours.	
4 A. M. to 9 P. M.	5	172	860	Leaving Chicago.
9 " 11 "	2	140	280	
11 " 12 "	1	42	42	
4 " 7 "	3	172	516	Arriving at Jersey City.
During day in tunnels and depots.	1	172	172	
Total			1870	

JERSEY CITY TO CHICAGO.

Time	Hours	No. of Lamps	Lamp Hours	
4 P. M. to 9:30 P. M.	5½	172	946	Leaving Jersey City.
9:30 " 11 "	1½	140	210	
11 " 12 "	1	42	42	
6 A. M to 7:30 A. M.	1½	32	48	Arriving at Chicago.
During day in tunnels and depots.	1	172	172	
Total			1418	

Total, 3,288 lamp hours during the round trip.

The cost of an installation for a six-car Pullman train—consisting of one combined baggage and smoking, three sleeping, one dining and one combined sleeping and observation car is as follows:

COMBINED BAGGAGE AND SMOKING CAR.

1 Brotherhood Engine	$500 00
1 Eickemeyer Dynamo	503 00
32 Cells Accumulators	392 00
Wiring	100 00
1 Set Wire Connectors	11 00
Battery Boxes, Crates and Connections	71 00
Steam Piping, Lubricator Gauges, etc	155 00
Voltmeter and Ammeter	77 50
Safety Switch	12 00
Lamps and Sockets	17 00
Switches and Cut-Outs	17 50
Shades -Holders and Fixtures	16 80
Partition for Dynamo and Engine	38 00
Two ⅛ H. P. Fan Motors	70 00
Miscellaneous	50 00
	$2,027 80

SLEEPING CAR.

Thirty-two Cells Accumulators	$392 00
One Set Wire Connectors	11 00
Wiring	00 00
Battery Boxes, Crates and Connections	71 00
Lamps	15 00
Sockets, Receptacles, etc	47 00
Switches and Cut-outs	17 50
Shades and Shade Holders	0 00
Berth Lamps	00 00
Miscellaneous	20 00
	$762 50

DINING CAR.

Thirty-two Cells Accumulators	$392 00
One Set Wire Connectors	11 00
Wiring	70 00
Battery Boxes, Crates and Connections	71 00
Lamps	16 00
Receptacles and Fixtures	32 00
Switches and Cut Outs	17 50
Three ⅛ Horse Power Fan Motors	114 00
Miscellaneous	20 00
	$743 50

COMBINED SLEEPING AND OBSERVATION CAR.

32 Cell Accumulators	$392 00
1 Set Wire Connectors	11 00
Wiring	00 00
Battery Boxes, Crates and Connections	71 00
Lamps	14 50
Sockets, Receptacles and Fixtures	10 50
Shades and Holders	10 40
Berth Lamps	15 00
Two ⅛ Horse Power Fan Motors	70 00
Miscellaneous	20 00
	$749 10

A total of $5,808.20, or an average of $968.00 per car.

As the fan motors are used but six months in the year, the average number of lamps will be 172+14=186. Therefore, the cost of equipment per lamp will be $5,808.-26÷186 =$31.22.

The average cost of labor and material for maintaining the lighting of three trains, or eighteen cars for nineteen months, from August, 1890, to February, 1892, inclusive, was as follows:

Average total cost per month		$1265 05
" "	per car per day	1 03
" "	of labor per month	712 30
" "	" per car per day	1 11
" "	of material per month	511 51
" "	" per car per day	87
" "	per lamp per day	07.17
Average number of lamps in use		558

The item of labor includes the wages of five attendants on the train, at $3.00 per day each, and two men at each terminal station, at $90.00 and $55.00, and $75.00 and $50.00 per month, respectively.

That of material includes the cost of renewal of batteries, etc.

The cost of labor is practically constant, while that of material varies from 12 cents to $2.04 per car per day, the average for 19 months being 87 cents. The cost per lamp per day varies from 3 $\frac{8}{10}$ cents to 12 $\frac{6}{10}$; the average is 7.17 cents.

The cost of power furnished by the locomotive boiler is not included in the statement, for the reason that a satisfactory measurement of the quantity of coal and water used has never been made.

So long as the dynamo can be run and the batteries properly charged, the system is reliable.

During the coldest part of the winter, or, as sometimes happens, when a poor quality of coal is furnished, it is difficult for the locomotive to supply sufficient steam to run the dynamo. In such cases the batteries are called upon to maintain the light. As a rule, they have sufficient charge to do so for about four hours. Trains so equipped have been run between Jersey City and St. Augustine, Florida, during the months of January, February, March and April of each year since 1888.

The conditions there are decidedly more favorable, for the reason that the trains leave both terminals early in the morning. In consequence, the dynamo is run nearly all day, and the batteries are therefore fully charged and in condition to furnish current for the maximum number of lamp hours. So successful has been the electric lighting of these two trains, that it is rare for other sources of illumination to be used. The system has also been used on other trains, viz., between New Orleans and the City of Mexico, Omaha and San Francisco, Chicago and Portland, Me.

Several specials have also been similarly lighted, notably the presidential, from Washington to San Francisco and return; the National Electric Light association trains, between Jersey City and Chicago, and Jersey City and Kansas City; the National Telephone Exchange association train to Minneapolis, and that of the Pan-American delegates, which was almost constantly on the road for three weeks.

A duplicate of this system was tried for a short time on the Chicago, Milwaukee & St. Paul railway. I must look to others to explain the causes for its being abandoned, and also describe that which has been substituted, and which it is understood has proven very satisfactory. One of the most serious sources of trouble met with in train lighting was the effect of the vibration of the car on different members of the plant. At first it was almost a daily occurrence to have lamps drop out of sockets; the shade-holders, which were made of thin sheet brass, were broken at the rate of eight or ten during one trip. Trains would arrive at terminal stations with two or three batteries out of circuit, caused by connections between cells being broken. In the earlier days it was the practice to use a rigid connection between battery cells, as it was considered best to prevent the elements moving in the rubber jar. It was soon discovered that the element would move irrespective of the rigid connection, and in doing so would break the terminal, and in a majority of cases the fracture was next to the plates. As we had no means of burning the lug on again, the element was useless. To overcome this difficulty flexible connections were substituted. Contrary to all expectation, no damage was done by the movement, and since then, should a terminal be broken, which however is seldom, it is in every instance due to a defect in burning on at the factory. Cast brass shade-holders were substituted for those of sheet brass. To prevent shades working loose and dropping out, ordinary rubber bands were placed under the lip, against which the holder screws were driven, and they, having a soft foundation, were prevented turning, and held the shade in place. The cause of the lamps falling out was due, in a great measure, to the socket rings working loose. This was overcome by the invention of a tool that would drive the ring into place much tighter than was possible by hand. Many minor causes of trouble that could not be foreseen were eliminated as fast as they developed.

A system of safety cut-outs was devised that protects each wire in the car. They are placed on the same base-board with the lamp-switches, and are located in the locker or closet, convenient for inspection and renewal. Later on portable lamps were demanded, that could be placed in

the sleeping-car sections, either before or after the berths had been made up. For this purpose No. 18 wire was connected to one of the lamp circuits on the roof, and led to a connecting block placed over the mirror between the windows in each section. Connection with the block was made with a plug, to which flexible lamp cord was attached. On the other end of the cord a frosted sixteen candle power lamp was connected, the lamp hanging from an arm which was placed in a receptacle in the corner formed by the side of the car and the partition between sections, and immediately over the shoulder of the passenger, the most favorable position for the lamp when used for reading.

It was early seen that the only uncertainty connected with the system is due to the absolute dependence upon the locomotive boiler for power to run the dynamo, for, as explained, there is a constant liability of the failure of the steam supply, which, if prolonged beyond the capacity of the battery, will result in the use of oil or gas for light. As many other problems connected with the system have been successfully worked out, it is believed that the solution of this one will also be found.

There is no doubt that the ideal way of running the dynamo is by a connection with the axle. Many apparent solutions have been suggested, only to be condemned as uncertain or impracticable. It is, however, thought that within the next year a reliable connection will be had, after which I believe the lighting of railway trains by electricity will be universally adopted.

Tested by Battery.

Ex-District Attorney Sullivan of San Francisco told an amusing story the other day, says the *Examiner* of that city. "A few years ago," he said, "Dr. Livingstone, one or two others, and myself were camping in Lake county. We had a canned plum pudding, which we prized very highly, and a stable boy who was not bad in his way. Just as we reached Saratoga Springs the plum pudding disappeared, and we rather suspected the stable boy, but suspicion wouldn't tickle our palates or fill our stomachs. In our outfit was an electric battery, and I determined to try it as a thief-catcher and mechanical detective. I herded all the cooks, scullions and waiters about the place and stood them in a row with the stable boy. Then I made them a little speech, telling of the theft of the plum pudding and asking the guilty one to confess. No one peeped, and the most innocent-appearing person in the company was the suspected stable boy. 'Very well,' I said, sternly. 'We have here an instrument which detects thieves as surely as a camera takes photographs. The innocent it will in no way affect, but it will cause the guilty to suffer excruciating pangs—in limbs and conscience. Doctor, apply the test.' With this Livingstone stepped out with the battery. Placing the handles of the apparatus in the hands of the first man in the row, the doctor looked him in the eye a moment, but didn't turn on the current. Of course the man was not affected and was declared innocent. So the doctor passed from man to man until he came to the stable boy. As soon as the lad gripped the handles Livingstone pulled the machine wide open. That night we feasted on our recovered plum pudding."

CORRESPONDENCE.

New York Notes.

New York, June 4.—If all the tunnels that have been projected for this great city are built, electrical engineering will undoubtedly have a boom. There is now on foot a big tunnel scheme to provide rapid transit to the New Jersey suburbs and according to Gen. Roy Stone, the engineer in charge, electricity is likely to play a most important part in the enterprise. Without going far into the details of the project it may be said that the Land Commissioners at Albany have approved of the application of the New York and New Jersey Terminal Railroad company for a grant of land under the bed of the Hudson River at Fourteenth street, and the granting of this privilege marks an important step in the development of a project for a tunnel system that is designed to provide rapid transit to the New Jersey suburbs. In brief, the project is to construct a four-track tunnel beginning at the Hackensack Meadows, passing under the Erie railroad, descending at a grade of 1 per cent. or fifty feet to the mile, running under Castle Point and under the Hudson River at a depth of 125 feet from the surface to Fourteenth street, New York. Here the tunnel will branch, the main tunnel passing under Fourteenth street to Union Square, and the branch with two tracks passing southward under Hudson street to Chambers, and continuing in the same line at a depth of about 100 feet to a terminus under Broad street, near Wall. A four-track road is proposed to Union Square, making the distance of this main tunnel three and five-eighths miles. The length of the proposed two-track road is two and one-half miles.

Gen. Stone says that the most careful calculations have been made both as to the physical feasibility of the scheme, and as to its financial prospects. He is perfectly confident that the tunnel can be constructed by the usual methods in the rock sections, and in the earth by the Greathead system, or by the Jennings & Stannard plan lately used by the London and Northern railway. With regard to the motive power Gen. Stone says that if the feasibility of tunnel construction shall be admitted there can be no possible doubt of providing fast and comfortable travel by electricity. Electric companies, he says, have undertaken to provide motors that will carry trains of 500 tons at the rate of thirty miles per hour through the tunnel of the Baltimore & Ohio railroad under the city of Baltimore. The construction will be undertaken in the Baltimore tunnel under this guarantee, and Gen. Stone has no doubt that it will be entirely successful, the underground conditions for the use of electricity being more favorable than are the conditions in the open air. There is no serious problem, he believes in providing ventilation, because with an electric system the well-known means of ventilating a mine can be satisfactorily employed in a tunnel. The ventilation of Hell Gate was a simple matter, in spite of the constant use of explosives during the excavations there. No trouble whatever, therefore, is to be apprehended in this respect.

The New York "L" roads will yet be run by electricity. The Short company has now entered the field offering to undertake the work. Col. Hain, manager of the elevated railroad, has told the officers of the company to go ahead and specify just what they would guarantee to do, what the cost would be, what would be the advantages in saving to the company, and benefits to the traveling public. An officer of the Short company said that the company would not be prepared to make a proposition to Col. Hain before a week or ten days.

During the recent trip of the monitor Miantonomoh from this port to Annapolis the electric steering gear put in by the Edison company was used for the first time. The general result of the trial was considered pretty satisfactory, but there are a number of changes and improvements to be made in the apparatus before it is safe to use in a narrow channel. The run down the coast was made at the rate of about eight knots, and in the face of sea and wind.

The submarine cable connecting the dynamo station on Sandy Hook with the new electric lighted buoy on Southwest Spit was laid on Thursday under direction of Capt. W. S. Schley, the lighthouse inspector for this district. The cable is two miles long. The buoy it will light marks a sharp right-angle turn for heavy draught vessels. The red incandescent light on the buoy will be displayed on and after the night of June 15th.

Sing Sing will have its electric railway, for the board of village trustees has granted the franchise to the Ossining Surface Railway company to operate for fifty years without payment to the village for the first twenty-five years, and after that for a percentage of receipts.

On Tuesday application was made to the Edgewater (S. I.) village trustees for permission to equip the Staten Island Belt Line Street railway with the trolley system, and to extend the tracks from their present terminus at Fort Wadsworth to South Beach.

W. F. O.

New England Notes.

Boston, Mass, June 4.—The event of the season in electrical circles in this city has been the house warming of the New England Electrical club. This thriving organization was unthought of but a little more than half a year ago, but now it has taken up its abiding place in a cosy home of its own, with a membership list of over 200. Its new home is at 14 Bosworth street, in the heart of the business portion of the city, and next door to the Press club. Its situation is essentially down town, and as central as could be wished. The first definite move toward the organization was taken in January, when a few of the best known electricians of the city called a meeting, at which an organization was effected, with Hon. Ferdinand K. Wyman as president. Mr. Wyman held this position till within two months, when failing health compelled him to resign. The vacancy was filled by the selection of C. S. Knowles. The other officers are as follows: Vice-president, E. A. Record, New England manager for the Vacuum Oil company; treasurer, A. O. Smith, treasurer of the Eastern Electrical Supply company; secretary, L. M. Hays, night city editor of the *Globe;* directors, Maybin W. Brown, president of the Eastern Electrical Supply company; Elmer P. Morris, manager railway supply department of the Thomson-Houston company; Chas. C. Pierce, manager of the railway department of the Edison company; E. R. Tilton, with the Pettingill-Andrews company; Edward P. Sawyer of Sawyer, Walbridge & Briggs.

With this energetic board of officers the work of providing suitable quarters has been accomplished most expeditiously. The club has a state charter, and is now placed on a footing that it may well be proud of. The ground floor of its new building is given up to a reception and dining room. The former is a large, handsome room, furnished elegantly in plush and leather. On the second floor is the billiard room, private dining rooms, kitchen and wine room. The third floor is devoted to sleeping rooms, and the fourth is occupied by the servants of the club. Every room is fitted with electric lights, bells, and all the most approved electric appliances.

The club's object is the furnishing of a rendezvous for all those interested in any department of the electrical profession. Next winter a course of lectures is to be established, and debates are talked of.

The house warming was a great success. Among those who enjoyed the hospitality of the club were the following named gentlemen: Morris W. Mead, president of the Pittsburgh Electrical club; Chas. T. Luther, manager of the Pawtucket, R. I., street railway; Geo. M. Phelps of New York, Postmaster Samuel K. Mosely of Hyde Park, Frank Ridlon, Boston; J. K. Robinson, manager for Chili, Peru and Bolivia departments of the Westinghouse company; D. A. Andrews, vice-president, and C. B. Pierce, secretary of the Pettingill-Andrews company; L. S. Dumouslin of the West End Street Railway company, Alexander Extrom, chief of the lighting department of the Thomson Houston company.

An important decision has been handed down by Judge Colt, in the United States Circuit court this city. The suit was brought by the Western Union to compel the Bell company to transfer one-fifth of the shares of the capital stock of numerous corporations operating telephones and exchanges throughout the United States, and also one fifth of the dividends of the companies and of the sums paid the telephone people for licenses to connect telephone exchanges and one-fifth of the bonds and securities received for the licenses for telephones. This claim was made on the basis of a contract made Nov. 10, 1879, between the American Speaking Telephone company, the Gold & Stock Telegraph company, the Harmonic Telegraph company, the Western Union and the National Bell Telephone company, which was the predecessor of the present defendant. The Western Union controls the stock of all the companies named, except the Harmonic, and the contract was brought about as a means of settling the great telephone war, and to settle the titles of the parties interested. It gave the Bell people the right to conduct the general business of the telephone companies and to use the Gray and Edison patents which were owned by the plaintiff. By its terms the defendant has to pay the plaintiffs 20 per cent. of all sums received for rents, royalties, etc.

The question which the court was to determine was whether the 20 per cent. was to be reckoned upon all sums received or only upon profits made by the defendant in the telephone business or upon certain annual rentals.

Judge Lowell was the master in the case and he was to submit his report to counsel before filing, but he inadvertently failed to do so. Afterward the report was withdrawn and the master having refused to hear additional evidence the plaintiff moved to dismiss the bill with costs. Judge Colt decided that the bill may be dismissed without prejudice. This is the case in which exception was taken to Judge Lowell's finding on the ground that he was an interested party.

The Thomson-Houston company has just received an order from the Belt Railroad company of Baltimore for electric engines with which to equip its tunnel line. There are already in use in this country several electric locomotives for handling freight trains on side tracks and in yards, but the Baltimore road is the first to extend their use to main lines. There is also in construction in the Lynn works a large electric locomotive of 500 horse power capacity which is intended for use in any department of railroading for which a steam locomotive can be used, whether passenger or freight.

Dedham is to have an electric street railway, but there is an interesting contest as to who is to build it. Two companies have been organized, the Old Colony Street Railway company of Hyde Park and the Suburban Street Railway company of Dedham. The line has been surveyed connecting the two towns, but the right-of-way has not yet been awarded. The Old Colony proposes to use a Johnson girder rail, which would not interfere with street travel. A single overhead trolley wire will be used. This company proposes to locate its power station in Hyde Park, using 300 horse power engines. The Suburban company would use a T rail.

The Boston fire alarm wires are to be put underground. Inspector Flanders has completed the plans, the fire commissioners have approved them, and the work will be begun not later than September.

The state senate has reported adversely on the order requiring the consolidation of the companies furnishing electric lights to the city.

The railroad commissioners are considering an interesting problem in the application of the Hull electric street

railway to cross the tracks of the Old Colony steam railroad at grade. This question came before the board last year. The commissioners reported that there were twenty-six such crossings in the state where electricity is a part or the only power. The Hull road wants to extend a line along the shore from Nantasket to Point Allerton, a distance of about two miles, and nearly parallel to the tracks of the Nantasket branch of the Old Colony. Its ultimate terminus would be at Hotel Pemberton, and would involve two more grade crossings. The Old Colony objects, saying that the business to be handled is unusually hazardous—summer excursions—and it offers a solution of the problem by saying that the branch is not paying, and that it will sell it to the electric road people. The commissioners have already refused two such requests, and it is probable that the Old Colony solution will be the one adopted.

Councilman E. H. Brown of Salem claims to have invented a system of operating electric railway cars which does away with the use of poles and overhead wires in the street and employs no conduits.

The Lynn and Boston railroad is to be operated by electricity. The railroad commissioners have just granted permission to erect poles and adopt the new system. The work will be begun at once, and it is thought that it will be completed by the latter part of the summer.

Leading electrical men in Boston and vicinity are at work organizing an electrical Lloyds to fill the much depleted lines of insurance on electrical risks. Treasurer Peach of the Thomson-Houston company is one of the projectors of the enterprise.

The West End street railway people are just extending their electrical system into Charlestown. They have been operating the South Boston line about a month.

Tufts College and Prof. Dolbear have furnished the West End with the major part of its electrical talent. Chief Engineer Pearson, R. C. Brown, who has charge of the work of fitting the cars with electrical machinery, W. A. Pearson, superintendent of the power station, M. G. Starrett, who had charge of the construction of the power station, and many others of the best men, are graduates of Tufts.

The inspection department of the Boston Board of Fire Underwriters has promulgated a new code of rules applying to electric risks. Hereafter the board will approve of only non-combustible supports for electric light wires, and there must be no opportunity for connection with any but properly insulated wires.

The West End company has now extended its electrical lines to Charlestown, and has petitioned the authorities of Medford for permission to operate its branch in that town by electricity. The company has also been permitted to use the overhead trolley system on the Harvard bridge on condition that it will adopt any other system of motive power or take up its tracks altogether if the Cambridge authorities should so request.

William Graves, superintendent of the Newburyport Gas & Electric Light company, died May 22d.

The Abington & Rockland Electric Road company has made arrangements to have its road in running order in thirty days. The only trouble the new road anticipates is with the Whitman authorities, and if they do not render a favorable decision the road will run direct to Brockton, via Brockton avenue, Abington.

G. W. Mansfield and F. O. Blackwell of the Thomson-Houston company announced publicly recently that they were prepared to guarantee the construction of motors capable of running trains at the rate of sixty miles an hour within ten days of the time they should be notified they were wanted. They say that their company could produce a sixty ton motor capable of drawing four cars of the ordinary elevated road type sixty miles an hour without danger of burning out or any other trouble.

The legislature having failed to grant a new lease of life to the Boston Rapid Transit commission the commission has gone out of existence and it is probable that its recommendations will not be acted upon this year. This leaves the entire problem still in the hands of the West End company.

The Railroad Commissioners have refused to allow the Hull Electric Street Railway company to cross the tracks of the Old Colony & Nantasket. This is in line with the previous decision of the board.

The first reception of the newly-organized New England Electric club was given Tuesday evening last week. The pretty club house on Bosworth street was thronged with members and guests. A complimentary concert was given by the St. Botolph orchestra.

Biddeford, Me., has begun to run its street cars by electricity.

Electrician Mansfield of the Thomson-Houston company was before the aldermen of Haverhill recently in behalf of the petition of the Lowell, Lawrence & Haverhill electric road to lay its tracks in that town. No decision was reached.

The Salem Board of Aldermen has requested the electric light company to put its wires under ground.

An electric road is to be built between Stoneham and Wakefield. The distance is about two and a half miles. It is expected to be running by August. The officers of the company are: Chas. F. Woodward, president; Ezra M. Southworth, secretary; Daniel G. Watson, treasurer.

J. C. E.

Milwaukee, Wis.

MILWAUKEE, June 4.—A suit for $5,000 damages has been instituted against the Milwaukee Street Railway company by Hubert Deuster of Sutton's Bay, Mich., who was injured by the scraper on a National avenue car near the Soldier's Home on April 29th. Charles Auterberg has sued the company for $1,000 damages. He alleges that he was thrown from his express wagon, and was injured as a result of the defective condition of the company's tracks.

In the case of Thomas Ramsey against the Holmes Protective Service company, Judge Austin has refused to grant the plaintiff a new trial.

The name of the town of Buckhorn, south of the city, where Cudahy Bros. have purchased several acres of land and propose to establish immense packing houses, etc., has been changed to Cudahy. The new manufacturing suburb is to have an electric railway. The plan is to build from the terminus of the Russell avenue line to Brookside, the country home of Secretary Langson of the Chamber of Commerce, along the Chicago road. From Brookside the line, leaving the road, is to follow a return line to the Thompson road, on which it will run east to the Packard road, and thence north to Cudahy. All the private property necessary for a right of way has been secured, and the town board will be requested to grant a franchise for building along the public thoroughfares mentioned. The Cudahys, it is said, were prepared to build the road themselves, but the Villard people expressed a willingness to construct and operate the line, and will be allowed to do so.

The common council has granted an appropriation of $5,000, with which to bury the fire alarm telegraph wires in the Wisconsin Telephone company's conduits.

C.

PERSONAL.

G. S. Mumford, treasurer of the C. & C. Electric Motor company of New York, was in Chicago last week.

J. W. Godfrey, general manager of the New York Insulated Wire company, and Augustus Noll of the same company, were in Chicago last week.

Frederick Sargent, electrical and mechanical engineer of the construction department of the World's Columbian Exposition, left for a few days' sojourn in New York last week.

Col. R. C. Clowry, general superintendent of the Western Union company, is in Minneapolis this week, supervising the telegraphic service for the Republican National Convention.

On May 13th a complimentary dinner was given to Prof. Ayrton, F. R. S., at the Holborn restaurant, in London, by twenty-one of his former students, who are now well known in the electrical profession. W. B. Esson occupied the chair, and among the guests were W. H. Preece, F. R. S., Prof. Thompson, F. R. S., Prof. Perry, F. R. S., F. H. Webb, and James Swinburne.

NEW INCORPORATIONS.

Carroll Electric company, Portland, Me., capital stock, $75,000; to manufacture and deal in electrical apparatus of all kinds; F. V. Chase, Portland, Me.

Alleghany Hotel company, Goshen, Va.; capital stock, $100,000; hotels, springs, electric plants, real estate and improvements, horse and electric railways.

Citizens' Electric company, Battle Creek, Mich., capital stock, $50,000; furnishing electricity for lighting in Battle Creek; F. M. Wadleigh, Battle Creek, Mich.

Suffolk Electric company, Portland, Me; capital stock, $300,000; to manufacture and deal in electrical appliances of all kinds; W. M. Payson, Portland, Me.

Columbia & Marietta Electric Railway company, Columbia, Pa; capital stock, $50,000; operating an electric railroad in Columbia, Pa.; Robt. T. Ryan, Columbia, Pa.

Delaware Railway company, Philadelphia, Pa; capital stock, $51,000; constructing and operating an electric railway between Darby, Delaware county, and Chester, same county.

Santa Ana Electric Power & Development company, San Bernardino, Cal.; capital stock, $1,000,000; to generate power by water and transmit by electricity, build and operate electric plants, railroads, etc., develop water and build and operate works; Andrew P. Paris, San Bernardino, Cal.

Bloomsburg Electric Street Railway company, Bloomsburg, Pa.; capital stock, $12,000; constructing and operating an electric railway in Bloomsburg; C. W. Miller, Bloomsburg, Pa.

New Kensington Street Railway company, Pittsburgh, Pa.; capital stock, $15,000; constructing and operating an electric railway in Westmoreland county; Lyon, McKee & Sanderson, Pittsburgh, Pa.

Delaware Electric Street Railway company, Delaware, O.; capital stock, $60,000; building and operating an electric street railway, furnishing light and power, etc.; J. K. Newcomer, Delaware, O.

El Paso Electric company, El Paso, Tex.; capital stock, $100,000; operating by means of electric power street railways, suburban and belt lines of railway, and supply of light and motor power.

Shickshinny & Huntington Valley Railway company, Huntington Mills, Pa.; capital stock, $60,000; constructing and operating an electric railway in Luzerne county; Col. R. M. Tubbs, Shickshinny, Pa.

Citizens' Passenger Railway company of Williamsport, Williamsport, Pa.; capital stock, $13,500; constructing and operating an electric railway in Williamsport, Pa.; H. C. & S. T. McCormick, Williamsport, Pa.

Lacon Electric company, Lacon, Ill; capital stock, $16,000; construct, maintain, use and operate electric light and power plant, etc., in Lacon, Ill., and all appurtenances, etc., thereto; C. C. Travis, Lacon, Ill.

Electric Railway Supply company, Chicago, Ill.; capital stock, $100,000; to manufacture, buy and sell trucks, wheels, and appliances for electric railways, supplies, equipment specialties and power plants; Thomas Clarke, 167 Dearborn street, Chicago, Ill.

Forest City Electric Light, Heat & Power company, Forest City, Pa.; capital stock, $1,000; supplying light, heat and power, or any of them, by means of electricity in the borough of Forest City, Susquehanna county; H. O. Watrous, Forest City, Pa.

Portland Consolidated Street Railway company, Portland, Ore.; capital stock, $1,000,000; to operate street railways and propel cars used thereon, either by horse, mule or by electric, cable, steam or other mechanical power; D. F. Sherman, Portland, Ore.

ELECTRIC LIGHTING.

The Electric Light & Power company of Quincy, Ill., will expend $12,000 in improving and enlarging its plant.

After considerable controversy, it seems probable that the Burlington, Ia., Electric company, recently organized by the Thomson-Houston company, will be awarded the contract for lighting the city.

The Westinghouse Electric & Manufacturing company is considering the advisability of connecting Middletown, Del., and Odessa, and putting in new machinery for the purpose of lighting both towns by electric light from one plant.

The Electric Light & Power company of Oshkosh will build a large addition to its plant. Two new compound condensing engines, one a 400 and the other a 200 horse power, will be put in. The improvements will cost several thousand dollars.

It is probable that visitors to Niagara this summer will see the cataract lighted by electricity. A powerful light will be placed on the Maid of the Mist landing, on the Canadian side, and current will be supplied by the electric light company at Clifton.

The Western Electric company has been awarded the contract for furnishing the Somerset, Pa., Electric Light & Heat company an electric light plant capable of furnishing incandescent and arc lights necessary for private, business and street lighting in Somerset.

The main steam pipe of the Brush Electric light company of Baltimore burst on May 29th. The entire line of pipes, steam and water, will have to be removed, bringing the total damage up to $5,000. The result of the accident was that, for two days, the city was without arc lights, for which the electric company will have to pay the city one dollar a day for each one, and there are nine hundred and sixty-five in all.

The Allegheny County Light company of Pittsburg has one of the largest central station plants in the country. It is claimed that this company operates 37,000 16 candle power incandescent lights, 1,200 arc lamps and 500 horse power in motors. The company employs 75 men, and the pay roll amounts to about $75,000 per year. A new station at Twelfth and Etna streets was completed last October. When the new plant is entirely installed, the station will have a capacity equivalent to 125,000 16 candle power incandescent lamps.

ELECTRIC RAILWAYS.

An electric railroad between Buffalo and Hamburg, N. Y., is proposed.

"Repeated attempts," says the Lebanon, Pa., *News*, "have been made since the Lebanon and Annville Electric Railway company opened the line to Annville to wreck cars between this city and Sunnyside. At least a dozen attempts have been made, several of which came near being successful. In one or two instances the cars have been injured, but, by being constantly on the look-

out, the employes of the road have thus far been able to avert serious consequences. All of these attempts have been made at or near Sunnyside." It is thought that revenge is the motive for the outrages.

There is a movement on foot in Brookline, Mass., for the extension of the Beacon street boulevard, so as to provide for a belt line of electric cars from the Tremont House, Boston, over the boulevard and return via Chestnut Hill avenue, Boylston street and Huntington avenue.

The Macon Ga., & Indian Springs Railway company, which intends to build an electric railroad from Macon to Indian Springs, a distance of about thirty miles, has applied for a franchise to lay tracks on certain streets in Macon. The preliminary survey between Macon and Indian Springs has been made, and work is expected to be began shortly.

The work of eqipping the Union Passenger railway lines at Baltimore with electricity will be begun this week. The York Road line will be the first to be equipped. The work will commence on the upper end of this line and be pushed toward the city. For the present no power house will be built, as the company will get its motive power from the plant of one of the local electrical companies.

The Pittsburg, Knoxville and St. Clair street railroad, the first electric road built in Pittsburg, is to be entirely abandoned. It is now under control of the Birmingham Traction company, but has not been operated for the last year and a half. The reason for giving up this enterprise is the near completion of the new electric road through Knoxville, Allentown and Mt. Oliver, which will connect with both the Mt. Oliver and Knoxville inclines, and prove more advantageous to the hill residents.

The street railway system at Rochester, N. Y., was thoroughly tested on Memorial Day, when thousands of visitors gathered to participate in the grand unveiling exercises of the soldiers and sailors' monument at which President Harrison, Governor Flower and many other distinguished visitors were present. The excellent service of the company was favorably mentioned by the visitors and throughout the crush there was no reason for complaint. President Beckley of the street railway company had the pleasure of taking the distinguished visitors to Ontario Beach and return in one of the electric cars, the president and governor taking turns in acting as motor man.

ELECTRIC MINING.

The Edison Electric Light company, of Tacoma, has just contracted with the Everett Mining & Milling company to furnish a complete electric plant for lighting and operating the latter company's mines and mills at Okanogan. The plant will be ready for use in August, and will be located two miles below Loomiston.

The machinery of the new electrical ore reduction works at Albuquerque, N. M., has been ordered and the plant will be in operation this summer. It is claimed that refractory ores can be successfully treated by this process, and experiments have been made with ore from that county, which are said to have been highly satisfactory. Ex-Gov. ernor Stover, who is one of the members of the companwhich will erect the works, is very enthusiastic, and is certain that the venture will be a success. If it will do what is claimed for it, a large number of mines in this territory which produce low grade refractory ores can be worked profitably.

The Alaska Mining company, whose property is located at Pike City, Sierra county, Cal., is arranging to install an electric plant to do the pumping and hoisting. It is intended to obtain water power from the Middle Yuba river with which to drive the dynamos by the use of Pelton wheels. Some years ago the Alaska mine was a large gold producer, but there was such a heavy body of water to contend with that the cost of keeping it under control was enormous and the company gave up the contest. By the use of electric power it is estimated that the cost of pumping will be greatly reduced, and that the mine can be again placed on a profitable working basis.

TELEGRAPH.

The Rocky Mountain Telegraph company has recently increased its capital stock $200,000, and the proceeds from the sale will be used to extend the lines south from Butte, Mont., over the Union Pacific to Salt Lake, Utah, thence to Grand Junction, Col., to a connection with the Postal company. Another wire will be strung north to Winnipeg, which is now the company's only outlet to the east.

The Western & Brazilian Telegraph company's steamer Norseman experienced a heavy gale on May 10th and sprung aleak, which put out the fires, when off Chuy. All the pumps were choked, and the crew were engaged all day and night baling with buckets, but the water gained. The weather moderated on the 12th, and during the night all hands were transferred to the Scotia. When left, the Norseman had 11 feet of water in the engine room and 3 feet and 6 inches in the after hold. The Scotia will attempt to tow her to Montevideo.

Probably no newspaper in the country has a more extensive telegraphic service than the *Globe-Democrat* of St. Louis. Its special dispatches average about 35,000 words a night, and on one or two occasions 65,000 words have been received between 6 P. M. and 3 A. M. In the new building, which has just been completed,, two rooms are devoted to the telegraphic department—one for the editors and the other for the operators. The latter is provided with tables and instruments for twenty men, although but fourteen wires enter the building at present. The building is lighted by an isolated Edison plant of about 1,900 lamps' capacity. A six horse power motor is used in the stereotyping department.

TELEPHONE.

The new building of the Omaha Telephone company will cost $60,000.

The Sunset Telephone company is erecting a new building at Los Angeles, Cal.

The new building of the Hudson River Telephone company at Albany will be ready for occupancy, it is expected, in the fall.

In Rochester, N. Y., the telephone compaay has laid 24.03 miles of underground ducts, and has applied for permission to lay 51.23 miles more.

The stockholders of the Bell Telephone company of Philadelphia propose to increase the capital stock from $560,000 to $1,000,000. The company propose to put all its wires under ground.

The Southern New England Telephone company is replacing the present lines in Hartford, Conn., with a metallic circuit. A number of new poles will also be erected and the local service otherwise improved.

L. T. Huebner, manager of the Beatrice, Neb., Telephone Exchange, and Clyde Hale, an assistant, met with quite an adventure on the occasion of the recent flood. They attempted to reach Blue Springs, twelve miles distant, in a boat. Half way down the river they encountered an island of which the tops of trees only were visible. The boat struck an eddy and the men becoming frightened grasped a tree top, when the boat was carried away. The men were compelled to remain in the tree until 10 o'clock the next morning, when they were rescued by farmers who heard their calls for help. When brought to the shore they were almoat exhausted and said they could not have remained in their position much longer.

TRADE NEWS.

The Heisler Electric company of Philadelphia, reports the sale of a large number of electrical plants.

The Warfield Manufacturing company, of Baltimore, is receiving a large number of orders for the new desk and ventilating fans.

The Chesapeake Belting company, of Baltimore, has just built a six story addition to its factory, having a frontage of 50 by 140 feet.

H. T. Paiste of Philadelphia, is at work upon a number of important electrical novelties that he will offer the trade in the near future.

The Automatic Switch company, of Baltimore, Md., reports numerous orders for the new Whitingham automatic motor starter. The company also promises several new specialties.

It isn't an easy matter to work up "catchy" advertisements, but G. T. Evans, 102 Fifth avenue, Pittsburgh, Pa, through his folder essay on "Wind" will doubtless succeed in raising one kind at least.

Treasurer H. N. Fenner of the New England Butt company, of Providence, R. I., reports that his company is completing arrangements for an exhibit of its well known braiding machines at the Columbian exhibition.

General Manager B. L Coe of the Steel & Johnson Manufacturing company of Waterbury, Conn., reports that the manufacturers of electrical apparatus are asking for the high grades of metal which indicates a prosperous business in their line.

C. Towles of the Jewell Belting company of Hartford, Conn., has just returned from an extended business trip through the South. It is rumored that it will take many hides to fill the belt orders that Mr. Towles secured from the electrical trade.

The Interior Conduit & Insulation company has just issued a code book for the benefit of customers who desire to order by telegraph. A postal card or letter addressed to 42 and 44 Broad street, New York, will bring a copy of this handy little book by return mail.

The Porter-Leavitt Electric Motor company of Providence, R. I., is filling a large number of orders for desk fans. Although having but recently moved into its new factory, which it was supposed would give ample facilities, the company now finds that it will soon have to build an addition.

William H. Bryan, until recently general superintendent of the Pond Engineering company, will in future devote his time exclusively to mechanical and electrical engineering at St. Louis. Mr. Bryan has had considerable experience, and his testimonials show that he has given his patrons satisfaction.

A handsome monthly calendar is being sent out illustrating the lathes, drills and other lines of machinery manufactured by the Universal Radial Drill company of Cincinnati. That for June is the last one received and the company is to be congratulated upon the good taste displayed in the design.

The Premier Electric company, Brooklyn, N. Y., is mailing circular letters to the trade, warning them against the sale of motors of other manufacture with three-pole self-starting armatures. The company's claim is that such types of motors are fully covered by U. S. patents, the property of the Premier company.

Pepper & Register, Philadelphia, electrical engineers, have recently received the contract for superintending the placing of the electrical apparatus, wiring, etc., in the Union League building, Philadelphia. A 2 000 light Waddell-Entz dynamo is to be installed in the building and it is expected the Julian storage battery system will be employed in connection with this plant. This same firm will also place the plant at Edgewater Park, N. J.

Antoine Bournonville, with Alfred Moore, Philadelphia, left for Europe last week. Mr. Bournonville is taking a much needed rest after a very close confinement to business. He will only remain abroad a short time.

The Standard Electric Time company of New Haven, Conn., has received three large orders for export, the orders having been given after a most careful investigation into the merits of its clock. This company is making preparations for an exhibit at the World's Fair.

H. B. Cutter, of Philadelphia, has returned from an extended trip through the South and West. Mr. Cutter visited Kansas City, Omaha and Chicago, and the large number of orders he secured for the "C. S." specialties, he looks upon as convincing proof that the West is territory where good things are appreciated.

F. A. C. Perrine, for many years with the Roebling company at Trenton, resigned his position recently and later was made treasurer of the Germania Electric company of Boston. The office of the company has been moved from 505 Exchange building to 620 Atlantic avenue. A growing business made the change necessary.

F. C. Ackerman, New York, representative for the American Electrical Works of Providence, R. I., reports large sales for electric light line wire, and also railway feeder and trolley wire. This company is very busy at present filling a large number of orders for flexible conductors, in connection with orders for future delivery for Americanite, magnet and annunciator wires.

The growth in the demand for electrical apparatus during the past year has had its effect on the market for first class mica; increasing, it is said, the demand to nearly 100 per cent. East India mica is much used for insulating purposes, and A. O. Schoonmaker of New York is supplying it in large quantities to electrical firms both in the East and West. Samples and quotations will be furnished from 158 William street, New York.

The Viaduct Manufacturing company of Baltimore, has recently offered for sale a very unique push button which is called the "Serene." It is claimed to have many advantages over the older styles and numerous orders testify to its practicability. This company is having its usual large trade in magneto bells, and has added to its line of specialties a very convenient holder for telephones that has several peculiar features.

The Wannopee Pottery company of New Milford, Conn., known for many years as manufacturers of high grade porcelain, have decided to manufacture a line of electrical specialties. Superintendent Thomas Davis, who has charge of the factory, has had a long experience in work of this kind and has a full knowledge of the difficulties of the work of producing this peculiar grade of porcelain. The company has recently added a new kiln built upon the most improved plan.

The Williams Engine company of Baltimore, Md., is very busy building engines. Orders are coming in and the company is compelled to work at night, and it is also contracting with another larger shop to take hold of some of the work. This company is building yacht engines, standard type, and very high speed engines for direct connection to dynamos. Through the employment of modern tools, and with the aid of the experience of the past, the builders of this engine are advancing to a leading position in this line of manufacture.

The office of the Jackson-Cornish Electric company, until recently in the Springer building, 207 South Canal street, Chicago, has been removed to room 26, 153 Monroe street. This company has successfully handled several large wiring contracts during the last six months, and a contract for the electrical work in the Potomac apartment house, at the corner of Thirtieth street and Wabash avenue, has just been secured after much competition. The building will have forty apartments, and is to be wired with kerite, the order for which has just been placed with the Enterprise Electric company, Chicago.

The current to operate the electric tramway at Armour's packing house, Chicago, the installation recently mentioned in the WESTERN ELECTRICIAN, is to be supplied by one 80 horse power multipolar generator, built by the National Electric Manufacturing company, Eau Claire, Wis. This company has recently sold also two 80 horse power generators of the same type to operate an electric street railway at Seattle, Wash. The motors on the former road will be supplied by the Thomson-Houston company, and on the latter by the Short Electric Railway company of Cleveland.

The Hart & Hegeman Manufacturing company of Hartford, Conn., is about completing its first year in business. From a small beginning this concern has advanced until it is now known to be among the foremost in the manufacture of switches and electrical apparatus. This company's business has increased so rapidly that it was necessary to add a large amount of special machinery, and increase the force many times from what it was originally. Secretary A. H. Pease continues to show his usual push and energy in bringing the company's electrical apparatus to the notice of the trade and President Gerald W. Hart is devoting his entire time to perfecting his various inventions which the company is exploiting.

Judge Gresham of the United States circuit court has recently rendered a decision that is of interest to users of steam boilers, but particularly to the makers and users of the Hazelton Tripod boiler. The infringement suits were begun by a New York corporation, in name almost identical with that which had been adopted by the older Chicago company, against six prominent business houses that had purchased the Hazelton tripod boiler. The suits were consolidated and after five years' contest have

been thrown out of court, every claim being dismissed for want of equity. The demand for boilers made after this pattern is evidently on the increase and this decision undoubtedly will largely increase the sales.

A very handsome and complete catalogue has been issued by the mining department of the Thomson-Houston Electric company. It contains over 200 large pages, and is beautifully printed and illustrated. The application of electricity to concentrating works, under ground haulage, hoist, pumps, coal cutters, rock drills, rock breakers, blowers and air compressors is clearly described, the letterpress being accompanied by cuts of unusual excellence. A description of the electric drilling at Rock Island is also included, as well as much useful information in the shape of tables of capacities and price lists.

Through the courtesy of General Manager F. S. Minott of the National India Rubber company of Bristol, R. I., a representative of the WESTERN ELECTRICIAN was taken through the large factories of this concern. The power for this factory is supplied by a 1,000 horse power Corliss engine, taking steam from 11 boilers of 200 horse power each. This concern makes almost everything that is heard of in the line of rubber goods, including its seamless rubber insulated wire. There has been such a demand for this last named product that it has been necessary to run this department of the work overtime in order to fill orders. This company now has under consideration the building of a large factory in order to meet the growing demands of this branch of the business.

One of the handsomest catalogues that has reached the office of the WESTERN ELECTRICIAN for many a day is that of the Dayton, Ohio, Globe Iron Works company, exploiting the new American turbine manufactured by it. The company also manufactures paper and pulp mill machinery, gearing, shafting, pulleys, etc. The catalogue is tastefully printed and handsomely bound in flexible morocco covers. It gives a detailed description of the "new American," with tables for the measurement of water powers and also giving the horse powers of wheels of different sizes, with directions for setting them up. All necessary information relating to turbine wheels and connected gearing is furnished, illustrated by many cuts. A large number of references are given, including the proprietors of about twenty electric plants.

J. Paul Gaylord, president, and Lewis Rodman Schultz, treasurer of the Pennsylvania Electric Engineering company, Philadelphia, were in Chicago for several days last week. Mr. Gaylord has recently been elected president of the company in place of Mr. Bosley, resigned. Both gentlemen are comparatively young men, and they have had a practical business education that will render them good service in their present undertaking. Mr. Schultz, during the last year, has made up a line of very attractive advertisements for "The Pennsylvania Lamp" for eastern publications. This special work will remain under his supervision. If suitable arrangements can be made a western agency for this lamp will be established in Chicago and its sale pushed energetically. This company will represent in Philadelphia the National Electric Manufacturing company of Eau Claire, and in a limited territory, the Western Electric company Chicago; besides these, though, several other valuable connections are under consideration. Mr. Gaylord's father, J. T. Gaylord, resides in Davenport, Ia., where he owns and operates an extensive gas and electric lighting plant. Messrs. Gaylord and Schultz met C. A. Daigh by appointment, at the National company's office in "the Rookery" on Wednesday of last week, and left that night to return to the Quaker City.

BUSINESS.

A list of shipments just received from the Ball Engine company of Erie, Pa, shows that the recent sales of the company amount to twenty-four engines, aggregating 3,260 horse power.

Albert E. Hay, president of the Robinson Machine company of Altoona, Pa, has been in Chicago for some days, arranging for an office and salesroom, made necessary by a rapidly increasing demand for the Robinson steel truck for electric street railways.

Secretary F. W. Davis of the Perkins Electric Switch Manufacturing company, of Hartford, Conn., will soon have a number of new electrical novelties to offer the trade. He states that the business since January 1st, shows an increase over that of last year of nearly 50 per cent.

Kerite wire seems to be coming to the front rapidly. F. W. Cushing, the general western agent, reports that his May sales were more than twice as large as those for any previous month since he has had the agency. The Enterprise Electric company handles the local Chicago trade and is finding the wire an easy seller.

The incandescent lamp is being more and more sought after not only for its superior advantages as a medium of light, but also for its great superiority over every other thing in its relation to artistic results. The lamp bulb itself is a plastic form in the hands of the decorator, and can be made a source of almost limitless effects. One of the neatest designs noticed lately is the acorn shaped Sunbeam lamp sold by the Electrical Supply company, Chicago. They are furnished in all colors, to fit any socket and for any voltage. This same company has just issued a pocket edition of its house goods catalogue, No. 44-A.

The Electric Heat Alarm company, Boston, is in receipt of a letter from C. M. Goddard, secretary of the New England Insurance Exchange, in which he says: "We have carefully examined your system of heat alarm, together with the rheostat used in that connection, and we are of the opinion that this apparatus will prove of value in giving timely warning of heated bearings. We believe that in all fast running machinery the installation of this apparatus would not only materially lessen the danger of fire from hot bearings, but would go further and very quickly pay for itself in preventing the destruction of valuable machinery, even when there was no probability of a fire resulting. We heartily recommend the use of this apparatus to all parties subject to danger from heated bearings, and believe that with a thoroughly installed system such danger would be reduced to a minimum."

President C. B. Thurston of the Jersey City & Bergen Railroad company has just closed a contract with the Ball & Wood company of New York for three improved cross compound engines of 300 horse power each. In deciding upon the Ball engine, the engineers of the Pennsylvania railroad carefully investigated the leading makes of engines, something like eight of which were in competition for this contract. The intention of the railroad company is to make the plant which will operate its lines a model one not only in respect to the latest and most approved type of engines but in its other machinery also.

The Short Electric Railway company reports orders for additional apparatus of the single reduction type from the Bloomington, Ills., City Railway company, ten 40 horse power equipments and one 100 horse power generator; South Covington & Cincinnati Street Railway company, four 40 horse power equipments; Schuylkill Electric Railway company, Pottsville, Pa., four 50 horse power equipments; West End Street Railway company, Rockford, Ill., six 20 horse power gearless equipments; Georgetown & Tenallytown Railway company, Washington, D. C., two 40-horse-power single reduction equipments; Wilkesbarre and Wyoming Valley Traction company, three 60 horse power single reduction equipments, one 200 horse power generator; and the Braddock Electric Railway company, Braddock, Pa., one 40 horse power equipment. The company has also closed contracts recently with the Baltimore Traction company, Baltimore, Md., and the Janesville, Wis., Street Railway company.

The exhibit of vulcanized fiber at the Crystal Palace electrical exhibition by the Vulcanized Fiber company of New York, through its European agents, Mosses & Mitchell, 68–71 Chiswell street, London, E. C., it is said, was the most complete and attractive display in this line of goods that has ever been presented to the public—in fact, the company claims that it surpassed the expensive exhibits at the Centennial Exposition, the National Railway Exposition at Chicago, the International Exhibition at Liverpool, and also that at the Paris Exposition. The large and handsome show-case occupied a very prominent location in the south nave of the main hall, nearly opposite to the crystal fountain, and received most complimentary notices. The display consisted of finely finished and polished vulcanized fiber in sheets, rods, sticks, washers, disks, tubes of all diameters, magnet heads of various shapes and sizes, field-magnet spools, insulating rail end posts, pinions, gears, etc., etc. There were also a number of electrical instruments, call boxes, switchboards, etc., all handsomely mounted on vulcanized fiber bases, with trimmings of the same material. In addition to this there was an attractive sample board of the "insulating saddle staples," the latest article placed upon the market by this company. Messrs. Mosses & Mitchell have acted as the European representatives of the Vulcanized Fiber company for sixteen years, and through their energy and ability have established subagencies in all the principal cities throughout the continent, where they have a large and constantly increasing trade.

ELECTRICAL STOCK MARKET.

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, June 4th, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	110½	111
Edison Illuminating company of New York	84	85
" " " Brooklyn	85	90
" " " Boston	115	120
" " " Chicago	130	140
Edison Ore Milling company	15	20
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	35	50
Brush Illuminating company of New York	40	60
Thomson-Houston Electric company	60	60½
" " " Preferred	30	31
North American Phonograph company	4	6
New York " "	2½	5
Automatic Exhibition company	3	5
Westinghouse company Common	27	28
" " Preferred	45½	46

ELECTRICAL PATENTS.

Issued May 31, 1892.

475,759. Electric Meter. Oscar Ericsson, Sioux Falls, S. D.

The invention consists of two cams, one driven by a constant motor and the other by the current measured; one imparting an effective movement to a pawl and the other regulating the extent of this movement.

475,781. Electric Wire Holder. Edwin L. Lloyd, Philadelphia, Pa.

475,783. Contact Post for Electric Bells. Frederick W. Manger and Otto H. Huebel, Brooklyn, N. Y.

475,809. Electric Self-winding Clock. Frederick M. Schmidt, Brooklyn, N. Y.

A reciprocating motor is employed in combination with a clock train and main spring so that, at given intervals determined by the movement of the clock train, the motor is brought and maintained in operation for a sufficient length of time to rewind the spring.

475,797. Secondary Battery Electrode and Process of Making the Same. Anthony Reckenzaun, London, England. Filed Sept. 13th, 1890. Serial No. 365,120. (No model.) Patented in England Nov. 22nd, 1889, No. 18,755; in France July 30th, 1890, No. 207,332; in Belgium July 30th, 1890, No. 91,462; in Germany Aug. 7th, 1890, No. 57,085; in Victoria Oct. 11, 1890, No. 8,155; in Italy July 8th, 1891, No. 409, and in Spain July 24th, 1891, No. 12,213.

This invention relates to a method of forming a battery plate which consists in subjecting its surface to the action of an electric arc or spark whereby the surface becomes physically changed.

475,877 System of Electrical Distribution. Cyprien O. Mailloux, New York, N. Y.

This system consists of circuits connected to a main supply source, and having interposed between the circuits and the supply source auxiliary generators, counter or assisting, and adjusted with respect to the relative drop in the feed wires to produce at full load a resultant drop necessary for the potential desired at the points of connection to the consumption circuit.

475,889. Machine for Making Hollow Wire Cable. Othniel Preston, Hornellsville, N. Y.

475,898. Rheostat. Frederick W. A. Schneider, Toronto, Canada.

475,920. Electric Conductor. Charles W. Bassett, Newton, Mass.

The invention consists of a metallic conductor having a seamless coating of paper extending over it and a protective covering over the latter.

475,925. Automatic Fire Alarm System. Charles Burgher, Newton, Mass.

475, 938. Telegraphy. Thomas Gothorpe, Rye, N. H.

The invention consists of transmitting apparatus, especially adapted for use with submarine cables, whereby a more equal variation of potential is produced at the receiving end of a line by currents of irregular alternation.

475 955. Railway Signal System. William G. Wattson, Tappan, N. Y.

475,970. Electric Railway Motor. Jabez F. Shawhan, Detroit, Mich.

An electromotor is mounted upon the axle, the motor having two field magnets and two armatures, which armatures are connected to a gear wheel upon the axle by pinions.

475,998. Seal for Leading-in Wires. Henry D. Burnett, Lynn, and Samuel E. Doane, Swampscott, Mass.

In this device an incandescent lamp has its leading-in wires sealed in the glass of the globe and a yielding support is interposed between the leading-in wires and the inclosing glass.

476,007. Submarine Telephone. Henry Finch, Michigan City, Ind.

476,021. Electric Light Shade. Howard A. Miner, Philadelphia, Pa.

476,026. Telephone. Stephen F. Sherman, New York, N. Y.

The invention consists in a variable resistance in the form of a conducting strip or ribbon folded or creased to form plaits, connected with the diaphragm of the transmitter. The plaits of the strips opening and closing through the vibration of the diaphragm effect a change of resistance of the strip or ribbon.

476 028. Safety Attachment for Railway Trolleys. Melvin A. Yeakley, Cleveland, O.

The trolley is drawn down beneath the overhead wires the instant the trolley runs off or leaves the wire, until restored in place by hand.

476,080. Electric Terminal. Hercules Sanche. Detroit, Mich.

476,054. Telephonograph. James P. Magenis. North Adams, Mass.

This invention is a combined microphone telephone and phonograph by means of which, while the operator is telephoning to a distant station, a record of the words uttered by the operator will be made upon phonograph cylinders at both ends of the line, so that a record may be preserved and the necessity of transmitting the phonograms from one place to another may be avoided. The pressure of the stylus upon the record cylinder is augmented by magnetic attraction instead of by gravity.

476,128. Conduit for Electric Railways. Walter F. Carr and Charles F. Ferrin, Minneapolis, Minn.

The conduit is provided with removable arch blocks, spanning the parts of the arch adjacent to the slot opening, the blocks being detachably secured together and held in position by lugs and lug seats.

476,151. Dynamo Electric Machine. William Koedding, St. Louis, Mo.

This machine has a number of field magnets of alternate opposite polarity, an armature rotating in the field with two or more separate wires, each end of which being in electric connection with two or more of the bars of a commutator which revolve in contact with the brushes, the brushes each extending over a number of bars equal to the number of armature wires.

476,156. Device for Testing Arc Light Circuits. Albert H. Manwaren, Philadelphia, Pa.

476 183. Incandescent Lamp. James Ball, Holyoke, Mass.

This lamp contains two filaments and means for placing either in circuit.

476,192. Hanger for Electric Railway Wires. Charles B. Elliott, Boston, Mass.

476,193. Swivel Pull-off for Overhead Wires. Charles B. Elliott, Boston, Mass.

476 200. Telephone. Edward M. Harrison, Fort Smith, Ark.

476,207. Insulator Pin. Fred M. Locke. Victor, N. Y.

476,225. Electrical Reciprocating Tool. William P. Carstarphen, Jr., Denver, Colo.

CROCKER-WHEELER ELECTRIC COMPANY,

¼ H. P. 500 Volt Armature, Ventilated. Constant Speed, 1,500.

SLOW SPEED MOTORS.

The Motors are made with the best appliances and material obtainable, and embody every improvement of merit, with the intention that they shall be the Standard of their class.

430 West 14th Street. - - - - - NEW YORK.

WANTED!

Agents to sell our

Niagara Electric Motors and Dynamos

In cities where we are not already represented. Liberal discounts and exclusive territory to responsible dealers in electrical apparatus.

LOVELL MFG. CO., Ltd., Erie, Pa.

Wanted—Position.

By competent superintendent and electrician familiar with the leading lighting and street railway systems. Best of references. Address **A 85,** Care of WESTERN ELECTRICIAN.

WANTED.

TRAVELING SALESMAN visiting Central Stations to handle a quick selling side line on commission. Address in confidence stating line you carry. **"B. T."** Care WESTERN ELECTRICIAN

FOR SALE.

One 16 x 42 Reynolds Corliss engine, built by E. P. Allis & Co., of Milwaukee, in first-class condition, now running electric lights. Taken in exchange for an Ideal engine of 200 H. P. Send for list of smaller sized engines taken in exchange for Ideal, and for sale cheap.

A. L. IDE & SON,
Springfield, Ill.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

HENRY A. CLARK, Treasurer and Gen'l Manager.

HERBERT H. EUSTIS, President and Electrician.

A LONG FELT WANT SUPPLIED.

WRITE FOR PRICES AND SAMPLES OF

"Crescent" Overhead Line Wire. It will Surprise You.

THE CRESCENT INSULATED WIRE & CABLE CO.,

MANUFACTURERS OF ALL KINDS OF

SEAMLESS RUBBER WIRES AND CABLES,

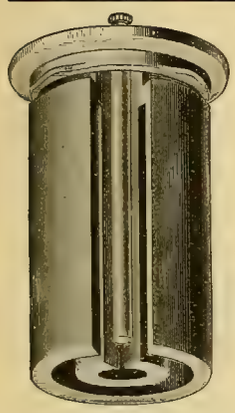
FACTORY AND MAIN OFFICE, TRENTON, N. J.

JOHN A. ROEBLING'S SONS CO., General Western Agents, 171 and 173 Lake St. Chicago, Ill.

SOMETHING NEW!

An improved 4 or 6 volt Combined Storage Battery especially for Dentists' use at very low price. Purchasers can exchange discharged for charged cells, without extra cost, beyond expense for charging the batteries. Manufactured by

J. K. PUMPELLY,
Room 301, 205 S. Canal St., Chicago.



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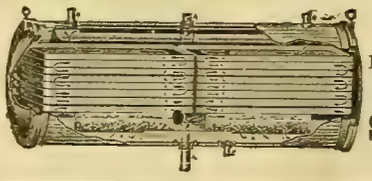

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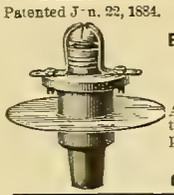

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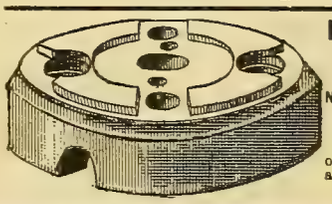

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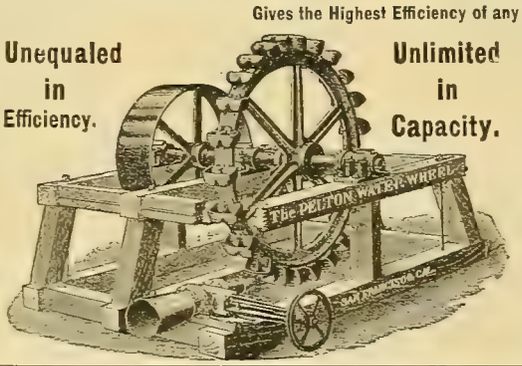

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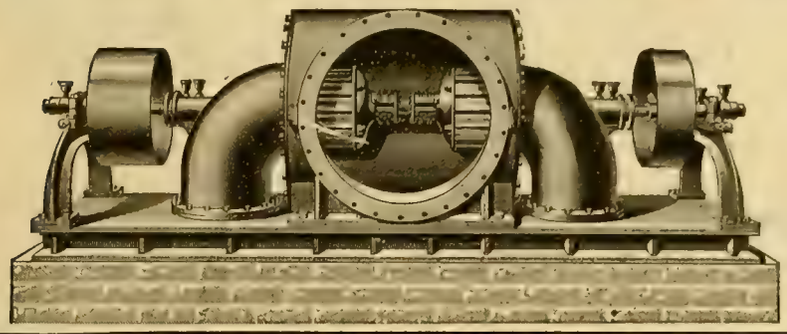

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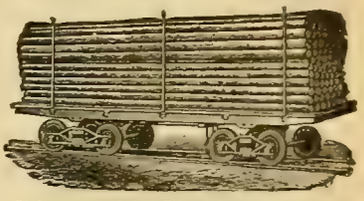

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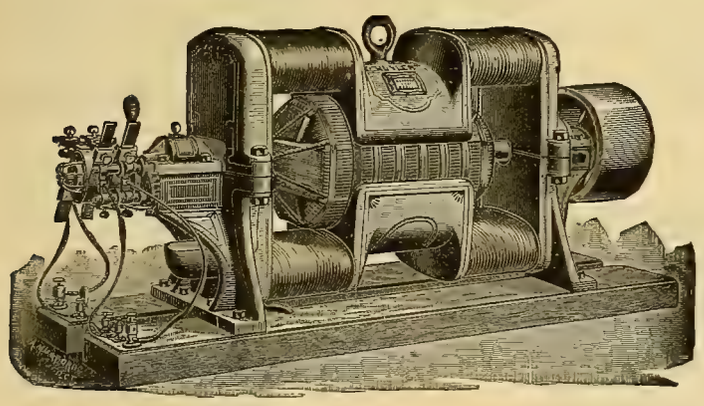

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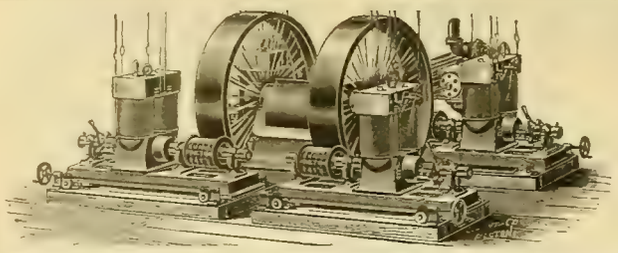

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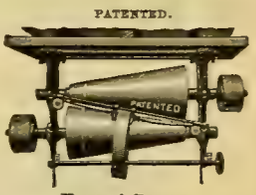

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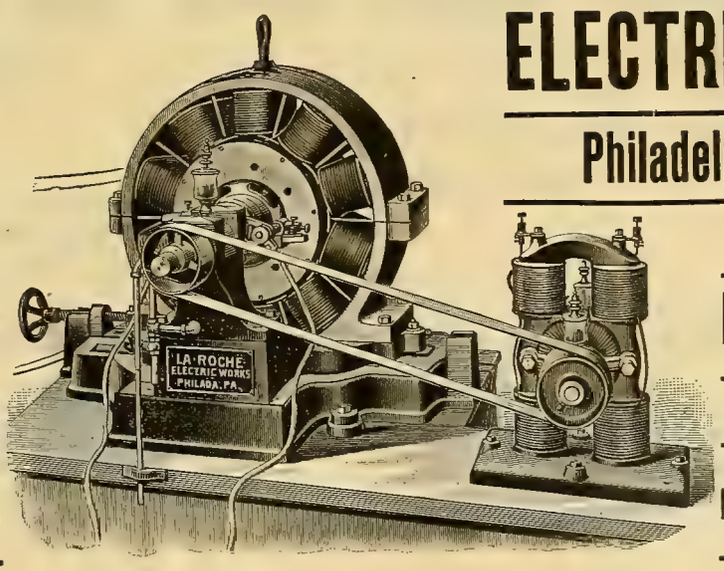

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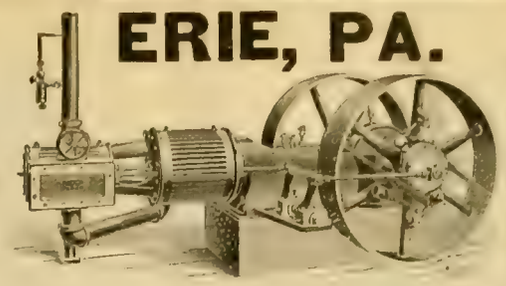

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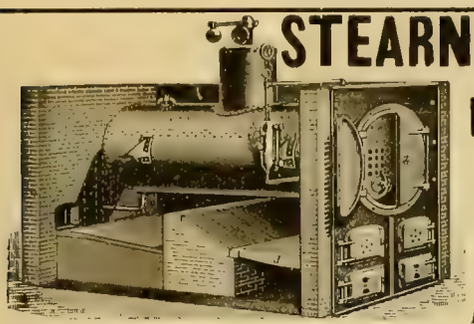

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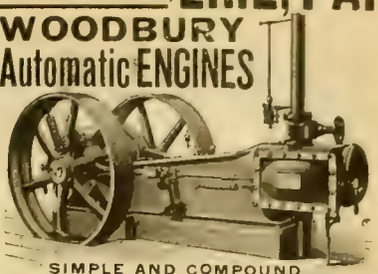

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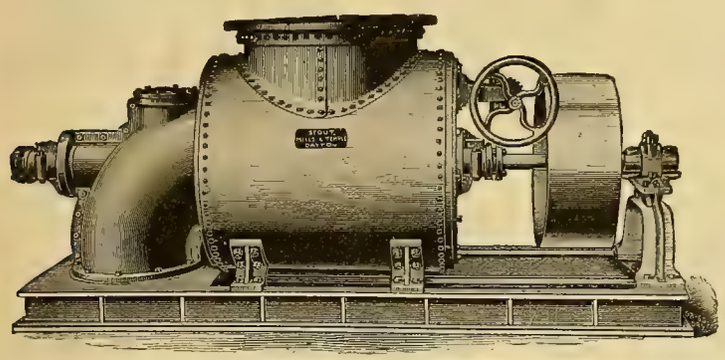

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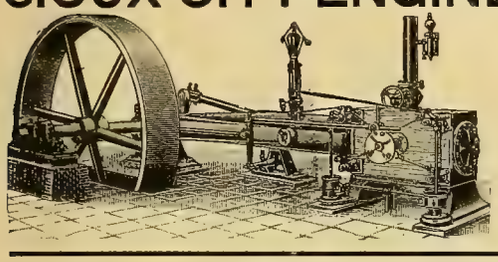

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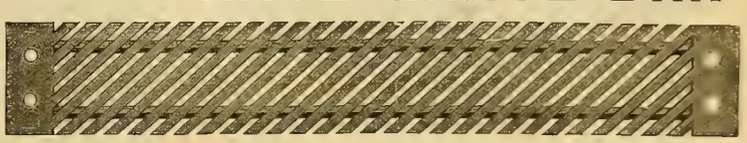

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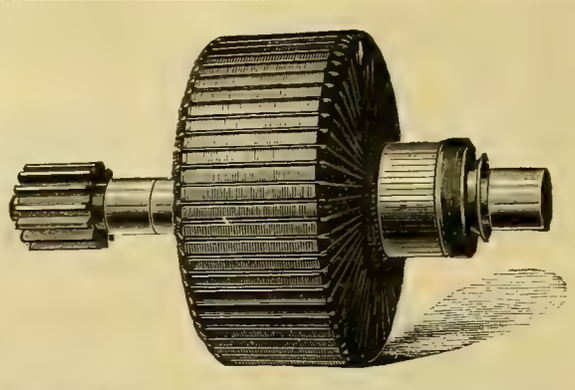

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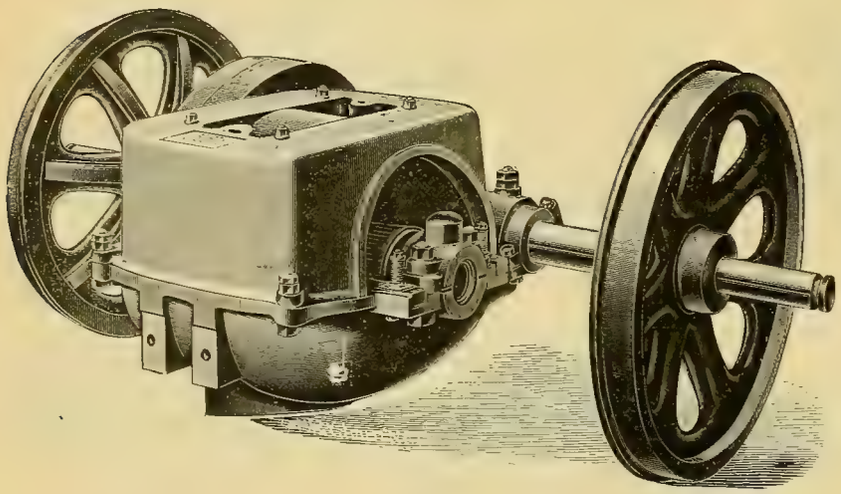

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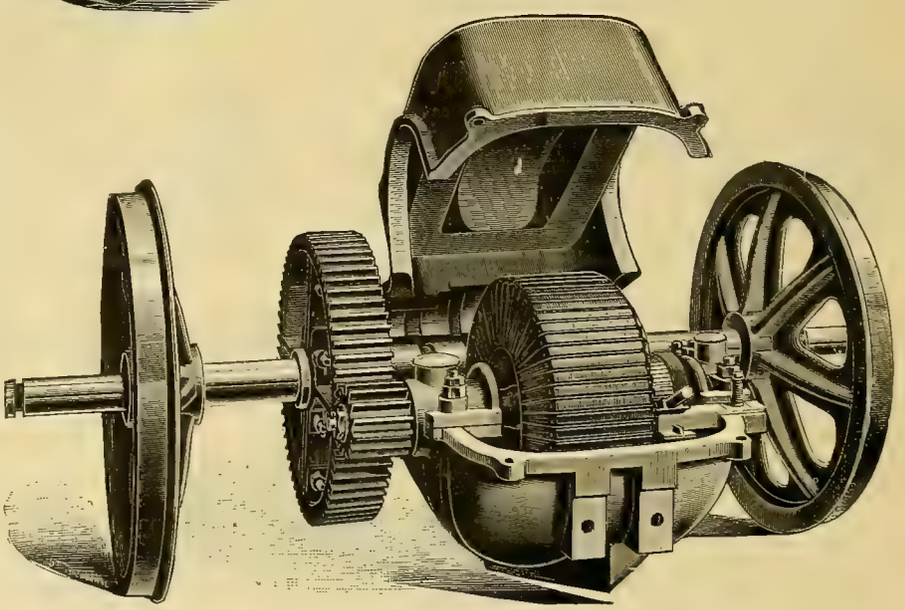

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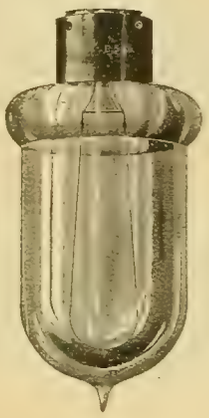

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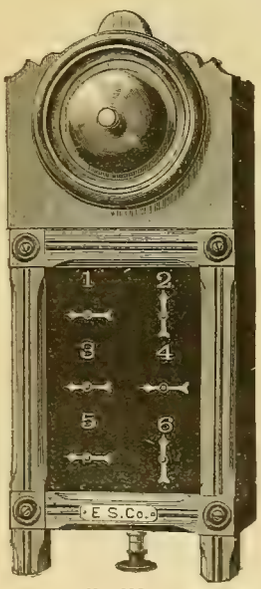

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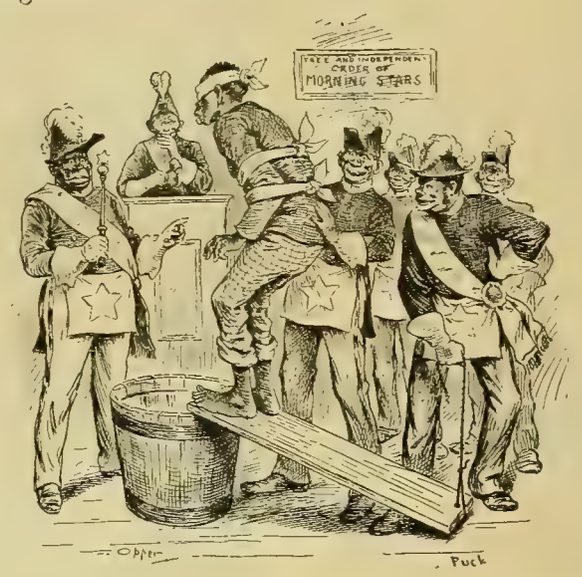

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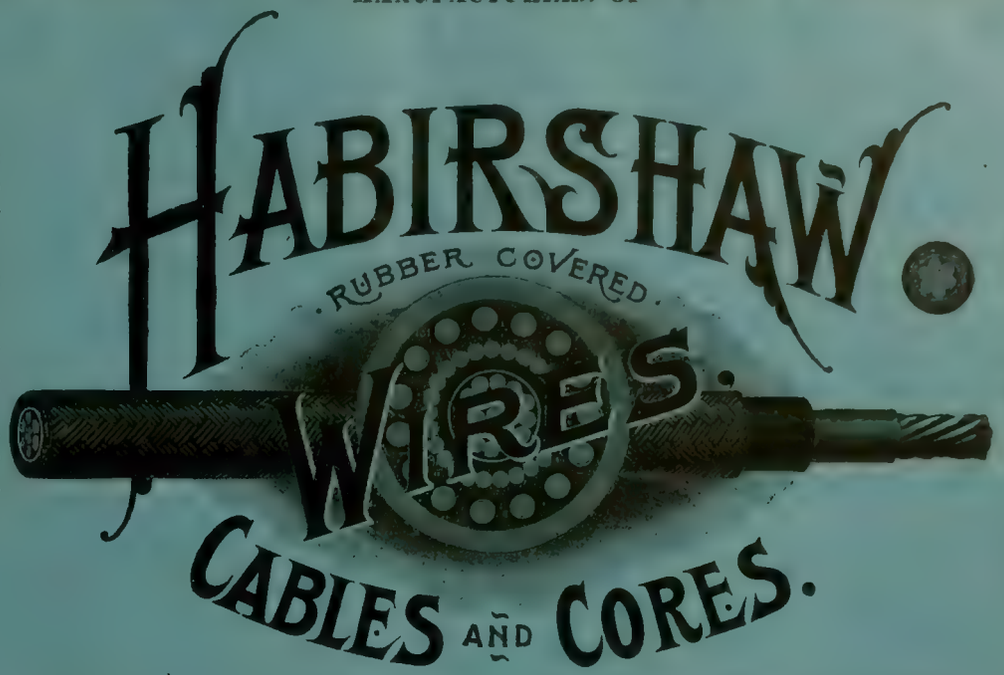

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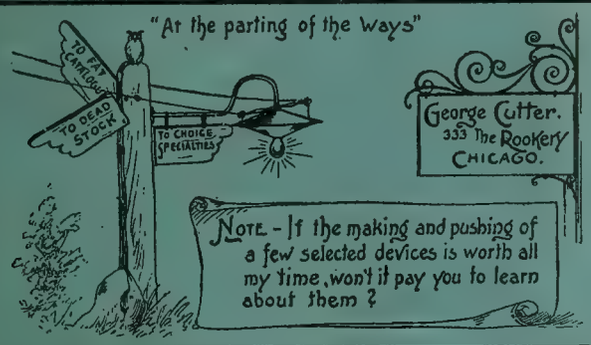

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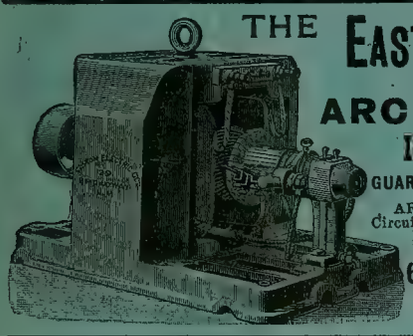

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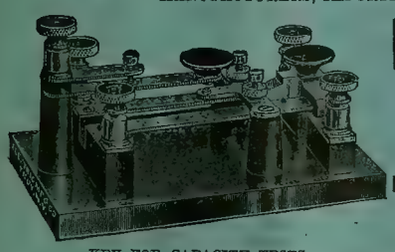

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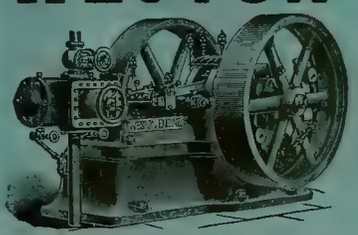

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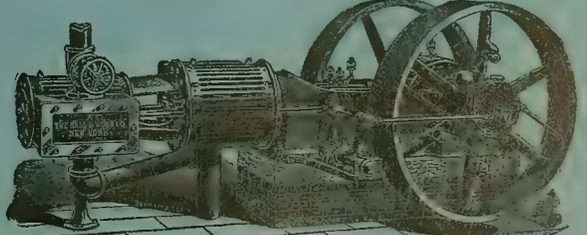

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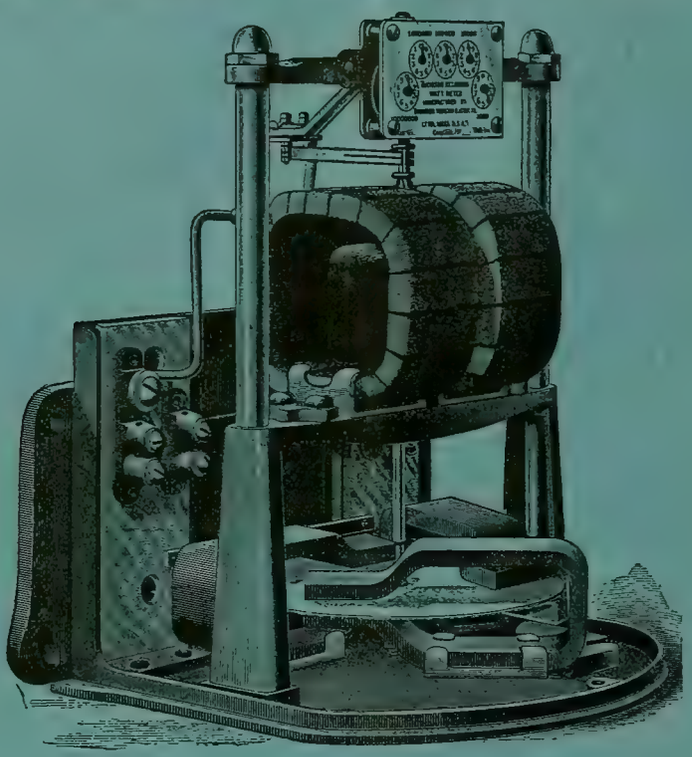

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GERMANTOWN ELECTRIC LIGHT CO.,

(Signed) Chas. M. Allen, Supt.

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Yours truly,

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(Signed) E. F. Cooley, Supt.

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Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co., W. R.
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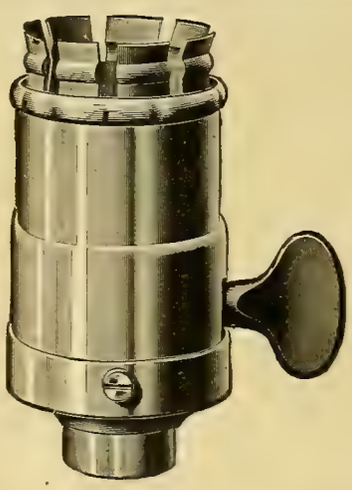

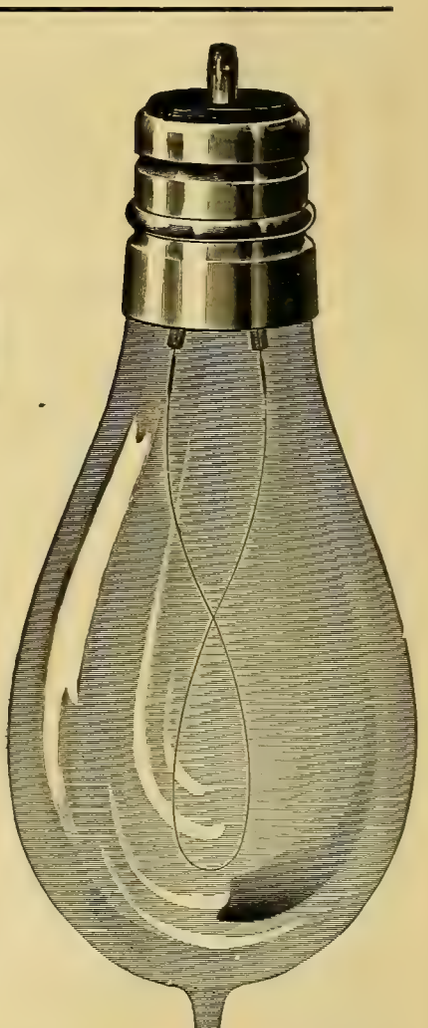

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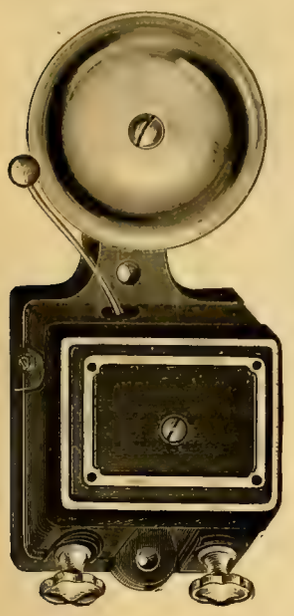

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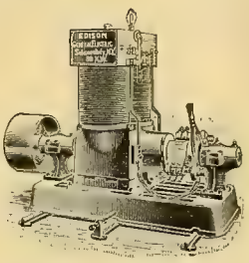

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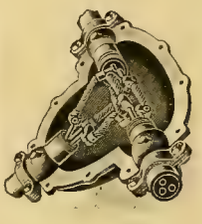

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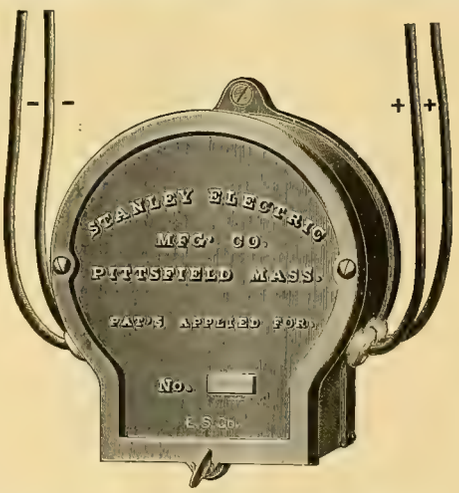

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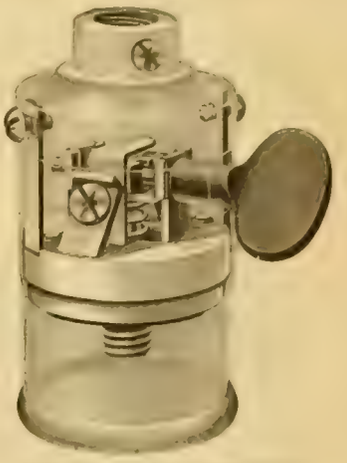

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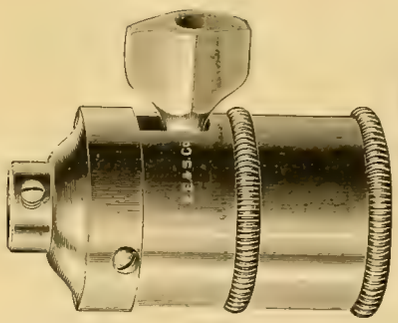

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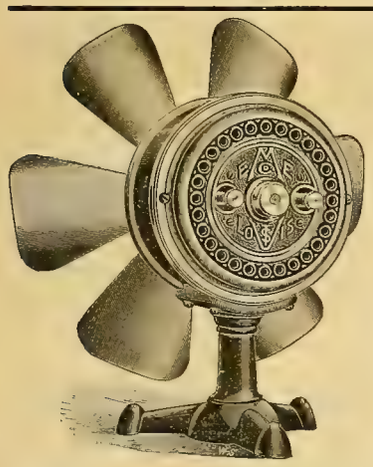

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Send for descriptive circular and price of the

"MESTON ALTERNATING FAN MOTOR."

It is not a toy, but a strong, well built, durable machine. Maximum speed 1,700 revolutions per minute. Can be regulated by moving a lever to as slow speed as desired, and flow of current is regulated accordingly. Commutator brushes feed up automatically and are guaranteed for three months' wear at constant use, ten hours per day. Manufactured only by

The Emerson Electric Mfg. Co., St. Louis, Mo.

"A MEANS TO AN END." THE USE OF THE "BUCKEYE" LAMP

A Lamp of DISTINCTION!

A Handsome Lamp!

SAMPLES FREE. TRADE MARK.

Have you seen the COILED *Filament?*

To Secure a Brilliant Light of 800 to 4,000 Hours' Duration, and a PROFITABLE Year's Business.

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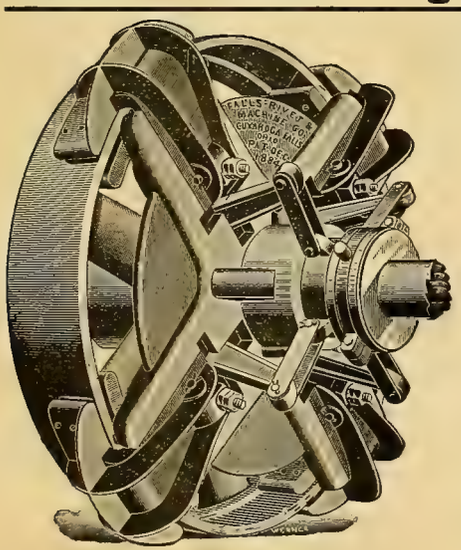
257 THE ARCADE, CLEVELAND, O.

437 "THE ROOKERY," CHICAGO, ILL.



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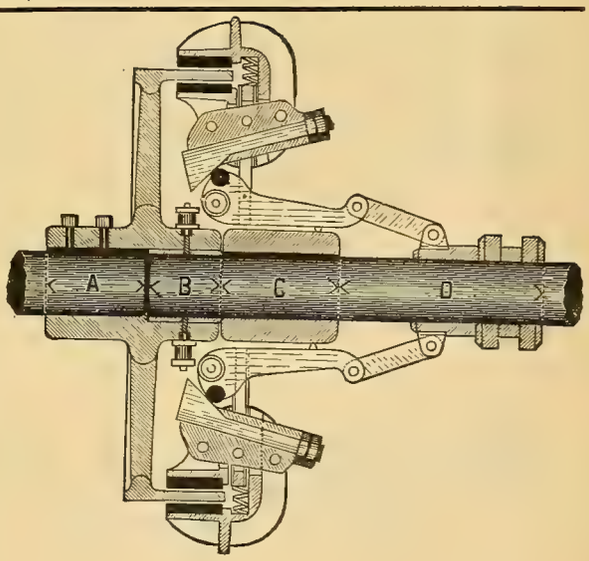

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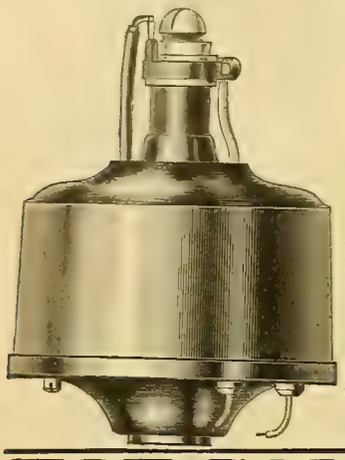

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Universally acknowledged to be **KING** of all automatic burners, and the only reliable burner of the kind in the market.

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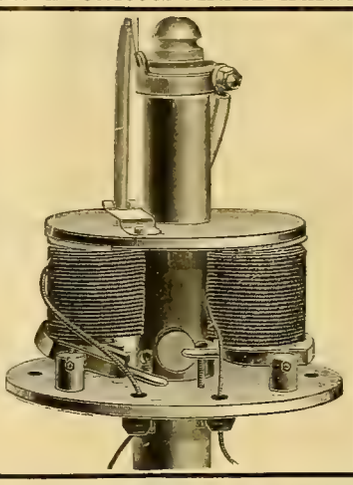

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Three 500 Lt. T.-H. Dynamos, Compound Wound, 110 volt, with Base, Rheostat and Ammeter.
Two 1,000 Lt. Fort Wayne Alternators, complete.
Two 25 Lt. American 2,000 C. P. Arc Dynamos.
One 50 Lt. Sperry 2,000 C. P. Arc Dynamo.
One 600 Lt. Edison Dynamo—not the latest style.
Twelve Knowles 12 Lt. Arc Dynamos with Lamps.
Nine 30 Lt. Westinghouse Arc Machines, 2,000 C. P.
One 30 Lt. Brush Dynamo, 1,200 C. P.
One 60 Lt. Vandepoele Arc Machine, with two Armatures and 25 Double 2,000 C. P. Lamps.
Twelve 50 Lt. Schuyler Dynamos, 2,000 C. P.
One 20 Lt. U. S. Arc Machine with 20 Single Lamps.
One 300 Lt. U. S. Dynamo, 110 volt, with complete Station Fixtures.
One 300 Lt. U. S. Dynamo, 50 volt, no Fixtures but Base.
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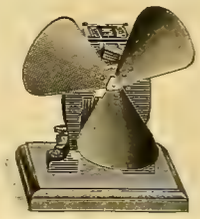
Six 30 Lt. Excelsior Dynamos, Arc, 2,000 C. P., with Single Lamps.

THE JOHN E. BEGGS MACHINERY & SUPPLY CO., - 74 Cortlandt Street, NEW YORK.

PREMIER BATTERY FAN MOTOR.

Patented June 30, 1885.



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Will run 5 to 8 inch Fans efficiently, Model or Light Machinery, etc.

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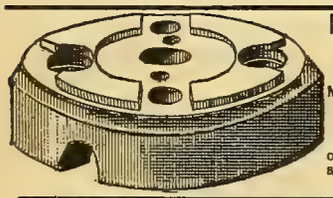

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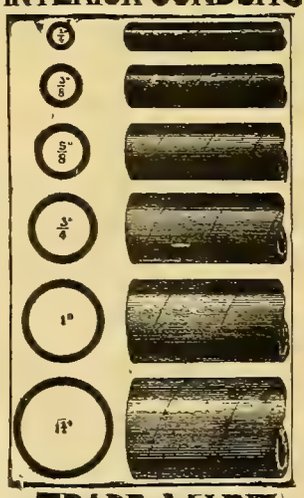

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The Solution of the Problem of Safe Guarding

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Wherever and for whatsoever purpose employed, is to be found in the

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WESTINGHOUSE ELECTRIC & MFG. CO.

NOTICE!!!

The Westinghouse Electric & Manufacturing Company will at its own cost and expense defend any and all suit or suits that may be instituted by any party against purchasers for the alleged infringement of patents, when such alleged infringement shall consist in the use of apparatus manufactured and sold by it.

We call the attention of users of electric railway and lighting apparatus to the attempts being made by the Edison-Thomson-Houston electric combination, or Trust, to secure, by threat and otherwise, a monopoly of the electric lighting and power business, which they are not entitled to, and cannot secure by means of their patents. If they could succeed in frightening users into entering into contracts binding them to take only the apparatus supplied by the Trust, then such users would be subject to a contract which they might have some difficulty in setting aside.

A proposed contract submitted by the Trust to one of our customers indicates that they intended to bind such customer to use exclusively apparatus manufactured by the Trust, and on such terms and for such prices as the Trust might name from time to time; and it is a fair presumption that the Trust would exact a margin of profit greatly above what is generally considered a fair manufacturing profit, in order to pay dividends on their immense capitalization (fifty million dollars capital stock, ten millions of which is preferred) and the interest on the proposed issue of ten millions of bonds.

The users of electric lighting and power apparatus, however, by refusing to purchase, except upon the terms and conditions on which they ordinarily purchase machinery, i. e., with the right to go into the open market unhampered to purchase their future supplies, or repairs, or alterations (as they should do), will always be free to select the best apparatus and details.

The Westinghouse Electric & Manufacturing Company sells all of its apparatus and makes all of its contracts on the above basis, and has never done otherwise, relying for future sales upon the merit of its apparatus.

We suggest the following as worthy of your careful consideration:

1. Enter into no contract with any electric light or power company except with respect to each purchase, and see that there are no hidden limitations or unreasonable provisions.

2. See that every contract contains a clause substantially as follows, for your protection as to patent matters, which clause is inserted in all of our contracts:

"The company shall at its own cost and expense defend any and all suit or suits that may be instituted by any party against the purchaser for the alleged infringement of a patent or patents, when such alleged infringement shall consist in the use of any apparatus, machinery or device, or parts thereof, manufactured or sold by the company, for which the purchaser shall have made all payments when due, provided that immediate notice of the institution of such suit or suits be given in writing by the purchaser to the company, and that the purchaser shall permit the company, through its counsel, to defend the same, and shall give all needed information, assistance and authority to enable the company to do so, and thereupon, in case of an award of damages in such suit or suits, the company shall pay such award, but the company shall not be bound to defend any such suit or suits, nor to pay any damages therein when the same shall arise by reason of the use of parts not furnished by the company."

3. Bear in mind that the agents of the Trust and its stockholders are numerous, and that specious arguments may be advanced, and threats used, to induce you to bind yourself to purchase apparatus only of the Trust.

4. If users of electric apparatus will act judiciously, then no Trust or Combination can expect to receive a higher price for apparatus than is warranted by fair competition.

When the Westinghouse Electric and Manufacturing Company entered upon the manufacture of railway apparatus, the price charged by the present members of the Trust was about $3,500.00 per car equipment. One-half of the above figure is the asking price to-day, and this reduction has been brought about by competition.

WHAT THE TRUST WOULD CHARGE IF THERE WERE NO COMPETITION.

The members of the Electric Trust (Thomson-Houston, Edison General, Fort Wayne and Brush Companies) made bids for the incandescent lighting of the World's Fair, in each instance amounting to about $1,800,000.00, and they have since offered to do the same work for $550,000.00, the result of our competition.

We invite the co-operation and support of all users of electrical apparatus, who desire to have the benefits of competition.

Pittsburg, Pa., April 29, 1892. **WESTINGHOUSE ELECTRIC & MFG. CO.**

Agents for Canada: AHEARN & SOPER, Ottawa, Ontario.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

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Second-Hand Dynamos

FOR SALE CHEAP.

We have a number of Dynamos and Motors nearly new, which we will sell at a low price, among the number being **two 650-light, 1,000 volt Alternators.**

WANTED TO BUY:

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For all Electric Insulating Purposes East India Mica is the best on the market.

I SELL NO OTHER.

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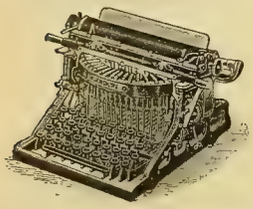
"THE WORLD'S GREATEST TYPEWRITER,"



Now contains all the contemplated improvements and should be examined before purchasing any other. Highest standard. Invented, owned and controlled by men having had fifteen years' experience on type bar machines It is built with a special view of simplicity, strength, durability, high speed, easy action, permanent alignment and is most convenient. Two interchangeable carriages for manifolding and letter writing. Steel throughout. Standard key-board with shift key for capitals.

A board of experts appointed by the government to examine and receive bids on the best machine, unanimously reported that the **Densmore** contained more points of excellence than any other, and that it was the best machine of all.

We will appoint a reliable dealer in unoccupied territory as soon as possible, and in the meantime will ship machines on approval to parties having a good commercial rating.

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"HERCULES" SWITCHES for Arc and Power Circuits.
"UTICA" QUICK BREAK—ABSOLUTE LOCK—KNIFE SWITCHES for any voltage and amperes.
AUTOMATIC MAGAZINE FUSE BOXES.
SIMPLEX, DUPLEX and QUADRUPLEX LIGHTNING ARRESTERS for Power, Telephone and Lighting Circuits.
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CARBON BRUSH HOLDERS for Generators, Motors and Dynamos.
CARBON HOLDERS, CIRCUIT JUMPERS and CONNECTORS.
Also General Dealers in ELECTRIC LIGHT and POWER SUPPLIES.

—THE—

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PUSH-BUTTON

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—AND—

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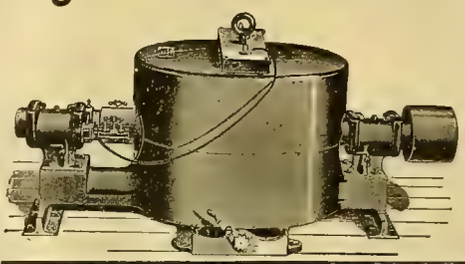

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St. Louis Engineering Co., St. Louis, Mo.
International Electric Supply and Construction Co., San Francisco, Cal.
Maxwell Electric Co., Louisville, Ky.
H. C. Marsh, - Cleveland, Ohio.
Wolf Electrical Co., Omaha, Neb.
J. H. Parker Electric Co., St. Joseph, Mo.
H. B. Day, - Des Moines, Iowa.
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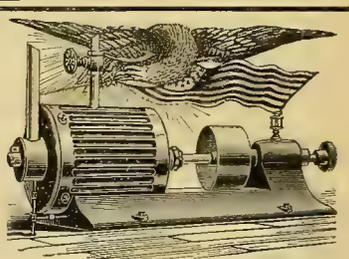

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SOLID BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

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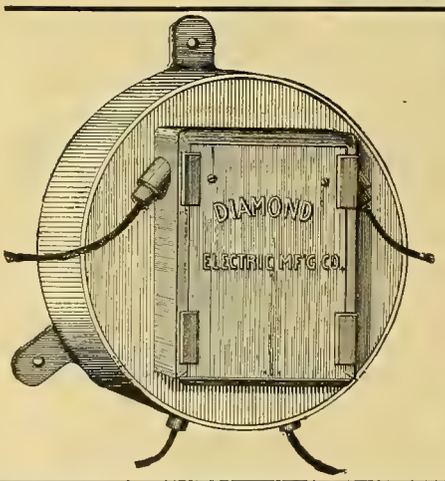

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THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.

SOCKETS, SWITCHES, CUT-OUTS; ALSO

A FULL LINE IN CHINA.—THOS. G. GRIER, Western Mgr.

THE BRYANT ELECTRIC CO.,

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The WADDELL-ENTZ COMPANY,

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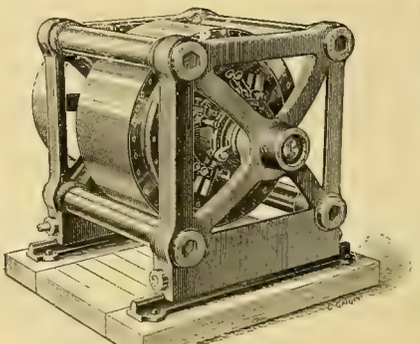

Improved Slow-Speed Generators and Motors. "DIRECT-DRIVEN" Slow-Speed Generators for Electric Lighting and Power. Low Running Expense. Insulated Wire and Flexible Cords. Estimates furnished. Isolated Plants a specialty.

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WORKS AT BRIDGEPORT, CONN.

Western Electrician.

EVERY SATURDAY.

Vol. X. CHICAGO, JUNE 18, 1892. No. 25

Electricity at the World's Fair.

The picture on this page will give the constituency of the WESTERN ELECTRICIAN a better idea of the finished appearance of the electricity building at the World's Columbian Exposition than any illustration heretofore published. It shows the elaborate ornamentation worked out in the staff with which the building is covered and the general rich effect. The view represents the northeastern corner of the building. By close scrutiny two of the names of deceased electricians, by which the building is distinguished, can be discerned. The other illustration, Fig. 2, shows the interior of the building, with a sawmill operated by electrically transmitted power in the foreground. The extent to which electric power has been utilized in the construction work at the World's Fair has been alluded to several times in this paper.

FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.

Friday, June 10th, was the last day on which Mr. Westinghouse could be allowed to file his bond for the performance of the incandescent lighting contract and execute the final papers, by the terms of the resolution of the committee on grounds and buildings adopted on May 23d. About half-past four o'clock of that day Mr. Carlisle, the attorney for the Exposition company, received a telegram from Mr. Westinghouse at New York, saying that he had signed the contract, and that the document had been forwarded by mail. In relation to the bond Mr. Westinghouse wired that he would furnish a bond of $500,000, and that "the surety company" would be the security, meaning thereby, it is believed, the American Surety company. It is thought that this company will be accepted as surety on the bond. It is a corporation organized for the purpose of furnishing bonds on approved risks in persons and companies, and it does not take any risk without careful investigation. Undoubtedly the long agitation over the incandescent lighting at the World's Fair is over, and it is probable that the Westinghouse company will commence work on the apparatus at its factory in Pittsburg at once.

It is now thought that the test of electric launches at the World's Fair will be made on Wednesday of this week. The test is to decide the relative merits of various boats, and will have great weight in the award of the concession for carrying passengers on the lagoons during the exposition. Under this concession the waterways at Jackson Park will have three classes of passenger boats—the omnibus, the express and the cab boat. The omnibus boat will make regular trips in the waterways, making sixteen stops on the trip, or one at each building. A stated fare will be charged for the round trip, and visitors can alight where they will, as from a street car. The express boat will make the round trip of the waterways without stopping, while the cab boat, which will seat four people, can be hailed at any point for any class of travel as a hansom may be hailed in the street. It is expected that the service will require forty omnibus boats, fifteen express, and twenty five cabs. A brief description of the Electric Launch & Navigation company's boat is presented on another page. General Barney of this company is now in Chicago.

The marble arc switch-board recently built in the factory of the Thomson-Houston company, and intended for the station of the Narragansett Electric Light company of Providence, a brief description of which is given in this issue of the WESTERN ELECTRICIAN will now be sent to the World's Fair. It is said to be the largest board of the kind ever constructed.

Electric street railway men will be interested in the following circular:

The special committee appointed by the American Street Railway association for the purpose of securing as commendable an exhibit as possible of all that pertains to the street railway business at the forthcoming Columbian Exposition at Chicago desires to urge upon you the importance and necessity of making application at once for such space as you will need to make a proper exhibit of your manufactures.

This association has secured 50,000 square feet, and the allotments of space as to desirability will be made in the order in which applications are received. Unlike any other World's Fair, the management of the Columbian Exposition will arrange the exhibits regardless of nationality, in departments, each comprising all that relates to any particular industry or subject. All, therefore, that relates to transportation will be in one building, and that devoted to street railways will be gathered together in one section of the building.

The exposition will make no charge whatever for space. It will be necessary in estimating the amount of space required, to state just the number of square feet needed for the exhibit, independent of aisle room. A limited amount of power will be supplied without charge. Exhibits will begin to be received as early as November 1, 1892, and no article will be admitted after April 10, 1893. Complete rules covering the entire subject will be sent on application to Willard A. Smith, chief of the

department of transportation of the World's Columbian Exposition, Chicago.

John B. Parsons, vice-president and general manager of the West Chicago Street Railroad company, has kindly consented to serve the association as its sub-committee, to advise with Mr. Smith in reference to the exhibit under the auspices of this association.

American Institute of Electrical Engineers.

The general meeting of the American Institute of Electrical Engineers, held in Chicago last week, was a complete success. An unusually large number of papers was read, and a high order of individual excellence was noticeable. The sessions were held on Monday, Tuesday and Wednesday, partly in the Grand Pacific hotel and partly in the new rooms of the Chicago Electric club, at the corner of Clark and Monroe streets. On Monday afternoon the members of the Institute inspected the shops at Pullman, and on Wednesday afternoon they were escorted to the World's Fair grounds, where a train of flat cars was placed at their disposal by the exposition authorities. Chief Barrett and Secretary Hornsby, of the department of electricity, explained the features of the grounds to the visitors, who were astonished and delighted. Most of the out-of-town members left for their homes Wednesday night or Thursday morning. Owing to the time taken by the two excursion trips the discussions were comparatively brief. All but four of the twenty-seven papers and addresses prepared for the meeting were read. Much of the credit for the success of the gathering is due to Secretary Pope, who was indefatigable in his efforts in arranging for the meeting and supervising the details.

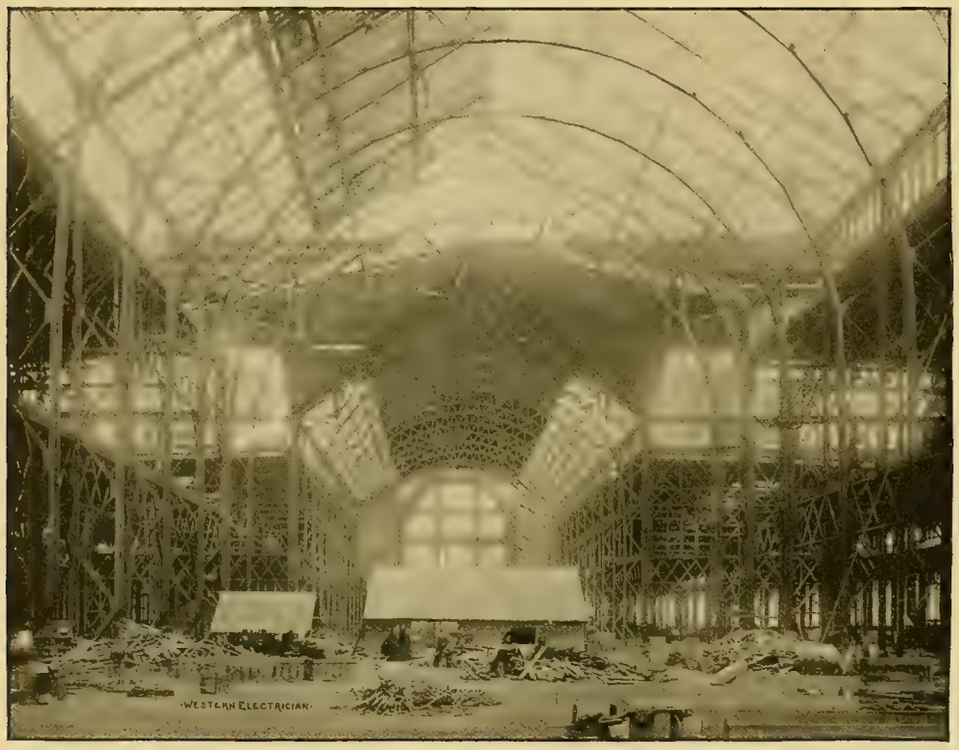

FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

Following is a list of the names of the members and visitors in attendance:

Barclay, J. L. ..... Chicago
Barton, E. M. ..... Chicago
Beals, P. P ..... Buffalo, N. Y.
Bogart, S. S. ..... New York
Bradley, C. S. ..... Avon, N. Y.
Brown, Chas. A. ..... Chicago
Bulkley, M. J. ..... Chicago
Burch, Edward P. ..... Minneapolis
Caldwell, Edward ..... New York
Carhart, H. S. ..... Ann Arbor, Mich.
Carolan, E. A. ..... Ithaca, N. Y.
Cleveland, W. B. ..... Cleveland
Collins, W. F. ..... Chicago
Connor, J. F. ..... Chicago
Cornell, C. L. ..... New York
Cothren, W. H. ..... Chicago
Cowles, A. H. ..... Cleveland, O.
Crocker, F. B. ..... New York
Cutter, Geo. ..... Chicago
Daft, Leo. ..... Seattle, Wash.
DeLand, Fred. ..... Chicago
Dickerson, J. W. ..... Chicago
Dunbar, C. H. ..... Pittsfield, Mass.
Edson, M. A. ..... Chicago
Emery, Chas. E. ..... Chicago
Flood, S. D. ..... Chicago
Gilman, Chandler R. ..... Milwaukee
Gregg, Jno. H. ..... Chicago
Hadley, A. L. ..... Fort Wayne, Ind.
Haskins, C. C. ..... Chicago
Hering, Carl ..... Philadelphia
Highlands, E. M. ..... Clinton, Ia.
Hitt, Robert I. ..... Chicago
Howard, M. S. ..... Minneapolis
Howell, John W. ..... Newark, N. J.
Hunting, F. S. ..... Fort Wayne, Ind.
Jackson, D. C. ..... Madison, Wis.
Keily, W. E. ..... Chicago
Kettlestrings, Jos. ..... Chicago
Khotinsky, Capt. A. de ..... Boston
Leonard, H. Ward ..... New York
Lindon, L. V. ..... Hornellsville, N. Y.
Lockwood, Thos. D. ..... Boston
MacFadden, Carl K. ..... Chicago
Martin, Percy ..... Columbus, O.
Martin, T. C. ..... New York
Marvin, Harry N. ..... Schenectady, N. Y.
Merrill, F. A. ..... Chicago
Miller, R. J. ..... Clinton, Ia.
Mills, F. P. ..... Ishpeming, Mich.
Nichols, Edward L. ..... Ithaca, N. Y.
O'Connell, J. J. ..... Chicago
O'Dea, M. ..... Notre Dame, Ind.
Ogden, D. H. ..... Chicago
O'Hara, J. B. ..... Chicago
Opperman, A. F. ..... Hornellsville, N. Y.
Outcalt, R. F. ..... New York
Owens, R. B. ..... Lincoln, Neb.
Park, C. Wellman ..... Troy, N. Y.
Perkins, Frank C. ..... Dunkirk, N. Y.
Perry, F. L. ..... Chicago
Perry, Nelson W. ..... New York
Phelps, G. M. ..... New York
Pope, R. W. ..... New York
Porter, Wm. M. ..... Detroit
Rae, Frank B. ..... Detroit
Ray, Thos. D. ..... Chicago
Roberts, E. P. ..... Cleveland
Sames, C. M ..... Rockford, Ill.
Scott, Chas. F. ..... Pittsburg
Seixas, E. F. ..... Chicago
Shain, Chas. D. ..... New York
Shepardson, Geo. D. ..... Minneapolis
Smith, T. J. ..... New York
Smith, W. N. ..... Chicago
Speier, M. B ..... Chicago
Sperry, Elmer A. ..... Chicago
Sprague, Frank J. ..... New York
Staley, Jno. R. H. ..... Joliet, Ill.
Strate, Arran ..... Chicago
Street, Clement F. ..... Chicago
Sullivan, M. J. ..... Chicago
Summers, L. L. ..... Chicago
Thomas, B. F. ..... Columbus, O.
Upton, F. R. ..... Orange, N. J.
Webb, Herbert Laws ..... New York
Williams, J. B., M. D. ..... New York
Willyoung, E. G. ..... Philadelphia

World's Congress of Electricians at Chicago in 1893.

In a recent number of *L'Industrie Electrique* E. Hospitalier contributes an article on the International Congress of Electricians in Chicago in 1893. A synopsis follows:

It is known that in connection with the Columbian Exposition an international congress of electricians will be held in Chicago in September, 1893. The executive committee has already been appointed, and its president, Elisha Gray, is now in Europe. His mission is to ask for co-operation, so that the meeting may be international in character as far as possible. Although there are still fifteen months before propositions must be submitted to the consideration of the congress, it is worth while to begin even now the study of questions which should be submitted to that body in order that the errors of previous congresses may not be repeated.

First of all, it should be stated that at these conferences there is a too pronounced national feeling among the delegates from the several countries represented, who should be uninfluenced by such considerations in dealing with questions of an international character; for the same reason there is a decided reluctance to adopt the findings of the congress when they are not entirely agreeable to the national *amour propre*.

Up to 1881 the practical unit of resistance was the B. A. ohm as represented by the resistance of a column of mercury 104 8 centimeters in length, 1 square millimeter in cross section, at the temperature of ice at the melting point. After the congress in 1881, the International Conference appointed to determine the length of the column of mercury representing the ohm, which was equal to 10^9 C. G. S., decided that the length should be 106 centimeters, and to this the name of legal ohm was given. But the legal ohm has never been adopted in England, and for several years the English have called the "true ohm" the resistance of a column of mercury 106.3 centimeters in height. The designation "true ohm" is not only misleading; it is absolutely false, for the *true ohm* by definition is equal to 10^9 C. G. S. units. The first task of the Chicago congress will be to bring order out of this chaos of ohms.

The congress of 1889 gave the name of *quadrant* to the unit of self-induction, which is thus defined: 1 quadrant = 10^9 G. G. S. units. This was an exceptional name, but it has not been very generally adopted, and it is almost certain that the Chicago congress will adopt in its place the name of Henry, while quadrant will designate more especially a length equal to 10^9 centimeters.

The congress of 1889 adopted respectively the names watt and joule for the volt-ampere and the volt-coulomb, but only since the congress of 1891 at Frankfort have the Germans even partially abandoned the volt-ampere and the volt-coulomb.

A second point to be considered is the useless creation of new designations. In our opinion it is the office of the congress to determine finally the name of a new physical quantity or a new unit wherever it is necessary, but not to multiply indefinitely these terms to the great annoyance of those who have to use them.

The Board of Trade in London furnishes an illustration. When it proposed to sell current from its central stations and to create a new unit for its commodity, the Board of Trade decided to adopt as a unit the power corresponding to one ampere under a pressure of 1,000 volts for one hour. Unfortunately they christened it with the senseless name of "unit," a term which has become, in order that confusion with other terms might be avoided, "the Board of Trade unit."

At the present time this name seems to be cumbersome, and it has been proposed to call it the "kelvin." This suggestion has been recalled at the instigation of the sponsor of the unit, Lord Kelvin (Sir William Thomson), who proposes to call it the "supply unit." We submit that all the names are absolutely useless. Since the units watt and hour have a legal official character, and since the prefix "kilo" is adopted as an international term to designate multiplication by 1,000, it is simple and logical to designate as kilo-watt-hour, the unit of 1,000 watts for an hour. If a unit ten times smaller is preferred, as is generally the case in France, the unit will be known as the hecto-watt-hour, and every one will know what it means without explanation, and without taxing the memory.

These observations are sufficient to indicate that a number of important and urgent reforms should be worked out in our terminology, in order that it may be in accord with the advance in the science.

The Ashland, Wis., Lighting company and the Ashland Street Railway company have consolidated. The street railway company has for some time been planning to change the present horse car system for an electric system, and the present arrangement is the outcome.

New Organization of the Chicago Office of the General Electric Company.

Under date of June 7th the following list of appointments for the Chicago office of the General Electric company was posted on the bulletin board in the company's Adams street quarters:

Accounting department (including credits)—George Martin, auditor; W. A. Willard, assistant auditor; W. J. Kehl, chief clerk.

Legal department—J. S. Cummins, counsel.

Merchandise, stock, shipping, etc.—H. H. Small.

Central station lighting—John L. Martin, manager; Messrs. Searles, Hills, Wheaton, Fisher, Cotton, Ross Davidson, Stedman, Dee, Foote.

Railway department—Theo. P. Bailey, manager; Messrs. Wheeler, Horne, Brewster, Elliott, C. B. Humphrey, Allen; B. J. Arnold, consulting engineer.

Isolated lighting department—Jas. W. Johnson, manager; Messrs. Buell, Polglase, Snowden, Clarage.

Stationary motors—George P. Nichols, manager; H. C. Hutchinson, assistant manager; Messrs. Mullen, Colton, Wethrell, Beckwith, Townsend, Harding, Parsons and Soule.

Meters—P. J. McFadden, manager.

Supplies (including wire, lamps, etc.)—W. E. Moore, manager; Messrs. Bunce, Ferris, Pionnie, Atkinson, Boger.

Mining—Lieut. F. B. Badt.

Fixtures (electroliers)—F. Overbaugh, manager; Messrs. Sheehan, Miller, Stromberg.

Engineering—W. L. R. Emmet, railway construction; E. C. Noe, lighting construction, repair department and draughtsmen.

Plants owned—H. S. Manning, superintendent.

Advertising, price lists, printed matter, stenographers, typewriters, telephone and telegraph—Jesse Scribner.

Omaha office—W. F. White, manager; J. H. White and W. J. McManigal.

Milwaukee office—L. A. Carr, manager.

St. Louis office—H. H. Humphrey, manager; M. L. Metzger and W. L. Arnold.

Dallas office—W. T. M. Motram, manager; T. E. D. Ritchie.

Branch offices will be directed in the sales of apparatus by the several heads of departments at Chicago.

The Electra—A Launch for the World's Fair Test.

The Electric Launch & Navigation company of New York made a trial trip with its new electric launch recently. This little vessel is the one which has been built for the competitive test in the lagoons of the World's Fair grounds. The boat is made of white cedar, with oak and mahogany trimmings. It was designed by Gardner & Mosher of New York. It will be remembered that this firm became famous as boat architects through the production of the Norwood, owned by Mr. Monroe of New York. The length of the vessel over all is 34 feet, with a length of 30 feet at the water line, and a beam of 6 feet.

The electrical equipment of the little vessel consists of seventy-eight storage cells of the "17-S" type, manufactured by the Consolidated Electric Storage company, and a 12 horse power motor designed by Anthony Reckenzaun.

With reference to the battery it may be said that each cell is claimed to have a capacity of 125 ampere hours. The cells are filled with gelatinous electrolyte.

The Reckenzaun motor weighs 420 pounds, and was designed to run at a maximum speed of 650 revolutions, and drive the boat at a normal speed of about eight miles per hour. It is possible, though, to drive the boat to eleven miles per hour. The motor, Fig. 1, is connected directly to the screw shaft. As will be seen from the drawings, Fig. 2, the motor is located in the middle of the boat, and the 1¼ inch shaft extends through to the stern on ball bearings. The length of the shaft is about 14 feet. The propeller is two bladed, 18 inches in diameter, with a 12-inch pitch.

The recent trial trip in New York waters was pronounced a success, the vessel making a 1½ hours' steady run on the Passaic river. The Electra has arrived in Chicago.

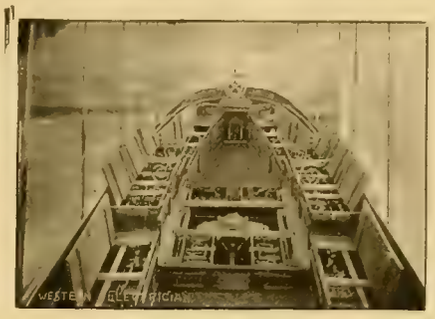

FIG. 1. THE ELECTRA—A LAUNCH FOR THE WORLD'S FAIR TEST.

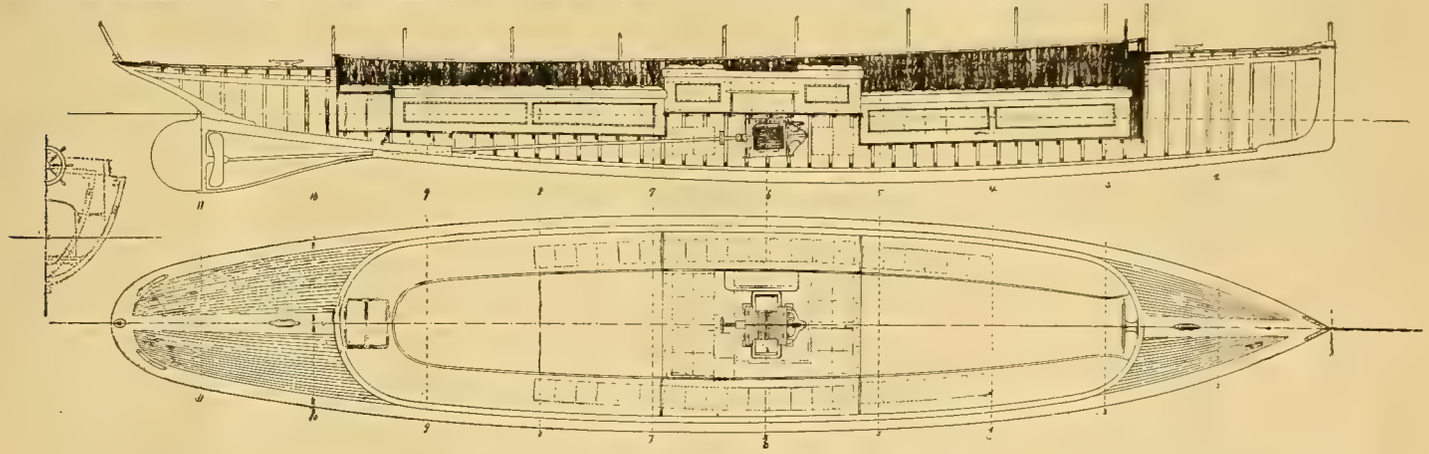

FIG. 2. THE ELECTRA—A LAUNCH FOR THE WORLD'S FAIR TEST

The Book Table.

DYNAMO-ELECTRIC MACHINERY. By Silvanus P. Thompson. Fourth edition. Published by E. & F. N. Spon, London. 864 pages. Price, $9.00.

The long looked for "fourth edition" of Prof. Thompson's well-known work is a bulky volume of 864 pages. There are 498 cuts and diagrams, not to mention 29 folders, and among the latter a number of scale drawings of recent forms of machines.

It is perhaps needless to say that the majority of American as well as English electrical students will feel as though an old friend, greatly improved, had returned to be introduced in a new form.

In reviewing such a creditable and comprehensive work there is a hesitancy to confess a feeling of disappointment at not finding within the book all that one might reasonably expect. While one is impressed with the very thorough manner in which Prof. Thompson has covered a now very extensive field, the American reader will, it is feared, feel slighted when he searches for information relative to railway generators and motors manufactured in a country that has witnessed the greatest development along this line. Under the head, "Machinery for Electric Railway," is found only a description of the large dynamos of the South London electric railway. The reader will seek in vain for a chapter that tells of the magnificent work of such men as Sprague, Elihu Thomson, Daft Rae, Short, Van Depoele, Eickemeyer, Westinghouse and others identified with the development of electric railway machinery. Sprague's stationary motor is favored with a paragraph and a small cut. It will take a pair of good eyes, though, to detect the characterizations "double reduction," "single reduction," or "gearless," all so familiar to American engineers and about which so much of interest might have been written.

The twenty-nine plates in the back of the book for the most part represent machinery and details of little interest or value to Americans. Plate III., for instance, is a detail drawing of the rocker, brush holder and oil cup of the Kapp dynamo. The Edison and the Brush machines are the only American types that are found on the folders. The Brush dynamo represented is, however, only a small model arc lighting machine. The most valuable plates of the lot are the two showing Ferranti's large alternating machines; but these might have been made more conspicuous, considering the immensity of Ferranti's undertaking and the lessons that might have been learned through a careful study of the design with the aid of more elaborate detail drawings. Railway men consulting the list of plates will be disappointed, too, to find only a reproduction from London *Industries*, of an illustration of the electric locomotive of the City and South London underground railway.

These points are not referred to in an unkind spirit. It was with regret that the conclusion was reached that such an immense compilation and so valuable a treatise as has been prepared by one as talented as Prof. Thompson did not contain more data relative to a class of machinery that is strictly American, and unquestionably marks an era in electrical development. It must be borne in mind, too, that only those features have been touched upon in the possession of which some might consider 'Dynamo-electric Machinery' to be lacking. In these respects our criticism must not be misjudged. A number of excellent additions to the work have been made. A chapter has been introduced on the theory of armature winding, and the subject of alternating motors, under the heads of apparatus for currents of different phases, has been treated in a most careful manner. Although stress has been laid upon what might be deemed faults in Prof. Thompson's revised book, it is almost needless to say that the library of no electrician, be he full fledged engineer, student, or amateur, will be complete until there has been a replacement of the old volume by a copy of this latest edition of Thompson's "Dynamo-Electric Machinery."

AMERICAN TELEGRAPHY. By William Maver, Jr. Published by J. H. Bunnell & Co., New York. 563 pages and 450 illustrations. Price, $3.

A book that will find many readers among practical men might be said of Mr. Maver's work. "American Telegraphy" treats of the systems, apparatus and the operation of the great variety of devices that are met with in this country in general telegraphic practice. Beginning with just enough on "theories," the author passes to primary batteries and the dynamo as they are employed in telegraphy. Thence the reader is made familiar with the many modern telegraphic and signaling systems, submarine telegraphy, telegraphy from moving trains—in fact, it is difficult to think of a system that has not been explained. The volume is comprehensive in its scope, and the author has expressed himself in a clear and concise style that enables the reader to grasp without effort the ideas intended to be conveyed. There is a tone of practicability throughout the book that is pleasing, and doubtless this feature of the writer's style will bring the work into favor with telegraphers and construction men.

Love Conduit System in Chicago.

The Love conduit which was constructed in Chicago within the last year, and which has been in operation for several months, has been accepted by the North Chicago Street Railroad company. Under date of June 8th Charles T. Yerkes, president of the North Chicago Street Railroad company, wrote:

"We are now trying the electric railroad which is built under the Love system. So far as the system itself is concerned it gives us perfect satisfaction, and, contrary to my fears, the insulation is not interfered with in any manner by moisture. We have had some of the most severe rains in this vicinity during the last three or four months that we have ever experienced, so much so that at one time the cars ran through water on the track three to four inches deep, the trolley in the conduit running in the water, owing to the inability of the sewer connections to carry off the flood fast enough, but at no time was the road stopped from this cause.

"Your construction, however, is not to be praised, and is not what it should be; but you are somewhat excusable, for the reason that the road was laid in mid-winter and in a great hurry. With proper construction we believe the Love system would be a great success.

"As to the cost of operating, our experience has shown we can run our road with about half the number of cars as required with horses, owing to the fact that we run much more rapidly, and consequently cover the distance faster. This enables us to economize greatly in the cost of motive power. This saving, however, has not been thoroughly developed on the line above mentioned, owing to the fact that the requirements of the road are very small, but we have demonstrated that we could operate five times the number of cars we are now running, with practically the same expense.

"I have also to congratulate you on the fact that, so far as our experience goes, there has been a positive inability of the electric current interfering with anything on the surface. We have had grounds, owing to the displacement of insulators, and have been surprised that no evidence of the existence of electricity could be found from contact with the rails or anything above ground. I therefore feel that your claim that your system is free from danger to the public is fully sustained."

Patin Alternator.

The Patin high tension alternating current machine is similar in general appearance to that designed some ten years ago by Anatole Gerard. The latter made no particular advance, however, as there was then no demand for alternators of large capacity. The present machine, built in accordance with the plans of O. Patin, differs in construction very materially from the Gerard dynamo.

The alternator is built with a revolving field and a stationary armature, the former taking the place of the engine flywheel. By this arrangement the advantage of

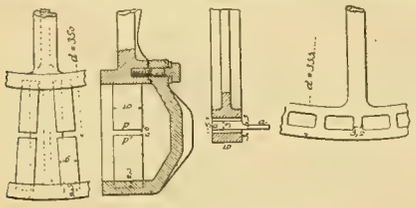

FIG. 2. PATIN ALTERNATOR.

direct coupling is gained, and at the same time the engine and dynamo occupy little floor space. Dynamos intended for direct coupling in this way ordinarily require such peripheral speed that high speed engines are necessary; the Patin alternator is intended for direct coupling to a Corliss engine.

The revolving field is keyed to the engine shaft and as stated before, serves as the flywheel of the engine. As shown in Figs 2 and 3, it is composed essentially of two rings which carry the coils. The inner ring is part of the wheel itself; the outer one is attached to the first in the manner shown in Fig. 2.

The armature can be moved laterally so that repairs can be speedily made, or a coil quickly substituted for a damaged one. The coils are made of flat copper wire as may be seen in Fig. 1. They are held in place by bronze strips sealed into the core by means of a special kind of cement.

The lateral movement of the armature is effected as shown in Fig. 3 by means of a screw and hand wheel. Motion is communicated to the armature by two cross pieces attached to the armature core. Two insulated copper rings attached the shaft are in electrical connection with the field circuit, and the two brushes resting against them receive current from the exciting dynamo on an extension of the shaft or entirely separate from it.

The following data of a 75 kilowatt machine are taken from *L'Industrie Electrique*:

Number of field coils	76
Electromotive force	2400 volts
Current	31 amperes
Peripheral speed	14.66 meters per second
Resistance of the armature	.75 ohm
Length of wire in the armature	520 meters
Cross section " " " "	3 sq. mm.
Electrical efficiency	96 per cent

A Lady Student in Electrical Engineering.

The electrical engineering department of that flourishing educational institution, the Ohio State University at

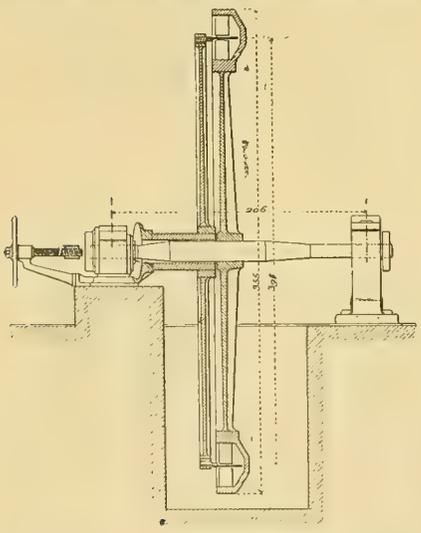

FIG. 3. PATIN ALTERNATOR.

Columbus, bears the unique distinction of having a woman, Miss Lamme, among its students. And, what is more, she is at the head of her class. It is believed that this young woman has the honor of being the only lady pursuing a course of electrical engineering in an American college.

Series Electric Traction.[1]

By Nelson W. Perry, E. M.

In telegraphy that application of electricity where preeminently long distances are concerned, the series system is alone adequate to the demands. In telephony, where more than two instruments are concerned, as in the case of several subscribers on the same circuit, or where, as in small towns, several of them are connected on a single wire, they are all connected up into series; and again, where larger amounts of energy are to be transmitted to considerable distances, as in the case of the arc light, the series arrangement is the only practical one now at hand. Why then should not this system commend itself for long lines of electric railroads? T. Carpenter Smith, in a series of articles on "Some Views of Central Station Management," lays down as one of his canons in the establishment of a plant, that it should be so planned as to permit of its ready extension as the demands increase; or in other words, that in laying our plans we should provide for the future rather than for the present. If this be good advice in the case of electric lighting stations, how much more force must it have, if it be applied to electric railway systems, which as we all know, are being rapidly extended, in many instances to double and treble the distance originally contemplated, only to be increased again as soon as these further limits are reached.

In railway practice, it is the distance rather than the quantity of current that forms the most important factor of increase, though the latter cannot be neglected in planning for the future.

In street railway construction, assuming the distance to remain the same but the traffic to double, the amount of copper required to maintain the same relative economy must also be doubled. This is a minor matter as compared with the case where both distance and traffic are doubled. In this latter case, to maintain the same economy the weight of copper must not only be doubled but squared. The limit of extension even on these lines is, however, soon reached, and the only recourse, by existing methods, is to erect at or near the further point another generating station, with all that it implies in the way of additional investment in real estate, machinery, etc, etc., and a duplicate set of employes.

In long lines the bugbear of the multiple arc system of distribution is the drop in potential at the further end. The potential may be amply sufficient near the generating station, but it becomes less and less so as this proximity is departed from, until at the further end, the lights which burn brightly near the station dim down to scarcely more than a dull red, and the cars are operated under heavy loads with difficulty or not at all. There are two remedies for this drop in potential at hand—either to increase the amount of copper in the feeders, which within commercial limits is but a partial remedy, or to increase the pressure, using the same amount of copper which, when the multiple arc method of distribution is employed, introduces as many difficulties as it obviates. There is still a third remedy, and that is to employ the constant current method, in which, under all circumstances, the current remains the same and the pressure varies as the work performed.

In the one case the copper must vary as the demands and distances—the pressure remaining the same, and in the other pressure varies, the copper and current remaining the same.

In an arc light (series) circuit, the wire will be of the same size whether it be erected to supply one lamp or sixty—whether the distance be one mile or five, and if at any future time it be desirable to extend the line to double or treble the distance, the wire already erected is amply sufficient for the part of the line it covers, and merely requires extension to the desired point to meet all the demands. There are in this country numerous arc light circuits in successful operation, twenty miles and more in length, yet I doubt if there is anywhere in the world a direct current constant potential circuit in operation today of anywhere near this length.

If energy can be so much more advantageously distributed to long distances by the constant current method for arc lamps, why should this method not commend itself to the ever increasing distances to which our electric street railroads are reaching? If the steam locomotive is ever to be supplanted by the electric motor, why should not this method of distribution be the one to be adopted?

The answer is that the constant current method, as heretofore developed has not been sufficiently elastic to meet the requirements, and although the generation of a constant current involved much less complex machinery, and the cost of distribution to distant points necessitated a much smaller initial outlay, still the difficulties introduced by this method largely outweighed all its advantages.

With the arc lamp or other stationary translating device, arrangements were readily devised for automatically shunting the current around in case of disability of the translating device, or the desire to throw it out of service. Not so with a moving object, such as a street car. No means had been found to shunt the current around the latter, or in case it got out of circuit by means of the trolley getting off the wire, of automatically closing up the gap thus made, and the disability of one car became the disability of the whole line and of every car on the line.

Could this and some other difficulties be surmounted, the constant current possesses many advantages over the constant potential that seem to me would bring it into almost universal use for traction purposes, especially on interurban lines and in other cases where long distances are concerned.

It is my purpose to show how all this has been accomplished, and how the constant current system may be made as elastic in every way, at least on paper, as the constant potential, without sacrificing in any way any of the advantages peculiar to the system, and how it is possible to make each unit in such a system nearly if not quite as independent of every other unit as is the case in the system now in vogue.

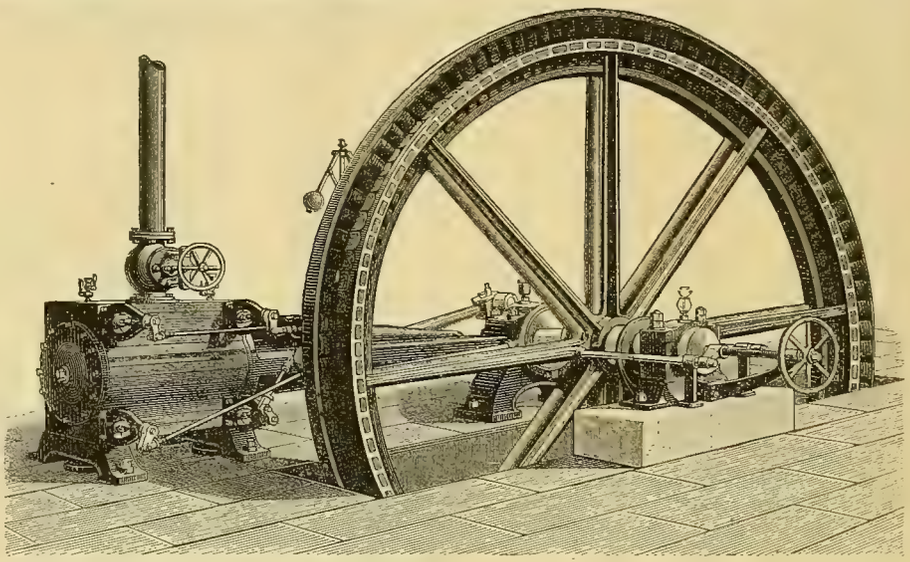

FIG. 1. PATIN ALTERNATOR.

The most ambitious and painstaking, and withal successful attempt up to the present time, to adapt the series or constant current method to electrical traction, was that made by Prof. S. H. Short, now of Cleveland, Ohio, and he actually constructed and operated for a considerable length of time, and with some success, two roads, one a single track road at Huntington, W.Va., connecting that city with Guyandotte, about three and a half miles distant, and the other a belt and double track road on South Broadway, St. Louis, which was, I think, about three miles in circuit. Prof. Short employed two wires, divided up into sections of any desired length, but necessarily not less in number than the number of cars to be operated. These sections were connected together by switches operated by a peg on the trolley mast, the peg on one car throwing the switch in one direction, and that on the succeeding car throwing it in the opposite direction. The current coming up one line of wires, crossed over through the motor to the other line, by which it was carried to the next car motor, through which it passed back again to the original line of wires. Each car as it passed a switch set it so that the current in the section it was entering would come up on the same wire as it had in the section just left, and the succeeding car would set the switches so that the current would come up to it on the opposite wire, and so they alternated.

Since the continuity of the circuit depended upon the presence of a motor between the two lines, if either of the trolleys got off its wire, the circuit was broken and all cars had to stop for lack of current, just as if we had an arc lamp without an automatic cut-out, and the carbons should become broken or the arc blown out, the entire circuit would be disabled, and any irregularities in the resistance of the arc of one lamp would affect all the other lamps on the circuit.

Since the switch must be thrown to opposite wires by each succeeding car, if one car failed to do this, as would be the case if an odd number of cars were added to or removed from the line, it would again become broken by reason of the failure to throw the switch in the proper direction. Cars had, therefore, to be added to or removed from the route in even numbers. This precluded the inter-communication of two or more systems, for the

1. Read at the general meeting of the American Institute of Electrical Engineers, Chicago, June 6, 7 and 8, 1892

reason that if a car was run off from one line onto another, it would be a case of the removal of an odd number to the other line, and both lines would become broken. So, too, it was impossible to operate a branched road on which part of the cars took one branch and a part the other, for the succeeding car, after it passed the forks, whichever route it took, would either break the circuit itself, by reason of failure to properly turn the switch, or would leave the switches in such a position that they could not be operated by the next car.

On a single track road where the cars passed each other on sidings, it was necessary to wire the whole route, as though it were a double track road, the cars going up one pair of wires and returning on the other, which followed the siding. This was the case at Huntington, where, although there was but a single siding, perhaps fifty feet long, where the two cars passed each other, the whole three and a-half miles had to be double wired to enable them to pass, else the two cars would be thrown into multiple with each other, and neither could run. I succeeded in devising a means by which if there were but two cars and one siding on the road, the only double wiring required was at the siding, but the plan failed where more cars and sidings were involved.

In Short's system the switches were purely mechanical, exposed to the vibration of the trolley wires and to the elements, and had to fit tightly else they would burn out. If they fit sufficiently tightly to obviate this, they were liable through corrosion or ice or some other cause to fit too tightly and fail to operate, in which case the line again became broken.

I speak more freely of the defects of the Short series sys-

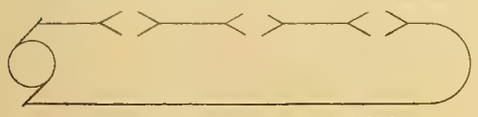

FIG. 1. SERIES ELECTRIC TRACTION.

tem from the fact that it has been abandoned by the Short company, and because its failure has been officially announced by its projectors, my object in dwelling upon it at such length being to point out more clearly some of the defects that must be remedied before the series can become a practical working system.

The system which I am about to explain may properly be described as consisting of a circuit interrupted by a series of breaks in multiples of two. Or one consisting of a circuit interrupted by breaks in multiple series, with each other—the breaks being multiples of two. The conception then would be like Fig. 1.

But in order that a current shall pass around this circuit, it is necessary that one of the breaks in each multiple shall be normally closed. It matters not which one is closed, so our plan would now look like Fig. 2.

If a translating device should successively occupy each of these breaks, it would receive current during the time that its terminals connected the ends of the two broken wires, in proportion to the relative conductivity of the two paths open to the current. But we are not satisfied to have a portion of the current only pass through our motor —it is necessary that all the current must so pass. We must therefore, make the resistance of the other branch infinite during the time in which the motor is bridging, through its terminals, the break, or, in other words, the normally closed branch must be broken.

If, therefore, we place an electro magnet in series with the normally broken branch; so that when vitalized it will open the switch in the normally closed branch, and allow it to close by gravity or otherwise, when the magnet is devitalized, we have provided in a crude way for operating traveling translating devices in series. Our conception now would be represented somewhat by Fig. 3.

By this arrangement the moving device only receives a momentary impulse as its terminals touch the ends of the break and will have to rely upon its acquired

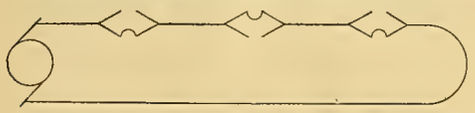

FIG. 2. SERIES ELECTRIC TRACTION.

momentum to carry it to the ends of the next break. It will be apparent, however, that it is immaterial whether the device receives its next impulse by the closing the next break in the circuit or whether it skips that one and gets it from any other break, either on that circuit or from one connected with an entirely different dynamo. It is this feature that permits the use of my system of sidings on single track roads, and of forks (the skipping of one or more breaks), and the inter-communication between separate circuits (the jumping from a break on one circuit to a break on another).

It is desirable, however, that the moving device be impelled by as nearly a continuous force as possible, instead of by a succession of momentary impulses. Instead, therefore, of having the ends of the normally open break face each other as represented heretofore, we may extend these wires for some distance parallel with each other, and our plan assumes the form shown in Fig. 4.

And it is desirable that the interval of time during which the device is without current, viz., that occupied in passing from one break to the next, shall be as small as possible. This naturally suggests having the normally open breaks all on the same side of the normally closed breaks, and if these parallel wires be continued so as to overlap those constituting preceding and succeeding breaks, a car or other moving translating device may pass from one break to another without even momentary interruption of current. In Fig. 5 the lower line, which I call the "feeder," contains all of the normally closed breaks, represented by mercury cups normally connected electrically by a fork taking into them, which constitutes a double pole switch actuated by an electromagnet in the manner to be described.

The upper pairs of wires, which it will be seen are merely the parallel extensions of the other possible path for the current, are in multiple with the path through the mercury cups. One of each of these pairs of wires, which will hereafter be denominated sections, is connected to the feeder wire on one side of the mercury cups, and the other has a similar connection on the other side. The two wires of each section, normally without electrical connection

FIG. 3. SERIES ELECTRIC TRACTION.

with each other, constitute what has been termed the "series of breaks normally open." If, however, these two wires be connected electrically through the terminals of a motor, the latter will be in multiple with the mercury cups and momentarily receive only the current due to the relative conductivity of the path thus offered. By the arrangement shown in Fig. 5 the electromagnet which opens the mercury cup switch is in series with the motor circuit, and the latter no sooner receives current than the former is actuated, the switch is opened and the whole of the current, which was momentarily divided between the two branches, is diverted to the motor.

If the corresponding wires of the succeeding sections be caused to overlap without making electrical connection with each other, and these laps be staggered as shown, a means is provided whereby the motor prepares the succeeding section for occupancy before wholly passing out of the one it is about to leave, and accomplishes this without interruption to the current. Figs. 6 and 7 show how this is done, and the arrows show the paths taken by the current as the transition takes place. When the motor is in the position represented in Fig. 5, there is but one path for the current, viz., around the open switch in the feeder and through the electromagnet by which it is kept open, back again to the feeder.

As the motor proceeds to the right, one of the terminals first embraces the lower lap, thus offering two paths for the current—one passing through the switching arrangement that controls the section the car is about to leave, and the other through that controlling the section it is about to enter (see Fig. 6). As it progresses still further this terminal passes beyond this lap at about the same time that the other terminal embraces the other lap. This leaves the first switch without current, and the succeeding switch is automatically opened. There is no break in the circuit,

FIG. 4. SERIES ELECTRIC TRACTION.

however, even during the short interval occupied by the two switches in acting, for, while the further terminal embraces the further lap, both of the switches concerned are short-circuited, as shown in Fig. 7. Before the further terminal has passed beyond the lapping portion of the two succeeding wires, the first switch will have closed and the succeeding switch will have been opened, thus diverting all of the current to the section upon which the motor has now entered.

Fig. 8 shows another arrangement by which a motor is enabled to pass from one section to another without interrupting the circuit. In this arrangement the ends of the sections, while mechanically continuous, are electrically disconnected, but do not lap as before. The break in the wires connected with the switch actuating device is longer than that between the other two wires. The larger gap, however, is lapped by a subsidiary conductor, which short circuits the switch actuating the section the motor is about to enter, as shown. As the car proceeds from left to right, before both its trolleys have passed off the section, one of its trolleys has embraced the subsidiary conductor and the electromagnet controlling that section is cut out of the circuit and the switch drops. While the switch is dropping, however, the current continues to flow through the companion wire, through the motor to the subsidiary wire and around the switch actuating the section it is entering. Fig. 8 represents a branched or forked road operated by a single dynamo. In the arrangement shown in Fig. 8, where the branch road is operated by the return circuit, a car turning to the left would really skip from the first section of the road to the very last, if we count them in the order in which they re-

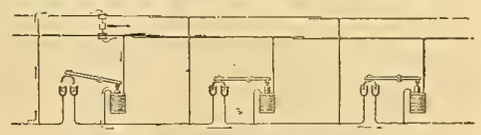

FIG. 5. SERIES ELECTRIC TRACTION.

ceive current, whereas in going straight ahead it would pass from section 1 to section 2, etc., counting them in the same order. In Fig. 9, however, which represents a similar road operated by the loop system, a car taking the left hand branch would pass from section 1 to sections 2 and 3, whereas if it went straight ahead it would pass from section 1 to sections 4 and 5. It will be apparent from what has preceded that in neither of these cases does the skipping of one or many sections involve an opening of the circuit.

But, returning to Fig. 8, and following the car still farther in its progress from left to right, we left it standing with one trolley on the farther wire and the other on the subsidiary or short circuiting conductor. In this position the current will continue to pass through the motor only so long as the switch actuating that section requires to fall into the mercury cups. Immediately that has occurred, which will be accomplished before the farther trolley has passed from its wire, the motor will have been short circuited, and the car will, by its acquired momentum, pass from the system without sparking, or other disturbance of the circuit. If the acquired momentum should carry the car to another section of the same system, or to a section connected with an entirely separate system, all that is necessary to enable it to proceed would be some arrangement by which the switch controlling the section upon which it was entering could be opened by the entrance to the car itself. It will be evident from Fig. 10, which represents two connecting roads operated by separate dynamos, that it matters not, as far as the integrity of either circuit is concerned, whether the car goes to the left or to the right; in either case the circuit is closed before it leaves a section, and as it enters the succeeding section it does so before opening the switch which actuates that section, and it is entirely immaterial whether that section belongs to the same system as the one just left, or to one entirely foreign to it. If only the proper switch can be opened the car may proceed on its way on either system of roads. In order to accomplish this automatically, each car may be provided with some such an arrangement as is shown in Figs. 11 and 12. M is a solenoid magnet in series with the motor D; L is a lever pivoted at P and playing between two stops, but

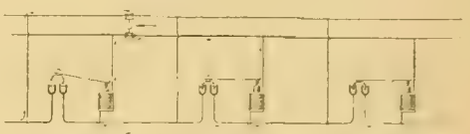

FIG. 6. SERIES ELECTRIC TRACTION.

when not actuated by the plungers of M, kept in contact with the lower stop by the spring S; B is a local battery; W W^1 are the trolley wires, and C is the mercury switch connecting adjacent sections of the feeder wire. As long as the motor is receiving current from the feeder, as is the case in Fig. 11, the current must pass through M, which, by its pull on the plungers, maintains the lever L against the upper contact. As the trolleys pass off from a given section and the motor loses its current as before described, the spring S causes the lever to make the lower contact, Fig. 12, thus throwing the battery B into the circuit, W, F, C, F', W'. The moment the trolleys enter upon a new section, this circuit is closed, the local current passes through the feeder switch magnet and opens the switch C, and diverts the current from the feeder to the section just entered. This strong current actuates the lever L, again bringing it against the upper contact and cutting the battery B again out of circuit. Since the battery B is only momentarily in circuit, the cost of maintenance will be insignificant.

On single track roads, where turnouts are required, the turnout constitutes merely an additional section to one side of the main line, which is skipped by the car keeping the main track, and taken by the other car in passing. It, like every other section, has its own individual controlling switch, and when both the main track and siding are occupied by cars, their motors are arranged in series with each other, as represented in Fig. 13. By following the arrows the course of the current can readily be understood.

But both of the plans thus far discussed possess serious faults. In both we have provided a means by which a car may leave one section on a given road and enter another one on the same or another road without breaking the main circuit, provided the car is always going in the same direction. In all of the cuts thus far the car is supposed to be going from left to right, and the switches are ar-

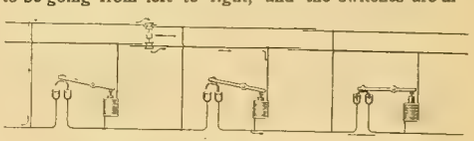

FIG. 7. SERIES ELECTRIC TRACTION.

ranged accordingly; but, if we examine the drawings again, it will be found that in the plan suggested in Figs. 5, 6 and 7, if the car were going in the opposite direction, the circuit would be momentarily broken as it left one section, and would fail to divert the current to the section it was entering. In the second plan, outlined in Figs. 8, 9, 10 and 13, the car is momentarily without current whenever it passes from one section to another.

By combining the two plans, however, all of the difficulties seem to be removed. Figs. 14 and 15 show how this combination is effected, and the courses of the current when the motor terminals are in different positions on the wire. It will be noticed that, as in the first plan described, the trolley wires of adjacent sections are lapped, and that these laps are staggered; that parallel to, but insulated from the nearer laps, is placed the subsidiary wire which short-circuits the switch to the right. The switch-controlling magnet, as is shown, has two coils wound cumulatively, and may be operated either by the current passing through the subsidiary wire, by that passing through the nearer trolley wire, or by both when it takes both paths.

The supplemental conductors and the laps in the trolley wires are so arranged relatively to each other that when a car is traveling in the direction of the main current, as the trolleys approach a lap, the trolley traveling upon the wire connected with the switch will contact with the supplemental conductor before reaching the lapping portion of

the trolley wires, and the companion trolley will reach its lap after the first trolley has reached its lap and before it has passed beyond the supplemental conductor, while, with a car traveling in the opposite direction, the order will be reversed, the trolley upon the wire not connected with the switch first reaching its lap, after which its companion trolley reaches first its lap and afterward the supplemental conductor. By this arrangement, in whichever direction the car may be going, in passing from one section to another, it first short circuits the switch controlling the section it is about to enter, next diverts a portion of that current to that switch, and finally all of it, cutting the switch controlling the section it has just left entirely out of circuit. In this manner the transition is accomplished in either direction from one section to another, either of the same or another connecting road, without spark or interruption of circuit.

Should either one or both trolleys leave the wires, or the circuit through the motor in any other way become broken, the magnet controlling the switch to that section

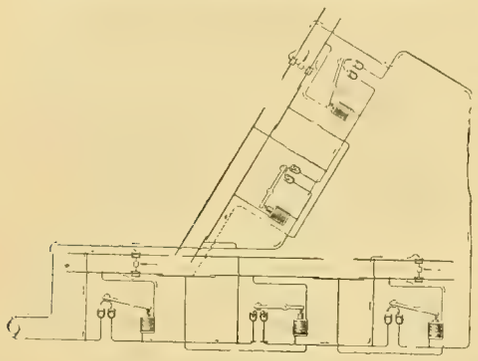

FIG. 8. SERIES ELECTRIC TRACTION.

would be left without current and the forks would immediately drop into the mercury cups, renewing the circuit through the feeder wire almost instantaneously. There would, however, be an interruption of the current while the fork was dropping. Even this slight interruption may readily be avoided by connecting with the switch any of the devices so successfully employed to obviate the same difficulty in arc light circuits.

Should a second car run upon a section already occupied, the two would be thrown in parallel and both would stop. This arrangement therefore constitutes a most perfect automatic block system, not dependent upon frail human nature, but sure and positive in its action. On interurban electric roads, where it is even now proposed to reach greater speeds than are customary or attainable with steam locomotives, the importance of this feature cannot be overestimated. Not only will collisions be rendered practically impossible, but by putting semaphores or other signaling devices in the wires connecting the main feeder with the two trolley wires, each car as it enters a section will automatically set a signal at each end of that section, showing that the section is occupied, and when it has left the section, set another, indicating that the way is clear. These signals cannot fail to act, for being in series with the motor, they must receive current when the motor does, and lose it when the latter has passed out of the block. This seems to be the solution of the block system problem, as it eliminates all the uncertainties inseparable from a dependence upon human intelligence and watchfulness.

This system will no doubt be criticized first, on the

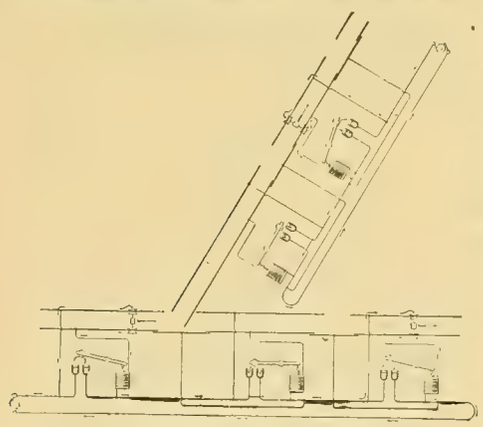

FIG. 10. SERIES ELECTRIC TRACTION.

score that it is a double trolley system, which many are opposed to on general principles, and second, on the score of the high potentials necessarily involved in series distribution to long distances. Anticipating these, I will say in regard to the first, that however valid the objections may be to the double trolley on multiple arc roads, they have but little force as applied to series circuits. In the latter, since both the wires on all sections not occupied by cars are of the same potential, the difficulties of insulation of the one from the other disappear entirely. Then again, I am satisfied, with an intimate knowledge of the electric roads in Cincinnati, where with one exception they are double trolley multiple arc roads, that most of the objections raised against them are greatly magnified. They certainly have the decided advantage over the single trolley of being independent, in their operation, of the condition of the track, their chief objection being the difficulty of insulating the positive and negative wires from each other which we have seen does not hold in series roads, and the multiplication of wires, crossings and switches where many lines converge and cross. In suburban districts where these complications do not occur (and this system is particularly adapted to such) the double trolley multiple arc system is in many respects superior to the single trolley. John Kilgour, president of the Cincinnati Street Railway company, is justly proud of the Avondale double trolley road (a suburban line), and I doubt if there is a more successful road in the country than this.

In regard to the other objection to the series method, viz.: the high potentials, the method outlined in this paper permits me the use of any number of feeders, each of which may be used to supply a different portion of the road, thus reducing the potential, which in series distribution is the variable quantity, in the same manner exactly that the "drop" is obviated in parallel systems.

It is perfectly clear to the members of the Institute that this question of potential on series circuits is very much misunderstood by the laity. In the parallel system of distribution the high potential impressed upon the circuit at the dynamo is carried to every translating device on the circuit, even to that at the extreme end of the line, whereas in a series circuit the high potential spoken of exists only at the dynamo terminals and is the sum of the electromotive forces consumed by all the resistances on the line.

As an illustration in point, supposing we have two circuits, one parallel and the other series, the differences of potential between the terminals of the two generators being exactly the same, let us say 2,000 volts. On the multiple arc circuit, no matter how insignificant the translating device may be or where it is located, one cannot handle its terminals without subjecting himself to a shock due to 2,000 volts. If the motor be generating one horse power or 100, the danger is exactly the same. On the other hand, in the series system, if we are using a current of say 40 amperes, which is a convenient one for street car purposes, if the motor be generating one horse power, the difference of potential between its terminals will be a little less than 19 volts. If it be generating 100 horse power it would be but 1,865 volts, and before it would be as dangerous to handle as a motor on the multiple arc circuit, it would have to be doing work equivalent to 197 horse power.

Not long since there was a very animated discussion at a meeting of the Institute as to which was the better method of electric street car control—that of commutating the field or the other one of employing a rheostat. Both sides of the question were ably handled, and the discussion resulted as discussions usually do when the subject is either politics or religion, viz., in the making of no converts. Both sides to the controversy admitted, however, that in either case there were disadvantages, and the question practically resolved itself into "which was the lesser evil?" The constant current system simplifies matters, at least in this respect, in that neither commutated fields nor external resistances are required in regulation.

As regards economy in transmission of energy to long distances by the constant current method, we have high authority in Silvanus P. Thompson, who, in his "Dynamo Electric Machinery" (edition of 1888, p. 531), says: "Now the method of distribution by a constant current is, where power is to be transmitted to long distances, a much more economical method than that of distribution with a constant potential, owing to the fact that to the former method thinner, and therefore less expensive, conducting wires may be employed."

He might have gone much farther than this. As to the cost of installation, the comparison is much in favor of the constant current method on account of the extreme simplicity of the plant required, and the smaller size of both motors and dynamos for the same output. But the economy in plant becomes more obvious where high potentials are used, and these are always necessary where long distances are concerned.

But important as are the economies in installation and in transmission of large energies to long distances, there is another that greatly outweighs them, viz., the economy in operating expenses. In this respect the series method is almost an ideal one. In the parallel or multiple arc method, when a car is going down hill or is being checked, the whole of its $\frac{m v^2}{2}$ is absolutely thrown away in the application of the mechanical brake. Not so with the series system. The mechanical brake need never be used, except in the case of an emergency. By merely reversing the position of the brushes, the motor becomes for the time being a dynamo in series with the one at the power station, driven by gravity or the acquired momentum of the car, and the energy thus absorbed, while checking the car or bringing it to a standstill, is thrown onto the line for use elsewhere. One of the arguments used in favor of the cable road is that a car descending a grade assists another one which is ascending. If this be an argument where at least 75 per cent. of the engine power is consumed in dragging the cable alone, how much more valid should it be if the same thing could be accomplished where there was no cable to drag? Such, in fact, is the case with the series method. A descending car of one being checked assists another car that is ascending a grade or being started from rest, just as truly as it would if the two were connected by cable, and the energy thus thrown onto the line continues to contribute to the economy of the system to the last turn of the wheels. This is not mere theory. Prof. Short demonstrated its actuality on the South Broadway line in St. Louis by disconnecting the circuit entirely from the dynamo, and causing one car to partly ascend a grade on one part of the line by electrically braking a descending car on another part of the line. It has also been demonstrated in England. Edward Manville, M. I. E. E., in a paper on "Series Electrical Traction," read before the British Association in September of 1888, says:

"It may be well to point out in series running that, owing to the employment of current of constant value, it is impossible for the most inexperienced car driver to damage his motor by either too rapid starting or by reversing while running. Indeed, it is a positive advantage when descending a hill to check the speed of the car by altering the field connections so that the armature tends to revolve in the *opposite* direction to that in which the car is traveling, as the power that would otherwise be lost in braking the car is actually added to that produced by the generator, and thus large systems with many cars and varying gradients would appreciably reduce the total power required to be generated, and the consequent consumption of coal. At Northfleet they could actually turn the engine back against the steam when they were going down hill; that is to say, the power developed by the car going down

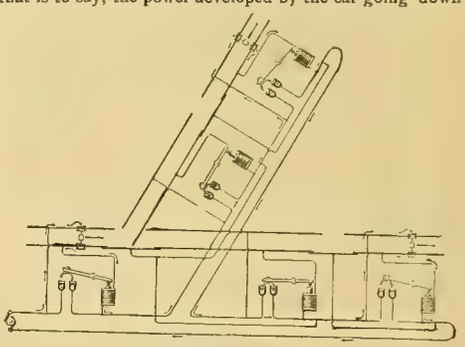

FIG. 9. SERIES ELECTRIC TRACTION.

hill, pas ing through the circuit, is more than at the engine at the moment."

The importance of utilizing electrical brake power, which is impracticable in the parallel system, is emphasized by some experiments on the Third avenue elevated railroad, New York, instituted by Frank J. Sprague, to determine in what manner the power generated was utilized. The result of these was that 83 per cent. of all the power utilized was consumed in overcoming gravity and the inertia of trains, and only 17 per cent. was actually consumed in traction.

I have endeavored in this paper to show both the advantages and disadvantages in the constant current method of distribution as compared with the parallel system. I think that many of the disadvantages which have heretofore been regarded as inherent in the series system are not so, and I have ventured to suggest a method by which many of them that were so grave as to preclude the utilization of the constant current in electrical traction may be remedied. I am glad to have the opportunity of bringing this subject before such an assemblage of practical men—all the more practical because they are theoretical.

Coming Development of Electric Railways.[1]

By Frank J. Sprague.

It is a trite but mistaken saying that electricity is in its infancy. It dropped its swaddling clothes when Morse sent the first telegraphic message. It put aside dresses

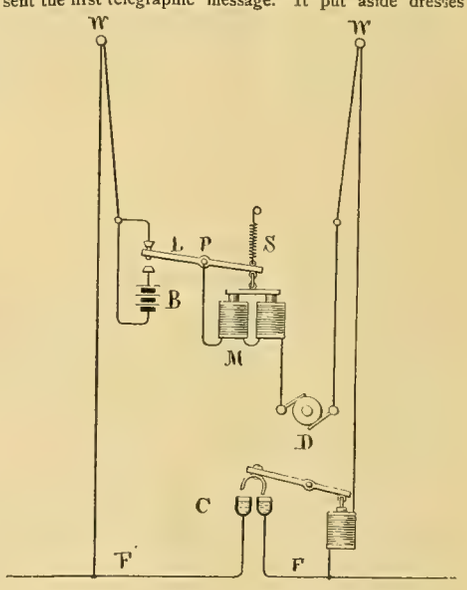

FIG. 11. SERIES ELECTRIC TRACTION.

and pinafores when the dynamo machine and arc light were invented. The incandescent lamp, the telephone, the art of welding, the transformer, are incidents of buoyant youth. The modern electric motor and electric railway mark a vigorous manhood.

The truly marvelous development of electric applica-

1. Read at the joint meeting of the American Institute of Electrical Engineers and the Chicago Electric club, Chicago, June 6, 1892

tions of every kind, the accomplishment of many things which in ignorance of the very art, or lack of knowledge of what are now well known facts, and more particularly the great commercial development of the transmission of power, whether for stationary purposes or for electric railways, has led to many a foolish prediction and idle boast.

This is no age of inspiration nor time for hopes never to attain fruition. It is above all things a practical age, perhaps too practical, but nevertheless one in which commercial enterprises to be successful must promise either a new field of development or economies in older fields.

As the orthodox few have been waiting in sublime faith for many centuries, and will wait for many more, for the

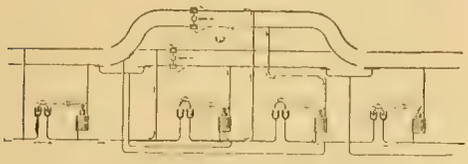

FIG. 13. SERIES ELECTRIC TRACTION.

fulfillment of ancient prophecies, so too will impracticable electric enthusiasts vainly wait for the millennium when investments are boundless, performances limitless and efficiencies unity.

It would perhaps have been proper in making my inaugural address to so representative a body as that of the electrical engineers that I should touch upon the special discoveries and experiments which have recently attracted attention, but there have been so many enthusiastic and brilliant workers that neither the time at my disposal nor the knowledge I possess would permit me to do justice to their work; hence it seems better to take up a subject with which I have been more particularly identified, which today commands so much attention, and concerning which there are such conflicting opinions. While finding encouragement in the achievements of our profession, I think the time opportune for a word of caution.

Electric street railways are no longer experimental nor is their success problematical. Their history for five years is that of an almost unequaled development. Almost within a decade has occurred the first working of a practical electrical railway. In a third of that period there have been put in operation or under contract more than 450 roads, equipped with nearly 6,000 cars and over 10,000 motors, and with over 3,000 miles of track. There is made a daily mileage of not less than 700,000 miles, and over a billion of passengers are carried annually. At least $75,000,000 has been invested in this industry alone; 30,000 horses in a single year have been relieved from the slavery of street car propulsion; stables are disappearing, and streets becoming cleaner; luxurious cars are running on smooth, well-built and rigid road-beds. Dividends have been increased, expenses reduced, investments enlarged, the unproductive has become productive, the impossible possible. Land values have been increased, habitable limits extended, homes created and time saved.

We no longer hear seriously of the dangers of the trolley wire, the failure of service. The time has come when legitimate investment is amply warranted. Electric street railway construction has become a matter of engineering, not experiment. Not only have the smaller towns adopted what is the only available means of current supply, but the larger cities are following their example. St. Louis and Baltimore, Minneapolis and St. Paul, Buffalo and Rochester, Boston and Brooklyn have fallen into line, and latterly even Philadelphia seeks an improved street service, and in New York public interest is being aroused.

In the latter city it is of course impossible to tell how successful will be the attempt to introduce electric propulsion. There is a strong and in many respects a legitimate objection to overhead wires. Many unsightly poles and badly strung wires have disappeared, and their place been taken by an underground service.

The general feeling of opposition to poles and wires ought not, however, to act as a barrier to such reasonable and proper introduction of an overhead system of supply, as the conditions now existing in that city very properly warrant. I have frequently pointed out the fact that the greatest good can come to the greatest number, especially in the over-burdened condition of transit which exists, if certain of the lines were electrically equipped; wherever, in fact, there would be no street obstruction.

In broad streets, where the tracks occupy only a small portion of the street and are near together, a line of poles of ornate design, with arms projecting on either side, can follow the center of the street, the same poles being used for lighting. Such a street, it seems to me, is Eighth

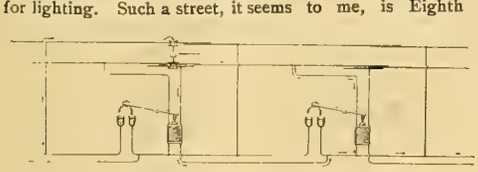

FIG. 14. SERIES ELECTRIC TRACTION.

avenue. Then, too, where there is a middle division or park, such as exists in many boulevards, and which is now used for telegraph poles, there is opportunity for an electric construction which would be entirely unobjectionable.

On streets occupied with elevated structures, these structures themselves would be used for a practically rigid overhead system.

Among the numerous places in New York where an overhead system could be put in perfect operation are Central Park west, the boulevard from Fifty-ninth street up, a part of the First and Second avenue lines, the Third, Sixth and Ninth avenue lines, and all the suburban extensions from the annexed district.

I am not sufficiently familiar with the streets of Chicago, which is the last remaining city which must consider electric street railways, to suggest a plan.

In these large cities, however, one condition should be insisted upon, and if this condition is met in the proper spirit, then much of the objection which has been raised against an overhead system must necessarily disappear.

The construction must be of the very best. The only overhead line allowed should be a contact wire with sufficient strength; the main conductors and the feeders should be put underground in proper conduits. There would then be overhead only a wire necessary for the smallest duty and of the requisite strength. In many streets, of course, the cable will hold its own until an electric conduit or surface contact system shall be proven satisfactory.

Impressed by the great development of this industry and brought face to face with the changes it has wrought, the query is continually made. Will the electric motor replace the steam locomotive? It is similar to the older question. Will the telephone replace the telegraph? Will the electric light annihilate the gas system? And in all soberness a like answer can be made: It will not, but it will, as the electric light and as the telephone have done, create a field of its own, and will replace a portion of the service now done by steam.

It seems to me that the growth of electric railways will proceed something in this order: First, the street systems in the various towns, then connecting lines between adjacent towns following the line of highways, then longer connecting lines, either on the tracks of existing steam lines, or, growing bolder, on exclusive rights of way on the same order. Then will come suburban traffic on a larger scale and freight transfer systems, and finally the more ambitious projects of trunk line service under limiting conditions, such as I will specify.

It has been very properly said that a man will make the

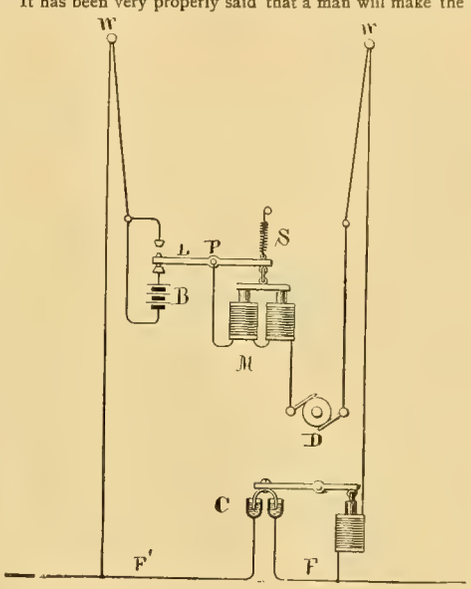

FIG. 12. SERIES ELECTRIC TRACTION.

first long ride on electric railways by transferring from one town system to another through connecting links, rather than on individual roads.

This is precisely the process by which great steam systems have been built up, although, of course, starting on a larger scale, and it is but natural that this shall be one step in the development of electric railways.

But evidently this natural process of evolution does not offer scope enough for the more enthusiastic, and we are now and again treated to an ideal electric road to be built on plans boldly defying both geography and the abodes of civilization. An air line route according to rules of surveying allowed only in Russia and on the desert of Sahara; abolition of the grades and street crossing; rigid and continuous rails; loaded cars of light weight, each operated by its own motor and making few or no stops; unlimited potentials and undiscovered resistance to insulation; new physiological and engineering laws; indestructible machinery; unheard, of powers of braking and new methods of train operation and signaling; around all a clear atmosphere, above all a perpetually smiling heaven, and behind all an unlimited bank account and the unlimited confidence of the investor.

These are some of the characteristics of such a road, but perhaps it is only fair to ask, given some of these conditions, what would be the capacity of steam traction?

No one will question the capacity of a motor to do the necessary work required, or to make a speed superior to that of the steam locomotive, provided sufficient energy be delivered to its terminals, but we must deal with existing or probable methods of supply. It is true that the speed at which a train is propelled by steam has only increased about 50 per cent. in sixty years, for in 1832 the "Matthew Baldwin" often made a speed of a mile a minute, but we must not confound speed with power, for while the maximum speed has not been so materially increased, the endurance, the perfection of the mechanism and the economy of performance have made great strides, and the increased speed, which is by no means the maximum possible of a locomotive *per se*, has been attained at much higher powers, and the schedule time has been shortened principally by cutting down grades, straightening curves, filling up ravines, abolishing trestle works, replacing wooden bridges by permanent ones of iron or stone, by the use of heavier and stiffer rails, better switches, improved methods of automatic signaling, the interlocking switch and signal system, and the abolition of grade crossings, in short, by improvements in details and management which permit of higher speeds on more extended sections of road because of greater safety, lower traction coefficients and a greater degree of confidence possessed by the engineer.

All these things are necessary for high speed electric railways, and any general improvements that will be of bene-

FIG. 15. SERIES ELECTRIC TRACTION.

fit to the latter must necessarily be of service to the former. Any predictions which are made concerning the future of electric propulsion, either in ignorance or disregard of the possibilities of steam duty and the limitations necessarily existing in all systems of transportation deserve and will receive little consideration.

Hence, let us note a few of recent locomotive performances.

Almost every one is familiar with the remarkable run recently made by a Schenectady locomotive hauling a special train on the New York Central railroad, when the distance of 439½ miles from New York to Buffalo was made at an average speed of nearly 60 miles per hour, and which was the precursor of the Empire State express, which makes the regular run at an average speed of over 52 miles per hour.

More recently, we have accounts of an interesting record made by a well-known writer on two runs between New York and Albany, on which a large number of indicator cards were taken. The weight of the train was about 270 tons. The steam pressure varied from 160 to 170 pounds. From an inspection of about a dozen cards, the indicated horse power varied from 551 horse power at 44 miles to 1,120 horse power at 78 9 miles. At 60 miles per hour the train resistance is stated to have been 15 pounds per ton, and at 70 miles, 17.10 pounds per ton. About seven pounds of water were evaporated per pound of coal.

A remarkable statement concerning this performance was made by Mr. Sinclair, which, while almost incredible, will, if borne out by an analysis of facts, prove to be something of a surprise to those who make their prophesies of the electric economies by comparative statements.

In the description of these tests it is stated that the whole trip shows an indicated horse power per hour for an average expenditure of only about 3⅛ pounds of coal per hour. This is far better than many stationary engines.

On the New Jersey Central road one schedule time is 86¼ miles in 89 minutes, which is made where there are a number of necessary slackings. On May 13th the time was taken of the speed of a Baldwin compound locomotive for a considerable period of time on one of the regular runs. Ten continuous miles were made in 452⅗ seconds and five were made in 222 seconds. The fastest time taken was 44 seconds, and the slowest noted was 47.

On February 26th a similar compound passenger locomotive running on the same road broke all steam records by running a mile in 39¼ seconds, or at the rate of nearly 92 miles per hour.

At this speed the indicator cards showed 930 horse power, and the drivers, which are 78 inches in diameter, were making 395 revolutions per minute.

In the very near future I expect to have the pleasure of riding on a locomotive when going on these high speeds, and I presume my respect for steam locomotion will not be diminished thereby, nor, on the other hand, will my confidence in the possibilities of electric propulsion under the proper conditions.

Experimental runs have been made with an electric locomotive at the rate of a mile in thirty seconds, that is, 120 miles an hour, and I confidently expect some day to go at that rate. But it will be under special conditions and not on the regular trunk lines of this country, and it is the height of folly to suggest that these steam trunk lines are to be abolished.

In making these very high speed runs there is not much attempt at maximum economy of coal consumption, the necessity being to generate steam as fast as required by the cylinder, but on taking an average of five trips, I

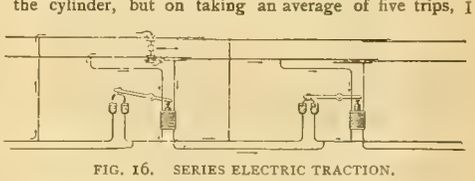

FIG. 16. SERIES ELECTRIC TRACTION.

find that there was evaporated 7.19 pounds of water per pound of coal used and 9.41 pounds of water evaporated per pound of coal consumed. The total weight of the train varied from 213 to 241 tons.

The personal equations of engineer and firemen necessarily enter seriously into steam operations, and this, compounded of course with the peculiarities of each engine and the conditions of service, is shown in railroad reports.

In this connection, I recently inspected a number of engine sheets. On one, which gave the duty of twenty-five engines, the average total cost per engine mile was

[*Continued on page* 365.]

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THAT the misuse of electrical terms is not confined to the American press is shown by a ludicrous blunder reported in the *Electrical Engineer* of London. The incident is thus described:

Mr. Preece's lecture at West Hampstead was very well attended, many having to be refused admittance, but not all understood even the simple technical terms used. A Hampstead paper speaks about people in the future "paying for electricity not by the number of 'bolts', but by a combination of them termed 'wats'" and further on it says "a kettle will boil with 100 'bolts' of electric light."

This will go a long way toward reconciling those who have felt chagrined at the technical mistakes in our own newspapers.

MUCH valuable information is presented in Lieut. Badt's paper "On the Electrolytic Refining of Copper," read before the American Institute. The author presents data never heretofore collected, and his paper is a valuable contribution to the science of electrolysis. It is strange that this subject was neglected in the Census Report of 1890, but Lieut. Badt's researches disclose the fact that such is the case. The present paper, by giving statistics and particulars of the existing American plants, so far as available, goes far toward providing the information which the government has omitted to supply. Lieut. Badt is an ardent advocate of the use of electrolysis in copper refining, and his investigations and practical experience entitle his opinion to respect. There is no doubt that this application of electricity is gaining in favor—if not with great rapidity, at least with a healthy growth—and the subject is worthy of more attention from electrical engineers than it has received.

ELECTRIC street railways have educated the people of this country up to a point where they demand quick and cheap transportation over great distances as well as in local traffic. Despite the fact that great advances have been made in the handling of passengers on steam railroads, the public demand still greater improvements, especially in the matter of speed, and they look to the electrical engineer for a solution of the problem. At the present time considerable interest is manifested in the project of an electric railway between Chicago and St. Louis on which it is proposed to attain a speed of 100 miles an hour. The details of the scheme have not been made public and of course there is no way of passing an intelligent opinion on the project until a thorough examination of the plans can be made. Electrical engineers have displayed little enthusiasm over the project on this account. It is the general belief that many radical improvements in track construction will be required before the managers of steam railroads will be justified in increasing the speed of trains to any appreciable degree.

THE severe electrical storm of last Monday appears to have raged more fiercely in Northern Illinois than in any other part of the country. In Chicago the city was so dark at half-past three o'clock in the afternoon that the Chicago Edison company kept pace with the demand for light with great difficulty, and at one time nearly all of the engine capacity of the station was in use. The electrical disturbance in the atmosphere was most pronounced, and considerable damage to property from lightning is reported. Many telegraph and telephone wires were blown down, one pole line on State street containing sixty wires to eastern cities being leveled to the ground. Chicago is so well supplied with telegraphic connection with the outside world, however, that the service was kept up with but little interruption by using other circuits. During the storm there was little short of a panic in the exchange of the Chicago Telephone company, where nearly two hundred girls are employed. When the switch-board became charged with electricity, with blue flashes and crackling discharges, many of the girls became terrified. Two fainted and were taken home and several others were hysterical from fear. As soon as the electrical display began, the manager instructed the girls who remained at their posts to sit back from their instruments and not to answer any calls until the storm abated. It was an unnecessary order, however, as there was not a single call until the worst of the storm had passed. Taken altogether, it was a remarkable storm.

WHEN the enthusiastic rural editor takes up the fascinating topic of electricity's prospective applications, his headway oftentimes carries him just a little way beyond the mark. At the present time the country papers have taken the cue from the electrical press, and on all sides we hear how the subtle fluid is to aid the progressive farmer on his road to wealth. Senator Peffer's bill to establish the experimental station for ascertaining the extent to which electricity might be advantageously used on the farm, has undoubtedly been the mainspring behind these utterances. Although the talk in some cases has been most visionary, the Peffer bill has undoubtedly started an agitation that will eventually bear fruit. It may be noted that a Wheeling, W. Va., paper has resurrected the old overhead-conductor-on the-country-road scheme, and points out that the time is "well in sight if not already in hand," when, instead of driving a team through the mud when he takes his produce to market, the farmer in all the more thickly populated states, will have a switch running to his barn from an electric country road, and will use his team only to pull his private cars to the road, where they will be taken in tow by a trolley car or some other device for applying electricity as a motor.

While all this may be brought about some day in certain favored localities, it is not well to indulge too much in conjuring up such beautiful visions for presentation to the farmer, as they will lead him to expect too much of an agent that in this field can only be applied to a limited extent, and under certain restricted conditions. It would be better if the enthusiastic friends of electricity would educate the agriculturist to a knowledge of the wonderful applications already proved thoroughly practicable, and leave the future to those who know enough of what has been accomplished to make well-tempered prophecies.

IN the last issue of the WESTERN ELECTRICIAN, there was presented a description of the equipment of the first electric launch that had put in its appearance at the World's Fair to enter the competitive test soon to take place. In this issue the boat entered by another company is described. Through the tests to be made at Jackson Park, the engineers of the Exposition will determine which is the most desirable propelling power for the pleasure boats. Steam, electricity and compressed air are to be tried, and whatever power proves most desirable will be employed on the launches that are to ply in the lagoons on the grounds.

Without attempting to discuss the relative efficiencies of the several motive powers that will be tested, it may be said that there cannot be advanced any good reason why electricity should not be given first place. The management of the Exposition has, from the start, laid great stress upon what were to be the "electrical features" of the great fair; it has shown an inclination to favor those who sought to introduce legitimate novelties, and for this reason alone, the electric launch should have the first place. There is no doubt in the minds of those familiar with storage battery development, that all requirements of this service can be fulfilled and that a serviceable boat can be furnished. It is true that little attention, comparatively speaking, has been given to this special line of development in this country. In England, on the contrary, advantage has been taken of every opportunity to perfect this particular branch. On the Thames, for instance, there are numerous electric launches and floating charging stations, and much pleasure and profit are derived from this source. There is no doubt that the English are ahead of the Americans, in this particular line, but there is no reason why we should not take advantage of their experience and even improve on their methods. The advantages of the electric launch over the dirty and noisy steam launch will no doubt be fully realized by the Exposition officials and there should be no hesitation on their part. In their zeal to secure the most efficient launch service on the lagoons, they should not overlook the fact that to the great majority of visitors to the Fair, a ride in an electrically propelled boat would be one of the most entertaining novelties of the Exposition.

ELSEWHERE in this issue is presented Frank J. Sprague's inaugural address as president of the American Institute of Electrical Engineers, before the recent joint meeting of the Institute and the Chicago Electric club. Mr. Sprague spoke on the "Coming Development of Electric Railways."

In view of the wild theories entertained by the general public concerning the possibilities of electric traction, the views of Lieut. Sprague should be carefully read, as there is probably no other man in the country who is so well fitted to speak authoratatively upon this subject. This paper will doubtless do much toward clearing away absurd and unreasonable ideas. On all sides one hears of schemes through which the trunk lines of the country are to be electrically equipped, with the the idea that wonders in the way of high speed, etc., may be accomplished. Mr. Sprague's conservative and common sense view of the situation is therefore just at this particular time most refreshing. To have, however, a thorough appreciation of the speech, it must be read through; a review would be, in one sense, an injustice. One paragraph may be referred to, though, as it characterizes in a forcible and amusing manner one of the wild cat schemes about which the daily papers have of late said so much. In describing the "ideal electric road to be built on plans boldly defying both geography and the abodes of civilization," Mr. Sprague says: "An air line route according to the rules of surveying allowed only in Russia and on the Desert of Sahara; abolition of grades and street crossings; rigid and continuous rails; loaded cars of light weight, each operated by its own motor and making few or no stops; unlimited potentials and undiscovered resistance to insulation; new physiological and engineering laws; indestructible machinery; unheard of powers of braking and new methods of train operation and signaling; around all, a clear atmosphere, above all a perpetually smiling Heaven, and behind all an unlimited bank account and the unlimited confidence of the investor."

Mr. Sprague does not mince matters; he talks as he has always worked and the conclusions set forth at the close of his address, coming as they do from a man knowing thoroughly whereof he speaks, will without doubt have the attention they merit.

[Continued from page 363.]

10.85 cents, of which 2.66 was for fuel. The total cost varied from 6.8 to 19.24 cents, and the fuel (wood) from 1.96 to 4 77 cents.

On another sheet giving the performance of twenty two engines, the total cost per engine mile was 14.70 cents, of which the fuel cost 4 61. The total cost varied from 8 82 to 27.98 cents, and the fuel cost from 2.04 to 7.48

In still another, that of the performance of eighteen engines, the total cost per engine mile was 14.73 cents, of which the fuel (coal) cost 6.62 cents. The total cost varied from 10.04 to 22.52 cents, and the fuel cost from 3.82 to 13 84 cents.

In discussing the electric system there is often a confusion of statements with reference to economy. Despite the undoubted fact that the electric motor can probably be run at variable high speeds with less variation of economy than can the steam locomotive, we must not forget that in the latter we are considering the economy of the unit as a whole, not merely of the steam cylinders, but also of the boiler and the furnace.

In electric propulsion a similar comparison of economies must take into account the variable duty of the central station and the losses on the line as well as those in the motor, and where single units are used the variation in economy of the whole system would be much greater than in the steam locomotive. There will be only a reasonable fixed efficiency of the central station and the line when the number of units is large enough to make the load on the central stations nearly constant.

Let us now consider another class of duty.

Some time ago I made a very careful analysis of the work done on the elevated roads in New York city with a view of determining the coal consumption and the duty performed by the locomotives. At the time this investigation was made, now nearly seven years ago, there were in use on the Third avenue division 63 trains at one time, running at very close intervals. The weight of the trains was from 80 to 90 tons; the speed was often as high as 20 to 25 miles an hour; stops were made every third of a mile; in short, the duty demanded of the engines was exceedingly severe.

The maximum indicated horse power of the locomotives was found to average about 163 horse power, although on occasions these locomotives have been worked up to 185 horse power. Work was divided approximately as follows:

Acceleration in starting 59 per cent., lifting 24.3 per cent., and traction 16.7 per cent. The average horse power exerted was 70.3 horse power, considerably less than one-half of the maximum.

The work on the line was so distributed that there was an almost constant total duty of about 4,500 horse power. The locomotives were on duty twenty hours, but used steam only six hours, and including all losses when standing still and the amount of steam used in braking, there was a horse power developed for about 6.2 pounds of coal per hour.

I believe that these figures are entirely reliable, and they show a remarkable performance when we consider the class of duty.

An analysis of the coal expenditures showed that, with an efficiency of 60 per cent. and without any of the energy of the train being returned to the line, the relative coal expenditures between steam and electricity would be about in a ratio of 2 to 1, but if the energy of the train was returned to the line to the extent which I believe it is possible, then the relative expenditure of fuel would in the proportion of 7 to 2. Since the coal charge on the four divisions was at that time about $550,000, it can easily be seen that, independent of any question of saving in the care of the structure and any reduction of depreciation of the motor equipment, the fuel saving would be sufficient to pay a good interest on the cost of electric equipment and a large interest on the cost of electric equipment minus this value of the present engines.

I have no reason to doubt the soundness of the conclusions I then made.

You will have here in Chicago, however, a somewhat more advanced condition of affairs. A compound type of locomotive has been adopted for the elevated road service, and I believe it will show an increased economy over that of the operation of the New York roads. Consequently, in discussing the question of economy, it is necessary to get full information concerning the duty which will be done here.

In discussing high speed possibilities and limitations, the testimony of Dr. Dudley, as given in a discussion of a paper before this Institute, Feb. 24, 1891, is interesting.

There are, generally speaking, three distinct elements constituting the resistance of train movement on a level, and they have a most important bearing when we consider the operation of long or short trains, and at high speeds. One of these elements is the friction of the train in its bearings; with good rolling stock this is about 8 pounds per ton. For all reasonable speeds it is probably fairly constant, provided the lubrication is good. Another element is that of air resistance, which varies with the shape of the forward end of the train, the condition of the air, the direction of the wind, and the velocity of movement. The third I may call the train lifting or rail bending effort, which depends upon the weight and swiftness of the rails and solidity of the road-bed.

Dr. Dudley stated that on the New York Central system he found that trains of about 250 tons when running at a speed of a mile a minute, had a resistance of from 10 to 12 pounds per ton, but that on short trains of two or three cars the resistance sometimes ran as high as 35 or 40 pounds per ton.

This is probably due not to any change in the friction of the bearings, but to the fact that the air resistance enters as a much higher component of the total.

It at once emphasizes the fact that the operation of short trains at high speeds must, no matter how good the track or how favorable all other circumstances, be with a train resistance higher than required by long and well vestibuled trains.

Such a shape can be given to the front of an electric locomotive as will make the air resistance not over one-half that presented by a plain surface of equal cross section and perpendicular to the line of motion, but even this fact does not alter the other, that the resistance per ton must be higher for small trains than for large ones.

Mr. Dudley further stated, in speaking of the influence of stiff rails, that the difference in power required on the Chicago limited when running on an 80 and a 65 pound rail was from 75 to 100 horse power per mile, that is, somewhere between 10 to 12 per cent. of the power actually developed, and he estimates that with a 105 pound rail, which is nearly twice as stiff as the 80 pound rail, there would probably be saved another hundred horse power per mile, making a total saving of a quarter by less than doubling the weight of the rail. In his opinion it is perfectly safe to run a steam engine 120 miles an hour on this heavy rail.

Such rail improvements increase speed possibilities with present engines, but we have not related the limit of steam duty.

Almost all the locomotive work of the United States has been done up to the present with simple engines. Their weight and capacity has been increased, their steam pressure raised until the standard is now about 140 pounds. Within recent years, however, the compound locomotive has come into use, and there is a comparatively large number of them in daily service. The steam pressure has gone up to 180 pounds as a standard, working sometimes as high as 200 pounds, but these are by no means the limits of steam pressure.

On the Paris, Lyons and Mediterranean railway the standard for steam pressure for compound locomotives is 250 pounds. The compound locomotive has still its battle to fight, but I think it would be a rash man who would say that the days of still higher steam pressure are not to come, and that the triple expansion locomotive will never exist.

Speed, capacity and coal economy are, however, not the only questions to be considered in railroad operation, and in discussing the general subject, it will be found that the signaling and braking questions at high speeds are serious ones. Undoubtedly an electric train with distributed motors, making the weight of the train available for traction, could by using the motors as dynamos to return the energy of the train to the line from the highest to mean speeds and then on a local circuit be more quickly and effectually slowed down and stopped than where shoe brakes are used, and both methods of course would be available.

But if using a motor ahead of a train then there will be comparatively little difference in the stopping power.

When riding at 60 or 70 miles an hour, it is a very quick stop to bring a train at rest in less than 2,000 feet. This is often as far as any signal can be made out, especially when the weather is at all thick. Hence we may expect to find on electric railroads, if high speeds are to be attained, and quite possibly also on steam railroads, an extension of automatic signaling so that trains indicate on more than two sets of signals. At present the practice is to divide the line into sections, and when a train passes a certain point it sets danger and cautionary signals, dropping the danger signal on the section just preceding, and the cautionary signal on the one beyond.

Turning now to the greater powers, we must not confuse the terms "large powered" and "trunk line" work.

These are two statements which I think will need no corroboration.

If we had a continuous train movement completely occupying a track system, there can be no question but that its operation from a central source by electricity would be more economical than if operated by steam locomotives.

So, too, if a large number of units in reasonable proximity are moved, and the stopping and starting so regulated that the total demand upon the central stations is fairly continuous and equal, then there is no question as to the economy of electric propulsion as compared with steam.

On the other hand, the operation of a single or very few units over a long distance would be so uneconomical and afford so small a return on the investment required, as to make it prohibitory.

Between these two lies the condition of operation where steam and electricity meet on planes of equality; as the number of trains decreases, steam operation is the more economical; as the number increases, electricity must be preferred.

In discussing the use of electricity instead of steam, a well known steam engineer recently stated that in his judgment it must be conceded that electromotive force for the propulsion of cars will not be economical except for suburban traffic, and upon certain sections of important trunk lines, like the New York Central between New York and Albany, the Pennsylvania system between New York and Philadelphia, the other lines of like character, where it is necessary to despatch a large number of comparatively light trains every day, and at short intervals. The principal field for a power of this kind would be in suburban service long enough to make the ordinary street electric cars unpopular because of the time required, and in such cases as these mentioned above; also for moving freight trains in cities; that is, for the performance of transfer service.

This is precisely in line with the arguments which I have advanced from time to time, and which I illustrated in a paper before the National Electric Light association at its convention in Kansas City, where I outlined the possible service between New York and Philadelphia, which I believed to be practicable, and to which I will again refer.

I must repeat that it narrows itself down to the one question as to the number of trains operated between two terminal points. Make that number of trains sufficiently large, and the electric motor is the best means of propulsion, whether for high or low speed, whether for large or for small cars. Decrease this number, and we must rely on steam propulsion, or to put it in another way, the answer to the query, Will electricity take the place of steam for railroad purposes? is Only in part, and then only when the number of units operated between the terminal points is so large that the fuel economy would pay a reasonable interest and depreciation of the necessary cost of the central station and the system of conductors.

Of course I do not in this general reply consider those special cases where advantages are to be gained for which there is a return for capital in another direction. Such a case is that of the Baltimore tunnel, where the investment and cost of operation will be greater than that for steam propulsion; in fact, there will practically be no economy in power because the steam locomotives are not done away with but simply unused for a period of a little over a mile. There is in this specific case, however, the incidental advantage of doing away with the necessity of a ventilating plant, and yet getting rid of the annoyances incidental to tunnel service.

Trunk line transportation being a great problem, we should not attempt the simultaneous solution of all the questions involved, but instead, determine what those questions are, consider their sequence, and the probability of success, and solve them in their order.

Every system has its limitation. The electric is not exempt from this law, and hence it will set forth what are well known limiting laws concerning the transmission of energy. They have been stated time and again, but somehow people often lose sight of them in discussing the question of investments in large electric railways, so that I think it would be well perhaps to restate and emphasize them.

The weight of copper necessary to transmit a given amount of power with a fixed loss will vary inversely as the square of the electromotive force used.

The distance to which it can be transmitted with a given weight of conductor will vary directly as the pressure.

The distance to which it can be transmitted over a conductor with a given cross section will vary directly as the pressure.

The weight of copper necessary where the supply station is in the center of a system is only one-quarter that required if the station is at one end.

The weight of copper will vary inversely as the square of the number of supplying stations properly placed.

The electromotive force required will vary inversely as the number of stations.

Lack of knowledge of these simple and unalterable laws have led to much misconception of electrical possibilities, and these have not been confined to the electrical engineers.

In many of the suggestions which have been made even by practical steam engineers, there has been an unnecessary confusion of the practicable and impracticable, and the specific object which should have been borne in mind has been lost sight of.

Committees have drawn impossible specifications for trunk line service, and demanded of electric motors a capacity and performance superior to that of the best compound steam locomotives. I unhesitatingly pronounce any attempt to build some such machines, for the present, certainly, unnecessary and impracticable. The service thus suggested, if at all needed, will for many years be better performed by the steam locomotive than by the electric.

Leaving out of present consideration trunk line work, there are three problems requiring solution in the application of electricity to propulsion on a large scale under conditions existing, for example, in Chicago or in any other place where there is a movement of a large number of trains on more or less complicated tracks, as will be found at almost all terminal railway stations. They are:

First—The development of an electric locomotive of ample power, which shall be as readily controlled as the steam locomotive, and shall be reliable in operation, and shall show a high economy. Of course such a machine must have all the adjuncts which are necessary for train movement.

Second—A system of conductors and method of supporting the same which can be relied upon for ample supply of current and absolute certainty of continuous contact at all speeds on curves, switches, cross-overs and the multitudinous combination which exist on yard tracks.

Third—A system of automatic block signaling, which, while effective for steam traffic will not be thrown out of operation by the use of tracks, as conductors of electricity for a general supply. This is a more serious question than is at first considered, for this use will materially interfere with if not absolutely destroy the utility of what is known as the rail circuit system.

This third problem is one which must necessarily follow the development of the other two, as the automatic signaling systems now existing have followed the development of steam practice.

While I am not by any means thoroughly familiar with the various methods of automatic signaling, I believe I am justified in saying that there is none at present existing which will meet all the requirements of railway practice, and which can be operated on tracks used by both steam and electric locomotives, where the rail is used as a part of the supply circuit. Some of the best known systems of signaling would be rendered entirely inoperative.

As difficult as it may seem to devise such a system, I believe that it certainly can be developed, but only properly so on a section of track which is more or less experimental on which at the time of operation automatic signaling is unnecessary, but which is actually operated by both classes of service. Such an experimental section would be a combination of single and double tracks with all the vari-

eties of curves, crossings, switches and ladders, such as would be found in any large yard.

It will probably be found necessary to erect a variety of kinds of conductors. From the most careful consideration which I have been able to give to the subject, I believe there is one way, and only one way, in which the current can properly be supplied in any complicated system, and that is from the overhead conductor, practically rigid in character, following very nearly the center line of all tracks and switches with no movable overhead parts, and with return through the rail. The locomotive would then practically be moving between two electric planes, the lower being the guiding one.

I know there has been a great deal of talk about other possible systems of supply. We have heard much of the charged rail using low potential currents supplied at frequent intervals by motor generators driven from a central station.

Since we have discovered no conductors devoid of resistance, and the art of welding is not particularly applicable for railway service where moving contacts are a necessity, little credence need be given to any scheme of this character.

We heard again of the central rail supported on posts in wells between the tracks. A center rail may be acceptable on a system like that of the elevated railroads, but in ordinary railroad work any ditch intended to drain a track so as to keep insulators dry and keep snow away from it would probably so open the track that any moisture and frost would cause upheavals of serious character, and the cost of maintaining the track would be prohibitory. The use of snow machinery for keeping the track clear would be impossible, and anything underneath the car is in the most exposed place for sustaining damage by defective rolling stock, and continually liable to all sorts of mechanical injuries and accidents with all the evil results of interruption of current, short circuiting and stoppage of traffic.

Another system which has been proposed is that of conductors supported on posts alongside of the track and elevated but three or four feet above it. While not open to so serious objections in the matter of insulation as a center rail system, its use is manifestly not to be thought of where there are crossings or switches. Even on a straight clear track in a hard climate there would be most serious trouble in the matter of clearing the tracks from snow, and with the grade crossings in this country gaps in the conductors would be too great for the contacts on a single locomotive to stand.

Some time ago I was requested on behalf of a well known financial man, whose enthusiasm as to the possibilities of electric traction is well known, but who is withal a most practicable railroad man, to inspect various railroad terminal tracks in this city with a view of, first, the substitution of the switching work now done by a part or all of the 1,800 or more switch engines by electric motors, and eventually the operation of suburban service.

Considering the railroads nearly as they exist on a number of systems in Chicago in the space of about two square miles, or more exactly 1¼ miles in length by ¾ of a mile in breadth, it is no exaggeration to say that there is or will be not less than 75 miles of track, and switches and crossings with their various combinations, almost innumerable.

I went over and over some of these tracks with the one thought in my mind: How can the current be delivered to the locomotives, and how can the automatic signaling be done? And I was forced to the one conclusion to which it seems every man who makes the investigation must come, and that is that the overhead system of supply is the only one, but that it must be as substantial and thorough in character as that of any other part of the system, and further that in view of the cost, such a system is only permissible where the number of units operated is large and continuous.

These conclusions are not new, but they have been emphasized by the particular problem which is here represented.

Intimately connected with the question of conductors, and one of the most serious ones which has to be met by the electrician, is that of potential. The personal danger limit of continuous or ordinary period alternate currents is pretty well determined, and it seems generally admitted by constructors that the danger limit for the continuous current machine, with its commutator, is about the same as the personal danger limit.

Hence we meet with two dilemmas. If using continuous current motors, we are limited to a difference of potential per machine of 1,000 to 1,200 volts, and we can so far as the safety of the machines is concerned, only probably go above this limit by putting the motors in series, precisely as has been proposed for long distance stationary transmissions.

If this is not done then we have the introduction between the transmitting dynamo and the receiving motor of a motor generator system, another pet theory which is often suggested but which I unhesitatingly pronounce as so uneconomical as to be impracticable.

If using an alternate current system, then converters must be used, either distributed along the line and supplying the working circuit or placed upon the locomotive to safeguard the motors.

While the use of a converter under these conditions is not as objectionable as the use of a motor generator, it cannot commend itself as a very practicable scheme, and certainly in view of the fact that no single phase single alternate motor promises up to the present serious success.

For the present, and I think for a long time to come, we must confine ourselves to the consideration of railroad problems where continuous currents are used, and where the traffic between two points is sufficiently large to justify the investment in central stations and conductors which would be required for the operation of such assistant.

There are two methods of propelling trains electrically, one by following steam practice, that is, by building a large motor and hooking it to the head of a train, the weight of the motor being such as is required for the necessary power and traction when grades or slippery tracks are encountered.

From all that has been developed up to the present, to get the control that is necessary and to build the machines safely, the electric locomotive will weigh nearly as much per horse power as the steam locomotive. This weight can be better distributed, but I do not think if steam practice is followed on trunk line service, that there could be any very material reduction of weight of train.

The other plan is to have each car propelled by one or more motors. This would be the ideal system so far as propulsion goes, provided the electric motor was unlike all other mechanical apparatus, and that it never failed, and if a number of machines could be as well taken care of, cost no more and show as little depreciation as fewer machines of larger capacity operated as a unit.

Should we ever arrive, as we all hope, to the possession of a single circuit alternate current motor, then in view of the simplicity of its control, we may fairly hope for the distributed motor system.

But here also the capacity and likewise the weight of the motor being determined by the total duty done, the weight of train limit would not be decreased, but rather increased.

If on the other hand, single units are used, the query naturally arises, what form would the electrical locomotive of the future take? I do not think this is by any means settled; undoubtedly gearless machines will be used, but whether they will be mounted directly upon the axle, or whether they will movably inclose the axle and be flexibly connected to it while their weight is carried on springs on the truck, or whether the motor will be carried on the truck frame and connected to the drivers by the ordinary coupling rods, are questions which will be determined eventually by the depreciation per car mile upon the motors, trucks and road-bed as well as by the speed to be attained.

Whatever the method of mounting the motor is adopted, for reasonable weights and powers, a 2 axle truck will be used, but where large powers and weights are necessary, two such trucks will be coupled together so as to keep the weight upon each wheel within limits, and this will carry a cab containing the regulating and collecting devices, and so shaped as to offer the least resistance to air pressure and high speeds.

I have never advocated the use of a connecting rod in transmitting the motion from an armature to a driving axle, but I think it fair to say in this respect that the so-called hammering effect on the rails, said to take place in the ordinary locomotive driver where the weights are counter-balanced, exists more in imagination than in fact, and that the chief trouble in the use of the connecting rod is the change of direction of its movement.

Among the roads which are ripe for the electrical engineer, and on which in the near future I hope he will demonstrate he has a most legitimate claim, are the New York elevated and the Chicago elevated, the handling of the trains on the New York Central and Harlem roads below the Harlem river, the long talked of rapid transit road of New York, the Metropolitan underground road of London, the proposed tunnel roads in London, Paris and Berlin, and coming more immediately home, suburban service such as that of the Illinois Central railroad, a most ideal track for the electrical engineer, and last, and as it will prove one of the most important, the operation of the terminal and warehouse systems for the interchange of freight on the lines entering a city situated as is Chicago.

Taking this last, we have here a definite problem, now performed in a more or less satisfactory way by steam service. It is a problem large enough of itself. It has little connection with electric trunk line service, and the present impracticability of the latter has little bearing upon the thorough practicability of the former.

Eighteen hundred or more switch engines, many of them on duty twenty-four hours a day, a large portion of the time standing idle, puff their foulness into your overburdened atmosphere, because from 80 to 90 per cent. of all the freight that comes into the depots of this city ought never come inside its limits, and would not were there a practical way provided to distribute it from one railroad to another outside the city limits. It has been suggested, and it seems to me a most feasible plan, that there shall be established a vast system for interchanging freight on the various railroads by a great 6 track crossing belt road which shall form a common zone of transfer either by itself or in combination with freight warehouses or storage yards.

Undoubtedly there are many difficulties in the way, but from an electrical standpoint there is absolutely no question but that such a system of belt line is practicable.

With such unsolved problems, such abundant fields, I deem it unnecessary now to attempt to build electric locomotives to pull trains of great weight 100 miles an hour, or to develop a system of conductors for trunk line service which is not possible for yard duty, or to consider a central station or track equipment for a duty never required. This problem is in a measure an experimental one, which being carried to a certain measure of success will clearly point the way for a future development and outline its limits.

I may be pardoned perhaps if I take radical views in some matters of railroad practice. I have fortunately or otherwise been thrown into direct touch with all the larger work which is to be done in this country during the coming year, and it gives me pleasure to announce, what many of you know from the current news of the day, that there will probably be in operation in the United States within twelve months not less than five locomotives varying from seven to twelve hundred horse power and from 45 to 80 tons in weight. The character of the work done will vary. In that work which I am most concerned from a personal standpoint, a 700 electric locomotive will be built for experimental work, and to attempt to solve as far as may be the various problems which are involved in railroad practice in Chicago. If my judgment is followed, there will be an experimental section of track in the form of a loop about thirteen miles long with eighteen miles of rail, and with every variety of single and double track construction, and simple and compound crossings and switches.

On this I hope to see erected such varieties of overhead construction as may be found best to meet the various kinds of service, and where the railroad problems on track jointly operated by steam and electricity can be developed in the most satisfactory manner.

On this track there will be not only this locomotive, but also one of equal rated capacity supplied by one of the larger manufacturing companies.

The duty demanded of these machines will be severe. They will be required to haul a train of not less than 450 tons, at 30 miles an hour, up a grade of 26 feet to a mile. They will probably be required to develop their full rate of capacity at all speeds between 30 and 60 miles per hour, and if there is sufficient track room they will be driven at a speed of at least 75 and perhaps 100 miles per hour for short distances. The potentials used will be nearly double that at present obtaining in street railway practice.

A still larger problem, so far as power goes, although not in the variety of conditions which will have to be met, will be that recently taken for the operation of the belt line tunnel now being constructed in Baltimore to avoid the necessity of boat transfer at Locust Point. The duty of the motor will be to propel the train with engines coupled on, but not in operation, through a tunnel about 6,000 feet long.

The conditions require the motors, which will weigh about 80 tons and have a capacity of about 1,200 horse power to propel a 1,200 ton freight train up a grade of 42 feet to the mile at a speed of 15 miles. Passenger trains of 450 tons' weight must be regularly started from rest twice in the tunnel on this grade, and in an emergency the motors must start the freight train. The draw bar pull under regular duty, and when not starting, may be as high as 32,000 pounds.

Perhaps the traffic from New York to Philadelphia affords as good an example as any of what may be done on regular passenger service, provided the track is clear enough.

For this I, some three years ago, and again the *Forum* of September, 1891, outlined an electric express service, with a method of supply through a rod carried above the car and a return circuit through the rails and earth.

The current was to be supplied from one or more central stations, equipped with high-class triple expansion engines, driving multipolar dynamos directly coupled. What the electric engineer, and the railroad man as well needs to know is whether the electromotive force required on the line, and the number of stations necessary would be prohibitory.

No attempt was made an excessive speed, but I confined myself to the average speed of a mile a minute for a distance of ninety miles, and considered a through service only. I assume a total weight of copper of only about two-thirds that which exists on the long distance telephone line between New York and Boston. The trains were to be two car units, leaving every ten minutes.

I found with these conditions the stations and potentials would be about as shown in the following table:

Station.	Miles apart.	Potential. 2 wire.	3 wire.
1	—	3,600	1,800
2	45	1,800	900
3	30	1,200	600
4	22½	900	450

If the 3 wire system is used, that is, the rails as a compensating conductor between two trolley rods, then with only two stations forty-five miles apart, it is seen that the potential is less than 1,000 volts, and this we undoubtedly can handle.

I am not prepared to say that we may not use even a higher pressure, because I believe whatever is demanded in the interests of economy, all things being considered, will be used, but if we can reduce the potential to perfectly safe and reasonable limits by multiplying the number of stations, then those stations should be increased so long as the increase does not seriously affect the general expense of working. On a service of this character, where I have made the conditions distributed work and the dispatching of units at brief intervals, which conditions I repeat are absolutely necessary if we are to consider long distance transportation by electricity, such increase of stations as is advisable will not increase the cost of central station operation.

Such is the work before you, a work well meriting your best efforts, yet it is well to temper your enthusiasm with prudence.

Limit your attempts to the solution of those problems which will prove of practical benefit.

Do not chase rainbows. They are beautiful and poetic, but they have small place in the world's economies.

Remember that neither sentiment nor ignorance are winning cards, but lessened costs of operation for equivalent duty and increased returns on invested capital.

All this is said in no spirit of discouragement, for I yield to no man in my confidence in the future of electric traction. No new field is so rich, none more pregnant with great possibilities, but the growth of the work will be more expeditious and healthy if we separate the visionary from the real, the impracticable from the practicable.

The Sedalia *Daily and Weekly Democrat* of Sedalia, Mo., will run its printing press by electricity. The Edison company has installed a three horse power standard Edison motor in the Equitable building, Sedalia, Mo., for this purpose. Current will be taken from the mains of the Electric Railway Light & Power company of that town.

Practical Notes on the Electrolytic Refining of Copper.[1]

By F. B. Badt.

There are many books extant on the art of electrolytic separation of metals, and much has been and is being written in scientific journals on the same subject, but, strange to say, most of it has been published in the foreign press and very little can be found in American publications.

From this it might appear that but little interest is taken in this subject and that copper refining is being done on a very small scale in this country, while, as a matter of fact, quite the reverse holds true. We cannot explain the dearth of information on this subject any better than by quoting from the preface of Mr. Gore's latest book.

"Much of the information hitherto published on the subject lies scattered about in short articles and fragmentary accounts in periodicals and books; and statements more or less inaccurate have been made, owing to the writers not having had access to the manufactories, the processes in which they have attempted to describe. M. Kiliani and others have observed the privacy with which electrolytic refining works are conducted; he says that 'its effect has been to some extent to make people believe that the operations carried on are based upon discoveries known only to a few and are surrounded by difficulties of a very special and complicated nature.' He writes with 'the object of dissipating this wrong impression and of convincing all those interested in the subject that whatever is done inside these works can be done by anybody who gives a little attention and study to the subject, the only secrets being slight and immaterial details of practice.' The probable explanation of this is, that each electro-refiner, in consequence of being imperfectly acquainted with the literature of the subject, and of how his fellow-refiners were working, has been obliged to ascertain by means of experiments in his own works the practical details of the process; and has thus independently arrived at the same general plan of operating as other refiners, whilst considering his own method a secret."

The foreign books above referred to naturally contain descriptions of plants and processes in vogue in Europe, and very little can be learned concerning the art of electrolytic copper refining in the United States.

It is the object of this paper to give a few practical data in relation to American practice, and to give a short description of the process in vogue in this country. While the writer has erected some of the largest copper refineries in the United States, and examined a few of the other plants, it is for the very reason that Mr. Gore gives that the data which the writer submits in the following are not claimed to be either complete or to be absolutely correct. The writer has endeavored to tabulate the electrolytic copper refineries in the United States.

This, to his knowledge, is the first attempt ever made, and he hopes that, considering the circumstances, his endeavors in this direction will not be misconstrued, but be properly appreciated.

In the table which forms a portion of this article we give a list of electrolytic copper refineries in the United States. It shows us that there are at present 36 dynamos of a total capacity of 1,814 kilowatts used for the electrolytic refining of copper, and that the total output of these refineries (when all are completed) will amount to 3,650 tons per month, or 43,800 tons per year. A capital of over $1,000,000 is invested in these refineries.

The Census Report, dated Washington, D C., July 15, 1891, shows the United States to be the largest producer of copper in the world, its product for the year 1889 being 226,055,962 pounds, or 113,028 (short) tons. The total expenditures involved in this production were $12,062,180, of which there was paid in wages, $6,096,025; in salaries, $120,896; to contractors, $334,443; for materials and supplies, $4,067,970; and for taxes, rent, etc., $1,442,846, the total capital invested being $62,623,228, and the total number of employes, exclusive of office force, 8,721. The same Census Report gives some statistics on "copper refining," but unfortunately fails to state how much copper was refined by the electrolytic process.

It is interesting to note that only a part of the furnace material produced in the United States, a small quantity of ore, and nearly all of the mineral from the lake stamp mills are refined in works, the majority of which are controlled by firms and corporations not directly connected with the mines. In some works copper refining is incidental to the working of other base and precious metals, and in others it is a part of a general chemical business. One concern failed to report. The returns cover establishments which produced 159,693,252 pounds (79,847 tons) of refined copper, valued at $19,686,561.86. Hence if our list is approximately correct only about 25,000 tons out of 79,847 tons of refined copper were treated electrolytically.

We might construe the following paragraph in the Census Report as referring partly to electrolytic refineries:

> It is interesting to segregate one group of refiners, which treats exclusively high grade, pure material, like lake mineral, Arizona bars, and Montana blister copper. Works which produce 105,400,664 pounds of refined copper incurred the following total expenses:

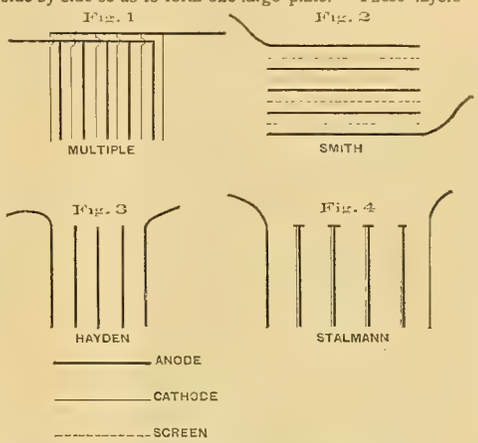
EXPENSES IN COPPER WORKS TREATING HIGH-GRADE MATERIAL.

Wages	$326,687
Salaries	42,056
Paid to contractors	4,735
Supplies and material	305,679
Rent, interest, etc.	40,462
Total	$719,019
or 0.65 cent per pound.	
Total refined copper, pounds	105,400,664

These figures will demonstrate conclusively that the subject is an important one. It is not intended to tire you with the details of the ordinary process of the electrolytic refining of copper, as this has been described in many books, and the theory and practice are well known. In the above table, however, I mention, in the fourth column the names of certain processes in vogue in the United States, and it might be well to show the main features of each. The crude material used in the anodes is black copper, or blister copper, containing from 97 per cent. to 98 per cent. of copper. The electrolyte is a solution of sulphate of copper.

In some processes refined copper is a by-product only, especially when it appears in a concentrated form in the mattes of lead smelters and refiners. In the process which we call the "multiple process," anodes and cathodes in each vat are arranged in multiple, in about the same manner as the plates in a storage cell, as shown in Fig. 1. In this process there is usually one more cathode than there are anodes. The electrodes are suspended in a vertical position in wooden vats, usually lined with lead. The vats themselves may be arranged either in series, in multiple, or in multiple series. For simplicity's sake and for numerous other reasons well known to the electrical engineer, an arrangement of vats in single series is most advantageous.

Another process is the "Smith process" (United States patent No. 393,526, Nov. 27, 1888.) In this process there are no cathodes of pure copper. The plates of black copper (anodes) are not suspended vertically in the solution but are placed horizontally. As it would not be practical in many places to cast the plates large enough to give a sufficient amount of surface, several plates are placed side by side so as to form one large plate. These layers



FIGS. 1 TO 4. PRACTICAL NOTES ON THE ELECTROLYTIC REFINING OF COPPER.

are then placed one above the other at a distance of about 1½ inches, the layers being supported by strips of wood running lengthwise of the vat. The top plate is connected as an anode to the generator, and the other pole of the dynamo with the bottom plate. The spaces between the plates are filled with the solution of sulphate of copper, which forms the only connection between the plates. The copper is dissolved from the under surface of each layer and deposited on the upper surface of the next layer below. The insoluble foreign matters in the copper, including gold and silver, fall upon screens of cotton cloth which are stretched between each two layers. The process is kept up until all the black copper is dissolved and nothing remains but plates of electrolytic copper.

Fig. 2 shows the relative position of plates in one vat. The inventor claims several important advantages over the common vertical multiple arrangement. He claims that the silver or other foreign insoluble matter is removed, that the space required for a given amount of depositing and the amount of solution required are relatively small, that the connection between the plates in each cell is made by the solution only, and that the copper is easily handled and prepared for the vats. The following is his patent claim:

"A vertical series of horizontal electro depositing cells formed by horizontal plates of the metal to be deposited, separated and supported by insulating supports, and immersed in an electrolytic solution, with screen interposed between the successive plates substantially as described, whereby insoluble matters are arrested as they are liberated from the lower surface of the upper plate in each cell by the combined action of the said solution and the electric current."

Smith arranges all vats in series.

Another process mentioned in the list is the "Hayden," Fig. 3 United States Patent No. 465,525, Dec. 22, 1891.) The Hayden process differs materially from that of the Smith, only in that he places his plates in vertical position instead of placing them horizontally, and that he does not use any screens. He uses removable grooved vertical wooden strips to hold the plates in proper position. He also states that it might be advantageous in many cases to cast the plates in small sizes and arrange them one above the other.

Mr. Hayden's patent claims are as follows:

"1. In an electrolytic bath having a number of plates unconnected electrolytically excepting through a solution in the bath, and having narrow partitions extending from opposite sides of the bath adapted to hold the plates in a vertical position and out of contact with each other, stops wholly between the partitions supporting the plates above the bottom of the bath, substantially as specified.

"2. In an electrolytic bath having a number of plates unconnected electrolitcally excepting through a solution in the bath, and having independent grooved side pieces in the bath, the side walls of the grooves forming narrow partitions engaging the lateral edges of the plates to be treated and holding said plates out of contact with each other, stops at the lower ends of said grooves, supporting the plates above the bottom of the bath, the said stops not projecting beyond the faces of the partitions, substantially as specified.

3. In an electrolytic bath having a number of metal plates unconnected electrolytically, excepting through a solution in the bath, a series of grooved strips removable from the tank, driven tightly on the side edges of the plates and constructed so as to be capable of sustaining the plates within the bath above its bottom, substantially as specified."

Hayden also arranges his vats in series.

Another inventor, Stalmann (United States Patent No. 467,350, Jan. 19, 1892, and No. 467,484, Jan. 19, 1892), practically uses the same process as Hayden, only instead of using single plates he uses, with the exception of the initial anode and the terminal cathode, pairs of plates of crude and refined material, but bringing the two plates together by connecting them by one or more bolts or rivets so that they become practically a pair of anode and cathode plates with no electrolytic solution between them (Fig. 4.)

The claim in the first patent is as follows:

"An electrode consisting of a plate of refined copper material and a plate of crude material with insulating material interposed between said plates and metallic connection between said plates."

The claims of the second patent are as follows:

"The method of separating from copper and like met-

LIST OF ELECTROLYTIC COPPER REFINERIES IN THE UNITED STATES.

Name of company.	Generators.	Number of vats.	Process (arrangement of vats.)	Output in electrolytic copper per month, tons.	Remarks.
1. Anaconda Mining company, Anaconda, Mont.	5 Edison—60 volts, 1,100 amperes.	320	Partly multiple, partly Stalmann.	350	Plant being extended for ultimate capacity of 900 tons per month.
2. American Nickel Works (Jos. Wharton), Camden, N. J.	1 Excelsior—6 volts, 1,000 amperes.	48 in series	Multiple.	30*	*By product.
3. Balbash Smelting and Refining company, Newark N. J.	7 Excelsior—15 volts, 2,000 amperes. 1 Excelsior—30 volts, 3,000 amperes.	7 series of 48, 1 series of 96	Multiple (18 anodes, 18 cathodes).	600	*They refine the product of the Oxford Copper company, whose smelters are in New Jersey, and who are general purchasers of copper ores, matte and bullion.
4. Baltimore Copper, Smelting and Rolling company Baltimore, Md.	6 Edison*—150 volts, 400 amperes.	.....	Hayden.	800	*Generators have sectional fields which can be plugged for different voltages.
5. Baltimore Refining company, Baltimore, Md.	2 Edison—80 volts, 700 amperes.	.....	Hayden.	300	
6. Boston & Montana Consolidated Copper & Silver Mining company, Great Falls, Mont.	3 Thomson-Houston, multipolar, separately excited 165 volts, 1,000 amperes.	288	Multiple (19 anodes, 19 cathodes).	550	Plant in construction. Dynamo capacity in excess of present requirements.
7. Bridgeport Copper company, Bridgeport, Conn.	1 Thomson Houston, 1 Mather, 1 Edison -150 volts, 400 amperes.	3 series of 10	Hayden (100 electrodes in each vat).	400*	*They refine the entire product (black copper) of the Parrott Silver & Copper company, Butte, Mont.
8. Chicago Copper Refining company, Blue Island, Ill.	2 Edison -80 volts, 800 amperes.	165	Multiple.	150	
9. Electrolytic Copper company, Ansonia, Conn.	3 Mather—100 volts, 300 amperes.	75	Smith.	100	
10. Lewishon Bros.,† Pawtucket, R. I.	1 Excelsior—15 volts, 2,200 amperes.	60 in series	Multiple (19 anodes, 10 cathodes).	110	
11. Omaha & Grant Smelting Works, Omaha, Neb.	1 Excelsior—6 volts, 1,000 amperes.	48 in series	Multiple.	30	
12. Pennsylvania Salt Manufacturing company, Philadelphia, Pa.	.....	.....	Smith.	3 *	*By product.
13. St. Louis Smelting and Refining company, Cheltenham, St. Louis, Mo.	1 Excelsior—16 volts, 2,100 amperes.	48 in series	Multiple.	60*	*This plant is operated in connection with an electrolytic silver refinery, using the Moebius process.
14. Washburn, Moen & Co., Worcester, Mass.	.....	.....	.....	90	Plant burnt; being erected.

†Agents for the following mining companies: Boston & Montana Consolidated Copper & Silver Mining company, Montana; Butte & Boston Mining company, Montana; Arizona Copper company, Arizona; Huron Copper Mining company, Lake Superior, Mich.; Tamarack Mining company, Lake Superior, Mich.; Osceola Mining company, Lake Superior, Mich.; Kearsarge Mining company, Lake Superior, Mich.; Santa Fe Copper company, New Mexico; Peninsula Copper Mining company, Lake Superior, Mich.

1. Read at the general meeting of the American Institute of Electrical Engineers, Chicago, June 6, 7 and 8, 1892.

als foreign matter which may be incorporated with them, which consists of arranging in an electrolytic bath an initial anode connected to the positive pole of the source of current supply and a terminal cathode connected to the negative pole, securing together by conductors intermediate anodes and cathodes in independent pairs, each pair consisting of an anode of crude material and a cathode of refined material, interposing said independent pairs between the initial anode and terminal cathode of the bath, and passing an electrolyzing current from the initial anode to the terminal cathode through the bath and paired plates, substantially as described.

"2. An electrolytic bath comprising a containing vessel an electrolytic, an initial anode, a terminal cathode, and intermediate pairs consisting each of an anode of crude material and an independent cathode of refined material removably connected thereto and in metallic conductive connection therewith, the several pairs being independent of each other, substantially as described.

"3. An electrolytic bath, comprising a containing vessel, an electrolyte, an initial anode, a terminal cathode, and intermediate pairs consisting each of an anode of crude material and an independent cathode of refined material, removably connected thereto and in metallic conductive connection therewith, the several pairs being separated on their sides and bottoms from the containing vessel, substantially as described.

"4. An electrode, consisting of a plate of refined material and an independent plate of crude material removably connected thereto and in metallic conductive connection therewith, substantially as described."

Stalmann's patent drawings show the vats arranged in either series or multiple. The inventors of the series processes, like the Smith, Hayden, Stalmann and others, claim for their processes very much cheaper first cost of plant, very much less copper carried as idle capital in the vats, and much less floor space and higher efficiency in operation, that is, a larger recovery per horse power hour. Whether or not these claims can be demonstrated in practice is yet an open question. One pound of copper will be deposited in one hour, theoretically, by a little less than 386 amperes out of a solution of sulphate of copper. If we, therefore, pass 386 amperes through one vat, we will deposit one pound every hour, and if we pass the same current through a series of 100 vats, we will deposit 100 pounds each hour. The amount of power expended in each vat, however, is $C^2 \times R$, but as it is always possible to reduce the resistance of a vat by increasing the surface of the plates, we can greatly reduce the amount of power required for the same output in copper per horse power hour. We may also reduce the amperage for a given production by joining more vats in series, or we may combine both methods.

It is therefore always possible to largely reduce the expenditure of electrical energy, and consequently that of the motive power. As a matter of fact, theoretically any amount of copper may be refined with any given horse power, but as soon as we attempt to largely increase the production of copper with a given power, we find it necessary to largely increase the size and number of vats and the quantity of copper under treatment. These conditions have been thoroughly examined, and the laws governing them have been explained in the several hand books extant.

As a resume it may be stated that if power is cheap we may make the internal resistance of the vats greater, employ small vats and less copper under treatment, requiring less floor space, thus decreasing the first cost of the establishment materially. If, on the other hand, power is expensive, we must make the internal resistance of the vats as small as possible, have a large amount of copper under treatment, requiring a larger floor space and materially increase the first cost of the plant. It can easily be seen that in each special case these conditions must be carefully determined in accordance with principles very similar to those laid down in Sir William Thomson's law.

From these statements, however, we may infer that the claims of the promoters of the so-called series processes are not well founded, because, no matter how the plates in the vats may be arranged, we can always arrange the plant for conditions of minimum first cost or minimum operating expenses. It is true that both Smith and Hayden do away with cathodes of refined copper, and thus save quite an item for copper under treatment. On the other hand, there is the disadvantage that particles of the original anodes will stick to the final cathodes of refined copper, and that it will be found difficult to separate them.

As a matter of fact, it is claimed by some assayers and selling agents that electrolytic copper obtained by these two processes is not so pure as copper obtained by a process employing anodes and cathodes arranged in multiple. Mr. Stalmann in his arrangement obviates the latter disadvantage by attaching removable plates of refined material to his anodes.

Another important item in order to obtain a pure deposit is the density of the current. American copper refiners usually adopt 10 amperes per square foot of active cathode surface as a maximum. I am told, however, that some of the refineries operating on the "series" processes go even beyond 15 amperes per square foot, which may account for certain impurities found in the electrolytic copper and for a greater efficiency of the plant; that is, a larger output of copper for a given number of vats and amount of copper under treatment.

High voltage in an electrolytic plant of course means considerable saving or less drop in conductors, less trouble from poor contacts, etc., and it is probable that for these reasons the so-called series processes show a greater efficiency per given horse power than the processes employing electrodes in multiple. For refineries using this latter process low tension machines and comparatively few vats in series are employed. By adopting as high voltages in the multiple process as in the series process, of course, the same advantages may be obtained.

One advantage of the series process is the fact that each electrode will get its proper amperage per square foot, as all the plates are in series, and are of uniform size. In the parallel process some trouble is always experienced in properly subdividing the current in each vat so that each plate will get its share, or, in other words, that the current density will be the same for each square foot of active cathode surface. By proper precaution, however, trouble in this direction may be easily avoided.

Another important item for the obtaining of pure deposits is a good circulation of the electrolyte. This insures a uniform specific resistance in the solution between the parts of the plates. Inasmuch as a solution of sulphate of copper is of greater specific gravity than the acid, which is liberated by the decomposition of the copper upon the surface of the cathode, such acid rises to the surface of the liquid while the solution of sulphate of copper settles toward the bottom. Where plates are arranged vertically, therefore, there is an ascending current before the surface of the cathode and a descending current before the surface of the anode. If there is not sufficient circulation of the electrolyte, the free acid attacks the upper portions of the plates more rapidly than the lower portion, and the deposition goes on most rapidly on the lower portion of the cathode.

In American practice the electrolyte is sometimes kept in circulation by arranging the tanks on the cascade plan, and have each higher vat siphon through a pipe whose orifice is near the bottom of the next lower vat. A better plan now usually adopted is to have a trough run through the whole refinery, and have each vat fed independently by means of a rubber hose. The electrolyte is raised from the connecting tank into the troughs by means of lead pumps or steam injectors. Both, however, are objectionable. The pumps are always getting out of order, and the steam injector means waste of steam, beside having the disadvantage of putting too much moisture into the electrolyte, which again necessitates the adding of free acid continually. A better plan is to have two collecting tanks, which are to be used alternately. Just as soon as one is full it is made air-tight, and a small air compressor driven by an electric motor compresses the air above the solution and drives the solution under a pressure of, say, 25 pounds through a pipe up into the troughs. Smith claims that in his arrangement no artificial circulation of the electrolyte is required. He claims that the free acid liberated over the whole horizontal surface of the cathode in each cell rises directly through the solution and the screen to the surface of the anode above and acts uniformly over its whole surface. As the the deposition also takes place uniformly over the whole surface of the cathode, uniform electrical and chemical conditions are secured over the whole surface of each plate and uniform liquid resistance between the parts of the plates, and the action of the cells is entirely automatic. Smith also claims that less heat is wasted by this arrangement than in installations which require the circulation of the liquid.

We might mention another incidental advantage of the multiple process over the series processes. Some of the patentees claim one-fourth of a cent per pound of refined copper as a royalty In one instance one plant gives the patentee, under this arrangement, an income of over $100 per day. Taking this in combination with the very doubtful advantages claimed for the series process, we need not wonder, that there exists prejudice against erecting electrolytic refineries employing these patented operations.

As to the value of the patents, from a legal point of view, I do not care to express an opinion. Some legal authorities state that anybody may arrange the electrodes in series within a vat without infringing if he omits some of the minor details of the combination patents whose claim have already been quoted.

The power installations of some of the electrolytic refineries which the author had an opportunity to visit reminded him very much of an electric light station put up about ten years ago. The old motto, "Cleanliness is next to godliness," he found inoperative, and the plants usually excelled by a total absence of voltmeters or ammeters or other electrical testing instruments showing the conditions under which the plant was operating. Such statements, therefore, as "working current of a thousand amperes," or "density of current of 10 amperes per square foot," which we get from electrolytic refiners, must be taken with several grains of allowance.

I could enumerate a long list of defects that exist to-day in almost all of the electrolytic refineries, and which may all be traced to one cause, and that is the refiners imperfect knowledge of electricity. Large amounts of money may be saved in the erection and operation of such plants by considering all the conditions carefully before making the final plans. One case came to my knowledge where the lead lining was put in the tanks, and plumbers were commissioned to wipe the seams in the ordinary way instead of having the edges of the lead melted together by means of the hydrogen blow-pipe. The latter plan should always be followed, as wiped joints will be destroyed by the electrolytic action of the solution in a very short time.

This is not by any means a small matter, as repairing of the lead lining involves large expense and great loss of time. In one installation the conductors leading from the dynamos to the tanks are underground, but run in such a careless manner that they are permanently grounded, often get short circuited, and in a few instances the wood conduit was set on fire. As a matter of fact all the experiences which we have gone through for the last ten years in constructing electric light and power plants, have been of no benefit it seems, to most electrolytic refiners. Even in the few installations where a voltmeter is used to indicate the proper working condition of the vats, this voltmeter is carried by two men from vat to vat, and the voltage of each vat is taken in this cumbersome manner.

In a plant just being erected, the writer proposes the erection of a potential board in the office of the superintendent. Both terminals of each vat are to be connected with two contact points of the potential board, and a voltmeter is to be arranged that by simply turning a switch handle the potential of each vat can be taken almost instantaneously. As a matter of fact, the working condition of each vat may be thus ascertained in a few minutes while it would take hours for two men to do the same by carrying the voltmeter from vat to vat. One of the occurrences which has to be guarded against is the short circuiting of an anode and a cathode, which in the multiple plan means the short circuiting of a whole vat. Such an occurrence should be detected immediately as otherwise the contents of the vat may be spoiled. The author proposed for a plant just being erected an electric tell-tale in connection with the potential board. This tell-tale might be constructed somewhat after the fashion of a hotel annunciator.

Each magnet might be permanently in circuit with its corresponding vat and the tension of the armature spring so adjusted that at the proper potential the armature would be held up, but just as soon as the vat is short circuited no current or but very little current will flow through the magnet and the armature will drop, ringing an alarm bell and indicating the number of the vat in which the trouble occurred.

All such appliances are labor-saving devices, and their installation would pay well in a plant where many thousand dollars worth of copper and solution is under treatment and liable to be spoiled. In a number of refineries there are T-rails suspended over the vats in such a manner that a pulley carrying a block and tackle can be used for lifting the plates out of the vats and moving them in the gangways for either washing off the slime or for substituting new anodes for the old ones. Some of the electrolytic refineries in the United States buy copper matte of from 45 to 54 per cent. of copper from the mining companies. In these cases they own their own smelters, resmelt the copper matte, producing black copper of from 97 to 98 per cent. of copper. This black copper is then cast into anodes and subjected to the electrolytic process. Other refineries buy the black copper direct from the smelters owned by the mining companies. For instance, the Bridgeport Copper company, of Bridgeport, Conn., buys the entire product of the Parrott Silver and Copper company, of Butte, Mont., as black copper.

There is another matter which should be mentioned, as it is very often misunderstood by the public and the electric companies. If copper matte contains, according to the assay, 30 ounces of silver or less per ton of matte, no extra charge is made for the silver, but the copper matte is sold at the reigning market price. If it contains, however, over 30 ounces, the silver is to be paid in accordance with the assay. Thirty ounces of silver per ton of matte, of course, means almost double that amount per ton of electrolytic copper. It can easily be seen that electrolytic refineries prefer to buy copper matte containing just a trifle less than 30 ounces of silver per ton.

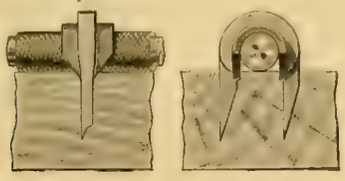
There are quite a number of points which need the attention of electrolytic copper refiners. There are, for instance, only a few of the refineries which manufacture their own sulphate of copper, but buy it at high rates in the market. Sometimes the cost of freight and haulage doubles its cost. Each copper refinery should have a little installation of its own for the manufacturing of the necessary sulphate of copper, which it can do at a small fraction of what it has to pay for it. The same holds good in relation to the refining of the slime or mud which collects at the bottom of the vats, and which contains the precious metals. Each copper refinery should have its own little plant for the refining of the mud. These little installations can be run at a small expense in connection with copper refineries, and it is almost nonsensical to have other concerns make large sums of money which could be saved by the refiner himself.

A few words as to electric generators may not be out of place. The author prefers separately excited machines for the reason that they cannot be reversed and other incidental advantages. When water power is used as prime mover a good deal of trouble has been experienced in the regulation of the wheels. As a matter of fact there is no water governor in existence which will regulate so perfectly as the governor of a modern automatic engine under varying loads. By running all the exciters from an independent prime mover (either water or steam) the strength of the fields of the generators will be uniform at all times whether there are fluctuations in the external circuit or not; the strength of the field of the generators which with self exciting machines, is subject to the fluctuations in the external circuit, and is a variable, becomes a constant. The author proposed this arrangement over three years ago for railway and power stations with the very best results.

Before closing we might mention some processes which have not been introduced in the United States yet but about which a good deal has been said during the last few years. There are in Europe processes by which electrolytic copper is produced direct from the "matte" containing from 35 to 55 per cent. of copper. From the reports that have appeared, from time to time, it seems that these processes have not been a great success. There are other processes which contemplate the extraction of copper direct from the ores by means of electrolysis. The best known are the "Siemens" and "Hœpfner." If we are correctly informed the Siemens process is now being used in one experimental plant only, which is owned by the Siemens firm. This is at Martinicken Fields near Berlin. Another one which they have in the Caucasus at their own copper works is said to have been abandoned because it did not give satisfaction. Dr. Hœpfner's process, it is claimed, is now in operation in three plants; one at Schwarzenberg, which began operations in September, 1890, and two others about which very little has been published. Mr. Hœpfner uses in his process a

cuprous chloride solution, out of which a current of one ampere will deposit 2.35 grammes per hour, while out of a solution of sulphate of copper, only one-half of this amount of copper can be deposited per unit of current per hour.

As it was the object of the writer to give practical points on the refining of copper, and as he does not know anything about these two processes from personal observation or from practical experience, he does not wish to comment any further, but prefers to wait until he can see one of these plants in operation in the United States. While



INSULATING SADDLE STAPLE.

these processes do away with the smelting and resmelting of the ores, and while they would make unnecessary the large, expensive plants now used for this process, they seem to be very complicated; their commercial value certainly should be investigated much more closely by American mining companies before they should be willing to invest large amounts of money.

We finally give below the approximate cost of a refinery with a capacity of 1,000,000 pounds of electrolytic copper per month.

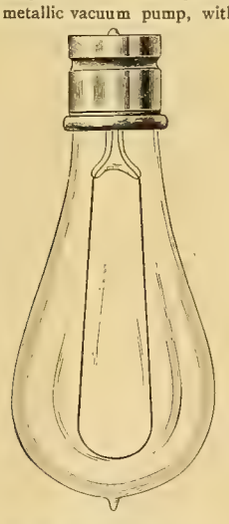
Building	$30,000
Pavement (asphalt)	2,000
Pipes for steam heating	4,000
Vats	6,000
Lead for lining vats, collecting tanks and troughs	28,000
Lead burning	1,500
Copper conductors	11,000
Rails for overhead blocks for handling plates	2,000
Sulphate of copper	3,500
Sulphuric acid	1,000
Steam injectors or pumps or air compressors	1,000
Electric generators, switch-board, instruments	30,000
Shafting and belting	3,000
Total	$123,000

To this sum must be added the copper under treatment, which in this case will amount to at least $80,000, and if a steam plant should be required, another $20,000 must be added, bringing the total of this plant up to $223,000. The above items include labor of erection, but do not include freights. These figures, although approximate and true only under certain conditions, will demostrate that electrolytic copper refineries are expensive plants, and should be erected on carefully prepared plans and under the supervision of responsible and competent engineers.

The Beacon Incandescent Lamp.

The Beacon Vacuum Pump Electrical company, Boston, Mass., has enlarged its manufacturing facilities. The company state that the growth of its business is attributable to the great advance which it has made in methods of manufacture.

The improvements consist largely in a new process of exhausting the lamps. This is accomplished by means of the company's metallic vacuum pump, without the aid of



BEACON INCANDESCENT LAMP.

mercury. By the use of this apparatus it is enabled to produce a lamp free from mercurial vapor, thus escaping the injurious effect that such vapor is believed to exert on the filament and the lamp in general. In addition, it is able to produce a uniformly high vacuum in the lamps, for the reason that a large number can be exhausted simultaneously.

An examination of the accompanying cut will make apparent the features peculiar to this lamp. It is made in such a manner, it is claimed, as to completely do away with any undue thickening of the glass and consequent danger of cracking from expansion and contraction upon heating and cooling. The mount is so constructed as to enable the filaments, irrespective of length, to be placed within certain limits in any size bulb, thus entirely avoiding the partial concealment of the filament by the cap or base in the finished lamp. This construction is especially advantageous in the company's anchored filament railway lamp. In anchoring the filament in this lamp it is allowed to vibrate from 1-32d to 1 16th of an inch, thus avoiding a dead contact at the point of support.

Railway Controlling Table.

In the operation of electric railroads not the least point for consideration is the control of the electric power generators. Until recently large switch-boards were employed, necessitating extreme agility on the part of the attendant to bring the output of the generators to the desired point. In the accompanying cut is shown a railway controlling table. On this table are mounted all the regulating and indicating apparatus in the most compact and convenient space possible. In front are the dynamo field regulators operated by wheel handles, and numbered to correspond with the machines they control. On the table are mounted the cross bar snap switches, the dynamo fuse blocks and the equalizing bar switches, a voltmeter and a voltmeter switch.

On the upright back piece are the ampere meters and the galvanometer. The ampere meters are of the standard

RAILWAY CONTROLLING TABLE.

Edison type, the solenoid, of bar copper highly polished, being mounted directly on to the marble. The covers are of polished brass with moulded edges, in which are set the beveled glass fronts.

The galvanometer shows when the voltage of the current of one of the generators about to be switched into circuit is the same as that from the other machinery already supplying the circuit. It consists of two coils, arranged one on either side of a pivoted indicating needle of soft iron. This needle is polarized, it being pivoted within a piece of steel previously magnetized. If the voltage of the current from the generator ready to switch into the circuit is too high or too low, the deflection of the needle indicates the fact, so that the field regulator can be adjusted until the voltage is correct, when the needle presents no deflection. This instrument is mounted directly on the marble, its cover being similar in style to those of the ampere meters just mentioned.

With this controlling table in the station, the attendant has no difficulty in quickly regulating the output of current to meet the varying conditions under which the road may be working. With one hand on the snap switch handle and the other on the wheel of the field regulator an almost simultaneous movement is possible, permitting instantaneous control. The table shown was designed for four generators, and was invented and constructed by the Edison General Electric company.

The Detroit Electric Light & Power company has purchased the property at the corner of Woodbridge and Randolph streets, Detroit, on which its lighting plant is located, from Vail & Crane, for $30,000. The property is 111 feet on Woodbridge street, and 70 on Randolph street.

The Insulating Saddle Staple.

This useful little tape is being introduced by the Vulcanized Fiber company of New York. A glance at the accompanying cut shows the appearance. The little device may be used to attach electric light conductors and telephone and district messenger wires in metal ways, on timbers, back-boards and switch-boards, telegraph wires in towers and offices, burglar alarm annunciator and other low pressure wires within the walls of buildings, and especially in basements and other places liable to moisture.

A reference to the national code of rules for wiring buildings for electric light and power, adopted August, 1891, shows that the Vulcanized Fibre company has an appreciation of what is required in the way of a staple. It should be mentioned that in using this staple no driving tool is required.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 11.—The New Yorkers may fight the trolley system as hard as they please; they may talk about its being dangerous, an eye sore, etc., but do what they will they will find it a hard task to keep the much needed system off some of the surface lines at least. As was stated last week the Short company is considering the problem of applying electric power to the "L" roads, and it is a bold man who would be willing to place himself on record in a statement that steam locomotives will not eventually be usurped on these lines by some electric system. So far as the surface roads are concerned if current reports be true, one would be inclined to believe that John D. Crimmins will be the man to push in the wedge, so to speak, a little farther. Mr. Crimmins favors the trolley as a substitute for horse power on the Sixth and Ninth avenue lines and furthermore he thinks that the question should be thoroughly discussed by the people. His own investigations had satisfied him that for purposes of transportation cars could be moved more rapidly and with more comfort to riders and with less noise by the trolley system than by any other means known. "Properly constructed," said Mr. Crimmins, "there can be no danger to the general public from the system. As a large property owner myself, and familiar, as I am, with the views of the property owners' associations having been an active member of several of them for many years, I feel that New York will gain more from the improvement of its surface roads, so as to provide easy and quick transit, than in almost any other way, and that there are many places where the electric system on the present cars would double the value of the property reached by it in a very few years; not the general residence property, but the business property, would receive incalculable benefit."

"It is proposed to try the trolley system on the Sixth and Ninth avenue lines," said Mr. Crimmins, "provided the necessary legal authority can be obtained and the required proportion of consents of property owners. If a satisfactory arrangement can be made with the Manhattan

Railway company, the trolley wires will be attached to the elevated structure, and the surface cars will run along under the elevated road from the Battery to One Hundred and Sixth or One Hundred and Tenth streets. As trolley cars would require a much heavier rail than the ordinary horse cars, it would be neces sary to relay all of the tracks. Petitions for laying tracks in Third street and in Fifty-third street are now in circulation." Mr. Crimmins said that there was no understanding as yet between the Manhattan Railway company and the roads represented by him.

The privilege of operating an electric surface railroad through Union street, Brooklyn, from Hamilton Ferry to Prospect Park, is to be auctioned off. A syndicate, headed by John Delmar, Louis C. Behman, and other politicians, has already applied for a franchise, and it is expected that a petition from Gen. Stewart L. Woodford and Cornelius E. Donnellon, representing several wealthy property owners, will be presented to the Aldermen. Gen. Woodford and his backers claim that the charter of the opposition company has expired, and they are going to appeal to the courts, if necessary, to prevent a franchise from being given to the Delmar political syndicate. The significant point about this fight will be the light it will throw upon the value attaching to the franchise for a street railroad in Brooklyn. W. F. O.

Indianapolis, Ind.

INDIANAPOLIS, June 11.—The Indianapolis Brush Electric Light & Power company and the Marmon & Perry company have consolidated, with the following incorporators: Daniel W. Marmon, John Cavan, Henry Schnull, Frank A. Maus, Clarence Wulsin, Charles C. Perry, William R. Evans and B. E. Sunny, the last named of Chicago. The other gentlemen are Indianapolis business men. The only connection between the new company and the Brush company is an agreement by which the former is to use Brush machinery exclusively. The new company completed its organization by the election of Daniel W. Marmon, president, John Cavan, vice-president, and Charles C. Perry, secretary and treasurer. The capital of the new concern is $600,000. The city lighting contract, which was secured by the Brush company, has been transferred to the new company, which has made application to and filed necessary bonds with the Board of Public Works.

Secretary Perry says: "The company will put in its new plant on Kentucky avenue, on the point of ground between the Vandalia and I. & V. railroads. All the electric lighting in the city and for West Indianapolis will be done from that plant. It will be one of the largest single electric lighting station in the world. When the plant is completed the incandescent plant on the Circle will be abandoned. The new plant will cost over $300,000. The first work will be on the contract for the lighting of the city, and we expect to have the lights ready to turn on at the time specified. The commercial lighting will then be transferred to the new plant as soon as possible. By the consolidation but one set of conduits will be used."

President Conduitt, of the Board of Public Works, says that the contract was signed about eight weeks ago, and the stipulated price per light is $85, the Board of Public Works having the privilege of ordering any number of extra lights at the same figure. The contract price is under the moonlight schedule. Until January 1, 1896, the contract requires 2½ per cent of the gross receipts of the company to be paid into the city treasury, and after that time 5 per cent. This, the board once computed, would bring the actual cost of the lights to an average of a little over $75 per year.

Milwaukee, Wis.

MILWAUKEE, June 11.—The Milwaukee Street Railway company has decided to adopt the Pullman closed car. About 200 cars will be used on the Villard system. The contest for the contract was very lively. All of the street car companies in the city tried to secure the order, and the sample cars which have been received are many and elegant.

The litigation in which Francis E. Hinckley and John A. Hinsey of Chicago, and Charles F. Pfister and other Milwaukee people are involved as a result of their investments in the Milwaukee Electric Railway, is becoming more and more complicated. Last Saturday, while on his way home from the Southwest, Mr. Pfister was served with papers in a suit commenced by Hinckley to recover damages in the sum of $1,000,000. The defendants, besides Mr. Pfister, are August Vogel, John A. Hinsey, John S. Schantz, Richard Burke, H. H. Field and Oscar D. Alppli. Hinckley claims that the defendants engaged in a conspiracy to defraud him. He claims that he furnished the money with which the road in question was constructed, and that the purpose of the defendants is to freeze him out. He seems to think that so far they have been partially successful, and hence has instituted the latest suit in the Chicago courts in the hope of securing an advantage. Three or four suits over the same property are now pending.

The Neenah & Menasha Street Railway company has filed articles of incorporation. The scheme is to build an electric line from Neenah to Appleton by way of Menasha. The capital is $150,000. The incorporators are Col. Garland of Minneapolis; W. W. Reed, Curtis Reed, and Silas Bullard of Menasha. The towns named are close together, and it is thought that such a line would be very well patronized.

Nicholas Solcheabach, whose daughter was killed by an electric car Oct. 25, 1890, at the corner of Galena and Eighteenth streets, has instituted legal proceedings against the Milwaukee Electric Railway company. He demands damages in the sum of $5,000.

The basis of a suit for $5,000 damages, which Clemens Borisch has begun against the Milwaukee Street Railway company is a broken finger and a $10 doctor's bill. He was on the rear platform of a Chestnut street car, he alleges, and wanted to get off at Twenty-fifth street. When that street was reached the car did not stop, but the conductor, after telling him to get off, pushed him from the platform, the result being a fracture of his finger.

The Becker company and its employes have made an agreement by which the latter are to receive ten cents more per day. No change has been made in the working time, which remains at about eleven hours, it being found very inconvenient to make any such change. The wages have been fixed at $1.95 a day. On the other roads the working time is about half an hour shorter, and the men receive 17 cents an hour.

The new electric railway at Janesville, Wis., has been opened.

In the case against the Milwaukee Street Railway company of Mary Hardy, who sued for $10,000 damages for personal injuries and received a verdict for $5 000, Judge Austin has granted the defendant a new trial. Miss Hardy, it will be remembered, was thrown from a Farwell avenue car. The counsel for the plaintiff did not oppose the motion for a new trial, being hopeful that when the case went to a jury again a still larger verdict would be returned.

At the last meeting of the common council a resolution was introduced to instruct the Milwaukee Street Railway company to run night cars on Third and Walnut streets. Permission was given to extend the Island avenue line to Burleigh street, and the company requested authority to tear up tracks on Broadway and on Second, Michigan and Clybourn streets.

The North avenue electric line, which runs across the city from east to west, will be operated as part of the Milwaukee & Whitefish Bay Dummy line. The street cars and dummy trains will make close connections at North and Farwell avenues. The new road is expected to greatly increase the dummy line's business. Trains and cars will be run every thirty minutes on week day's and every fifteen minutes on Sundays. C.

PERSONAL.

August P. Munning of New York, spent a few days in Chicago last week.

Thos. C. Wood, president of the Ball & Wood company, New York, was in Chicago last week.

F. H. Leonard, of the Electric Engineering and Supply company of Syracuse, N. Y., was in Chicago last week.

William H. McKinlock, president of the Central Electric company, Chicago, has just returned from New York.

R. Eickemeyer, Jr., and S. D. Field, of the Eickemeyer-Field company, Yonkers, N. Y, were in Chicago last week.

William McVay of New York, lectured at the Third Unitarian church, Chicago, on June 9th, on "What Electricity Is."

B. P. Van Court has resigned the management of the Detroit Motor company, and A. A. Robinson has been elected to the position.

Dr. John McKinlock of the Central Electric company, Chicago, has recently been confined to his house by sickness, but is again at his desk.

C. A. Lathrop, western manager for the Huyett & Smith Manufacturing company, Detroit, returned a few days since from a successful business trip to Memphis and other southern points

C. A. Daigh of the National Electric Manufacturing company, Eau Claire, Wis., was in Chicago on Monday, and started the same night on one of his "radius" trips, taking in Kansas City, St. Louis, Cincinnati, New York and Boston. Mr. Daigh expects to complete the "circuit" in seven days.

The friends of Charles E. Lee, western manager of the Electric Gas Lighting company, are extending their sincere sympathy on the occasion of the death of his wife, which occurred recently. Mrs. Lee was a most estimable lady, and her demise is greatly regretted. The interment took place in Lockport, N. Y.

Henry W. Goode has been chosen second vice-president of the Northwest Thomson-Houston Electric company of St. Paul, Minn. Mr. Goode has been connected with the Thomson-Houston company for several years, and has been engaged in exploiting that company's apparatus on the Pacific coast. The success of the Thomson-Houston company in that territory, due largely to Mr. Goode's efforts, is the best possible evidence of his ability.

NEW INCORPORATIONS.

Electric Power company of Staten Island, New Brighton, N. Y.; capital stock, $250,000; to produce electricity for light, heat and power.

Electric Construction company of St. Joseph, Mo.; capital stock, $5,000; to deal in electrical machinery, etc.; Stauben & Crandall, St. Joseph, Mo.

Hamilton Electric Light & Power company, Hamilton, Wash.; capital stock, $30,000; to maintain, control and operate electric light system; J. L. Warner, Hamilton, Wash.

Platte Valley Electric Railway company, Denver, Colo; capital stock, $500,000; to construct and operate an electric railroad from Denver to Brighton, both in Arapahoe county, Colo.

American Electric Heating company, Portland, Me.; capital stock, $1,000,000; to manufacture and deal in all kinds of electrical heating apparatus; Drummond & Drummond, Portland, Me.

People's Electric Light & Power company, Benton Harbor, Mich.; capital stock, $100,000; to purchase and sell electricity for light and power; Jas. L. Clark, Tacoma building, Chicago, Ill.

New England Electric Heating company, Portland, Me.; capital stock, $250,000; to manufacture and deal in electrical heating apparatus of all kinds; Drummond & Drummond, Portland, Me.

Hopedale Electric company (incorporated in W. Va.), Boston, Mass.; capital stock, $5,000,000; manufacturing and selling electrical batteries, dynamos, motors, etc.; W. S. Hall, 53 State street, Boston, Mass.

Kester Arc Lamp & Manufacturing company, Chicago, Ill.; capital stock, $50,000; to manufacture arc lamps, electrical appliances and specialties; Gibbons, Kavanagh & O'Donnell, Reaper Block, Chicago, Ill.

Denison Normal School association, Denison, Ia.; capital stock, $60,000; buying, platting and selling real estate near Denison, Ia.; constructing and operating an electric light plant; Shaw & Kuehnle, Denison, Ia.

Northwestern Electric Fixture Manufacturing company, Chicago, Ill.; capital stock, $2,000; to manufacture and sell electric, gas and combination fixtures and parts thereof; Julius Rosenthal, 164 Dearborn street, Chicago, Ill.

Manhattan Electrical Supply company, Jersey City, N. J.; capital stock, $20,000; to manufacture and sell electrical and acoustic apparatus, appliances, machinery and supplies; Miller & Savage, 47 Broadway, New York, N. Y.

Cuyahoga Falls & Akron Railway & Power company, Cuyahoga Falls, O.; capital stock, $100,000; constructing, operating and maintaining a street railroad to be operated by electric or other motive power, furnishing gas, water, electric power, etc.; G. F. Parmelee, Cuyahoga Falls, O.

Kansas City Gas & Electric company, Kansas City, Mo.; capital stock, $10,000; acquiring, owning, constructing, maintaining and operating gas and electric works and supplying gas and electricity for heating and power purposes; Gage, Ladd & Small, New York Life building, Kansas City, Mo.

ELECTRIC LIGHTING.

Silver Creek, N. Y., will be lighted by electricity, the vote on the proposition having been 178 to 70. A plant valued at $20,000 will be installed.

The Edison people are said to be endeavoring to secure a franchise to erect poles and wires for a new electric lighting company in Peoria, Ill.

The position of superintendent of the Albany Electrical Illuminating company, says the *Albany Journal*, has been tendered to Nicholas Hussey, and he has declined it. E. A. Maher, Jr., is a candidate. His father, ex-Mayor Maher, received $5,000 salary, but the company has decided to give his successor only $1,800.

Elaborate preparations are making for electrical decorations at Denver during the coming conclave of Knights Templar in that city. The *Sun* of that city says: "The Denver Consolidated Electric Light company has placed an order for 22,000 incandescent lamps with the Diamond Incandescent Lamp company of this city. These lamps are to be in colors, and are designed for the illumination during the Knights Templar conclave. Already the mechanical preparations are in progress by the Denver Consolidated Electric Light company. A number of magnificent pieces are to be erected, prominent among which will be a grand triumphal arch, exceeding anything of the kind ever presented on a similar occasion. Every down-town street will be a blaze of light. All the work of this illumi-

nation will be completed and tested a week before the meeting of the conclave, so that the weak points may be strengthened."

In describing the recent lighting arrangements for Minneapolis, the *Tribune* of that city thus describes a council committee meeting: "The committee on gas submitted specifications for bids for electric street lights for the whole city, to be of 2,000 candle power, and to burn all night and every night. The contract is to run for five years, and all lamps to be suspended from mast arms. The city clerk is to advertise for bids to be received before the first meeting in June, the contractor to give a $100,000 bond to indemnify the city for all accidents and damages that may result. The number of lamps shall be 600, 800 or 1,000, as the council may determine. A $10,000 certified check is to accompany the bids as a guarantee that the contract will be accepted if awarded. The specifications allowed a fluctuation of from forty-seven to fifty 'volts,' and the council got mixed up on the matter of 'volts' or 'votes,' as some of them called it. Some of them wanted the '47' stricken out. They seemed to be in favor of all the 'votes' that can be had. The report of the committee was adopted by a vote of 17 ayes to 9 nays."

ELECTRIC RAILWAYS.

The Richmond, Va., Railway & Electric company is building a new plant on Johnson's Island.

The Rome, Ga., Street Railroad company has been granted permission to lay tracks and operate an electric railroad in North Rome.

City Engineer Brown of New Orleans has prepared specifications for the proposed electric railroad from the upper to the lower city limits. The franchise for this line is to be sold to the highest bidder.

The street car system of Youngstown, O., was tied up on May 23d by a strike of all the conductors and motormen, who two weeks before had demanded an increase in pay of twenty-four cents a day. This was refused, and the men held a meeting and decided to strike. The strikers belong to the National Federation of Labor.

The proposed route of the Pawtuxet Valley electric railroad in Rhode Island is from the village of Hope, following the highway through Jackson, Fiskeville, Arkwright, Harris and Phenix to River Point. From Clydebridge to Arctic Center two routes are suggested, one by way of Allen street and the other through Main street, thence up High street to Front street to its junction with Main street, Arctic. At the square at Arctic Center the routes will be through Main street to Centerville and Crompton, and via Quidnick street through Quidnick and Anthony to Washington. It has not been decided yet which of the routes through River Point will be selected.

TELEPHONE.

It is said that it will cost the Omaha Telephone company $300,000 to put its wires underground.

The city electrician of Dubuque, Ia., had the assistant foreman and four men who were working for the telephone company, arrested recently for erecting poles on Johnson avenue when he had ordered them not to do so.

A contract has been let by the Nebraska Telephone company to the National Conduit Manufacturing company for cement-lined iron pipe and manholes for its underground work in Lincoln, Neb. Work is to be begun by June 10th and finished by October. The contract price is between $40,000 and $50 000.

MISCELLENEOUS.

The office of city electrician has been created in Detroit, Mich.

A Chicago man has invented a device for shaking dice by electricity.

A branch of the Electrical Workers' organization has been formed in Duluth, Minn.

It is proposed to utilize the power of the Lachine Rapids on the St. Lawrence by electricity.

Electricity is said to have been applied to the heating of curling irons for dressing ladies' hair.

Preparations are making for an extended electrical exhibit at the coming Buffalo exposition.

The international exhibition of electrical appliances at Moscow, Russia, was opened on June 1st.

The Canadian Niagara Power company has asked for bids for construction of the Canadian tunnel.

The electrical department of the Brooklyn Institute will give an exhibition at the Clarmont avenue rink next November.

At Fort Gratiot a martin's nest containing five eggs was recently found on the hanging board of an electric lamp.

Three hundred and eighty-six birds were killed during the past year by flying into the electric lights of the Statue of Liberty.

It is rumored that the new General Electric company may establish a factory on the Pacific coast, possibly at Tacoma, Wash.

John Torrent of Muskegon, Mich., proposes to dam the Muskegon river, and to transmit the power thus obtained by electricity to consumers.

An entire page in the *Pittsburg Times* of June 1st was devoted to an account of the Thomson-Houston Electric company and its manufactures.

According to Professor Stirling, the English naturalist, there are in existence upward of fifty species of fishes having more or less specialized organs, the function of which is the generation of electric discharges.

The Union Pacific coal department has just made a contract with the Thomson-Houston company for the erection of a new electric light and haulage plant at Rock Springs. It will be put up this summer and will cost about $25,000.

Over fifty feet of electric light cable was recently removed from the wheel of the steamer H. C. Schnoor at Port Huron, Mich. The wheel had nine turns of the cable wound around it and considerable difficulty was experienced in removing it.

In a recent issue of the *Manufacturers' Engineering and Export Journal* of London 50 pages, with elaborate illustration, were devoted to a description of the electrical works of Siemens Bros., at Woolwich, Kent, and of the products of the firm.

An Ohio horse thief claimed on his trial recently that he had been "electrified" by the daughter of the warden of the prison in which he had formerly served sentence. He told the prosecuting attorney that if she said he was guilty it must be so, for he was completely under her control.

The California Safe Deposit & Trust company has brought an action against the Cheney, Wash., Electric Light, Telephone & Power company, to recover $10,000. The court is asked to appoint a receiver to settle up the company's affairs. The plaintiff claims to have purchased $10,000 in bonds and that the payment of interest has been neglected. It is claimed that the employes of the light company have not been paid.

The eleventh annual issue of J. A. Berly's "Universal Electrical Directory" shows the rapid increase of electrical industries and the numerous subsidiary trades in connection therewith. The list of central electric lighting stations in Great Britain, arranged in map form, is a feature. Berly's "Universal Electrical Directory" must be of great assistance to all those who are engaged as electrical and mechanical engineers, manufacturers, traders and contractors.

The large switch-board for the Narragansett Electric Light company of Providence, built by the Thomson-Houston company, is about completed. It is 18 feet long and 10 feet high, and is arranged for 40 arc circuits. In it are 3 000 pounds of marble, 1,793 pounds of brass, 6,400 brass bushings, 9,300 brass nuts, 1,995 steel bolts, 6,040 brass washers, 3,400 rubber bushings, 3 200 rubber buttons, 2,000 brass screws, 3,400 brass connections, 320 brass binding posts, 640 feet of copper wire, 80 contact plugs and eight cast-iron standards.

The *Street Railway Gazette* of Chicago has been purchased by M. J. Sullivan, who has been the editor of the paper for some time past, and who was formerly connected with the New York office of the Edison General Electric company. Under the new management a marked improvement in the appearance of the paper is noticeable, and many new and attractive features are promised. Mr. Sullivan is an energetic young man with a wide acquaintance among electrical and railway men. His friends are wishing him success in his new departure.

The St. Louis *Globe-Democrat* tells of a merchant in that city who hit upon a plan for increasing the efficiency of the electric lighting of his window display. Appreciating the fact that an unshaded light is too bright for the eye, he had a shade made in the form of a hemisphere, which protects the street side of the lamp and turns the full light of the lamp into the show windows. The result is that his display is illuminated with great brilliancy, and the passers-by, having their eyes protected from the glare of the lamp, are able to see what he has in his windows, and enjoy the spectacle.

The electric lights of Sacramento, Cal., recently attracted swarms of beetles. Chinamen soon appeared with big cans and baskets and proceeded to gather them in. They attracted considerable attention from curious observers, who questioned the Mongolians as to what they were going to do with their harvest of bugs. The Chinamen were non-committal and gave no tangible information to their questioners. These beetles are blown in from the Yolo swamps by the north winds, and are always thick on summer nights when the wind comes from that quarter.

The army medical service of Austria has been experimenting with the electric light as an aid in recovering the wounded after an engagement. It has been found that powerful search lights with reflectors are very effective on open ground, but in cases where the battle has raged over a wide extent of country, or where the fighting has occurred amid woods and brushwood, such luminants are not of much use. Hence it was resolved to experiment with the electric light in another form. Men were sent out with portable electrical lanterns, which were fed by accumulators contained in their knapsacks. The experiment was fairly successful, and it is likely to be repeated.

An electrical display at the home of Miss Kittie Friend of Lockland, O., a few evenings ago caused a sensation. About 6 o'clock in the evening a throbbing of the ground was felt, and Miss Friend, upon investigation, found a current of electricity playing over the lightning rods which encircle the building. The electrician of the Electric Lighting company at Wyoming was sent for, and the occupants of the house instructed to keep away from the scene of the electrical display. Miss Hattie Ayres, a visitor, inadvertently did not follow the instructions of the electrician and received a shock from the ground several feet away from the place where the sparking appeared in its greatest brilliancy. The cause of the display was the crossing of two incandescent light wires.

A curious apparatus was recently exhibited at a meeting of the Royal Society of Great Britain. It is a heat engine, based upon the principle that nickel, magnetic at ordinary temperatures, becomes non-magnetic at a temperature of 572 F. A disk of copper is suspended by two strings so that it can swing as a pendulum. Mounted on the copper disk is a magnet and below it a piece of nickel. An alcohol lamp placed below the disk heats the nickel until it becomes demagnetized and drops away, when the copper pendulum moves to the left. During this oscillation the nickel cools sufficiently to regain its magnetic character, and is caught up by the swinging magnet only to be passed again over the lamp, which causes it again to drop, and so on, the pendulum being thus kept in motion.

The Westinghouse company is said to have signed a contract with the San Antonio Light & Power company of Southern California for transmitting nearly 1,000 electrical horse power a distance of from fifteen to thirty miles. The power plant will be located in San Antonio canon, where water power can be obtained under a head of 435 feet, with a minimum flow of 1,300 cubic feet per minute. To develop this power a rock tunnel 1,300 feet long and a steel pipe about 2,000 feet long will be required. Pelton wheels will be used at the generating station, and will be coupled direct to alternating dynamos. By means of the transformers the potential will be raised to 1,000 volts, and the current at this pressure will be conveyed over bare hard-drawn copper wires to Pomona, a distance of fifteen miles, and to San Bernardino, thirty miles away.

On the occasion of the recent Oxford-Cambridge boat-race on the Thames, the London papers containing the result and full details of the race were on sale within four minutes after the Oxford crew had passed the winning post. The press boat, as it steamed up the Thames, paid out a cable consisting of a seven-strand conductor, insulated with vulcanized rubber warps and with braids of flax, which had been especially manufactured for the purpose. Over this cable the progress of the boats at intervals of a few minutes along the entire course was transmitted to the papers and published all over London almost as the crews were passing the point indicated. Immediately following the result there was dispatched a complete description of the race from start to finish, which was in the hands of the newspapers and others provided with the instruments of the Exchange Telegraph company long before a single newspaper man was able to land his "copy" from the press boat at Mortlake, and also before the pigeons dispatched from the scene were able to settle down in a homeward direction. The instruments used were Morse sounders. The short description of the race which was finally sent contained over 150 words. Another conspicuous feature of the contest was the fleet of electric launches, which was the largest ever seen on the Thames.

TRADE NEWS.

The Safety Electrical company of Newark, N. J., contemplates building a large factory and increasing its force of men.

The C. McIntire company of Newark, N. J., is keeping pace with the large number of orders it is receiving for the McIntire connectors and metal terminals for fuse wire.

Baker & Co., the well-known platinum dealers of Newark, N. J., report that the sale of platinum for electrical purposes has increased very materially during the last six months.

That automatic machine tools are appreciated by electrical manufacturers is shown by the way in which the Gould & Eberhardt factory in Newark, N. J., is kept busy in filling the large number of orders for gear cutters, lathes, drill presses, etc.

A factory complete in every detail, at 173 South Canal street, has been fitted up for the Kester Arc Lamp and Manufacturing company, recently organized in this city, and work on a large order of arc lamps for low tension circuits has already commenced.

The Knapp Electric & Novelty company of New York is sending to the trade a very handy little circular giving prices and a description of what the company's well-known little fan motors are capable of doing. Although this company is comparatively new to the trade, it is very busy in filling orders for this class of goods.

The Buckeye Electric company, Cleveland, Ohio, is about to put a new 32 candle power lamp on the market having a double coiled filament. This filament will have great strength and for a lamp of this candle power it is thought that it will be very desirable. The Buckeye company is also meeting with success in the sale of a railroad lamp having a "stayed" filament.

Lafayette Cole, salesman for Holmes, Booth & Haydens in this territory for several years, was in Chicago on Monday. Mr. Cole has rented an office and storeroom in the Crocker building, opposite the Palace hotel, San Francisco, and will handle electric railway supplies, representing Holmes, Booth & Haydens and the Railway Equipment company, Chicago, on the Pacific coast. Mr. Cole's popularity and the reputation of the firms he is to represent, is sufficient guarantee of the success of the undertaking.

The Ries Electric Specialty company of Baltimore, is now making its sockets for all the standard makes of lamps, and for alternating current circuits of any voltage, from 50 to 110. This socket is also being sold in considerable numbers to manufacturers of alternating fan motors. They claim it is the very thing that is needed to regulate the speed of fan motors. The Ries company has delightful offices at the corner of Eutaw and Baltimore streets, Baltimore, Md., and it extends a cordial invitation to visitors to make their headquarters there while in Baltimore.

Gilbert M. Smith, who has held an important posirion

with the Ansonia Brass and Copper company during the past eleven years, and who has been manager of this company's Chicago office for the past four years, has resigned his position and started in business for himself in the Unity building, Chicago. Mr. Smith will represent the leading manufacturers in brass and copper, bare and insulated copper wire, hardware specialties, etc., and with his wide acquaintance and popularity should step into a successful business at the start.

Queen & Co. of Philadelphia, are issuing a revised price list of the magnetic vane ammeters and voltmeters, in which two forms are given, one with brass and the other with iron cases. The difference in price is occasioned only by corresponding difference in material used and external finish, for both types are calibrated to the same degree of accuracy. These instruments are extensively employed for switch-board purposes, and enjoy an excellent reputation. As decided changes in appearance and prices have been made, it will be well for interested parties to obtain a copy of the special descriptive circular No. 330.

The Enterprise Electric company since it commenced business on June 1st, has met with flattering success. Among other sales during the past week was that of 40 miles of weatherproof line wire with the necessary insulators and other supplies for the extension of a fire alarm system in a western city, and 24 000 locust pins in one lot going to St. Louis. A number of fine orders have also been taken in Chicago for Kerite wire, inthe aggregate amounting to a good round sum. The affairs of the latest candidate for favor in the electric supply business are apparently in good hands.

The New York Safety Steam Power company, Milton Thomas western agent, Chicago, has recently made the following sales: Havana, Ill., Electric Light company, 150 horse power engine with boilers, heater and pumps; Abingdon, Ill., Electric Light company, 80 horse power engine and complete outfit; Lacon, Ill., 80 horse power engine and outfit; Maywood, Ill., Electric Light company 150 horse power engine to increase plant; Blue Island, Ill., 100 horse power engine to the Purington & Kimbell Brick company. This company has recently sold to the Edison General company, for use at Greentown, Ind., two vertical automatic cut-off engines of 20 horse power each. Estimates have been made on a large number of important installations and business at this season of the year is reported as never having been better.

It may be truthfully said of the "C. & C" Electric Motor company, New York, that it is one of the oldest of electric motor manufacturers. For this reason its apparatus, constructed in the light of an extended experience, has a well-merited reputation, and its specialties are generally appreciated by dealers. No better index may be found of the line upon which the concern has been working than the new 'C. & C." catalogue. This little book is more elaborate than any catalogue that the company has yet issued. It includes not only a list of "C. & C." motors and dynamos, but also a careful description of all supplies necessary for the equipment of complete electric light and power plants. It should be mentioned in this connection that this concern has sold a large number of its standard generators during the last few months, and in fact this department of its business is rapidly attaining equal importance with that of the motor department. The other specialties of "C. & C." manufacture to which the company directs attention are switches of special design, an automatic motor starting box, an organ rheostat and organ attachments. The fans, blowers and other ventilating machines illustrated on the last ten pages, are already familiar to users of "C. & C." apparatus. Both dealers and consumers will find a penny well spent if they send by postal card their addresses to 402-404 Greenwich street, N. Y.

BUSINESS.

C. J. Hirlimann, New York, reports large sales for his batteries.

"Always working on some new and useful specialty," might be said of Geo. Cutter, Chicago. Mr. Cutter is now developing a new line of resistances and heating devices, the peculiarity of which is that the heating wire is embedded in an insulating enamel.

The Central Electric company, Chicago, is putting on the market a very compact fan motor, made in sizes of $\frac{1}{4}$, $\frac{1}{6}$ and $\frac{1}{8}$ horse power. These motors can be used on desks and can be attached to the wall. The arrangement is controlled by the Interior Conduit & Insulation company, for which the Central Electric company is general western agent.

The Eickemeyer-Field company of Yonkers, N. Y., manufacturers of the Eickemeyer-Field street car motors, shipped last week the last motor and truck of the half dozen ordered by the Steinway railroad of Steinway, L. I. This company may erect a new factory, in order to have increased facilities for the manufacture of its trucks. The factory is at present working overtime.

Western buyers of mica will be interested in the announcement that the firm of Eugene Munsell & Co. of New York is in a position to fill all orders for this commodity with the greatest promptness from its Chicago headquarters at 86 Lake street. This house, it is said, carries one of the largest stocks of mica in this country of both cut and uncut North Carolina, India and amber qualities.

The Railway Equipment company, Chicago, reports the receipt during the last week of orders for the complete equipment of roads in New Haven, Conn.; Brooklyn, N. Y.; Baltimore, Md.; Evansville, Ind.; Chillicothe, O.; Pittsburg, Pa.; Hamilton, Canada; Augusta, Ga.; Kokomo, Ind., and Put in Bay, O. The company has also made large sales for extensions of present roads, and its business is constantly increasing. The standard material of the company's manufacture is known to be reliable, and its facilities for promptly filling orders are most excellent.

Yankee ingenuity in the manufacture of mechanical devices has placed the United States at the head of the nations of the world. In the progress of the electrical arts, the irrepressible American has always been to the front. An excellent illustration of this enterprise is the Bryant Electric company of Bridgeport, Conn. This firm has established a reputation in the manufacture of single and double pole switches, sockets, cut-outs and other specialties, which places its name in the foremost rank of electrical exploiters. The Bryant company is paying attention not only to features of usefulness, but also to beauty as well, and elsewhere in this issue the company's cosmopolitan representative and western manager calls attention to the fact that the western office "has a full line in China." Those who have seen the china switch admire it, and where beauty as well as good workmanship is essential, this switch will find a place.

ELECTRICAL STOCK MARKET.

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, June 11th, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	108¼	109½
Edison Illuminating company of New York	87	88
" " " Brooklyn	85	90
" " " Boston	115	120
" " " Chicago	135	145
Edison Ore Milling company	15	20
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomson-Houston Electric company	65½	66
" " " Preferred	29½	30
North American Phonograph company	4	6
New York " "	2¼	5
Automatic Exhibition company	3	5
Westinghouse company Common	29	30
" " Preferred	46	47

ELECTRIC PATENTS.

Issued June 7, 1892.

476,236. Electro-magnet. Andrus D. Ayres, Kalamazoo Mich.

This invention secures a long pull from electro-magnets. A series of coils are arranged to be consecutively energized, thereby causing the armatures to move throughout the distance required.

476,240. Railway Signaling System. Frank P. Benjamin, New York, N. Y.

476,292. Apparatus for Trimming Carbon Points. Philo Moses, Fremont, O.

476 296. Electric Battery. Richard P. Osgood, Methuen, Mass.

476,311. Electrical Governor. Mark A. Replogle, Mattawana, Pa.

476 317. System of Testing Electric Circuits. Charles H. Rudd, Chicago, Ill.

The invention embodies an artificial circuit, containing high resistance of invariable amount in parallel with the main circuit. The artificial circuit has its resistance proportioned between connecting sockets by means of which with a testing apparatus the neutral point may be determined.

476 330. Safety Device for Electric Motors. Elihu Thomson, Lynn, Mass.

A protective device responsive to abnormal currents opens the circuit after a certain interval of time has elapsed.

476,331. Dynamo Electric Machine. Elihu Thomson, Lynn, Mass.

The armature of an alternating current machine is provided with coils so arranged that the wire of one is subjected to its maximum inductive effect, while that of the other is zero, thus doing away with the dead point.

476,334. Base Ball Game. Morris Ullman, Washington, D. C.

476,346. Alternating Current Motor. Merle J. Wightman, Lynn, Mass.

Alternating currents are conveyed through the armature and field magnets in a direction to set up repulsion between armature and field at each alternation, those portions of the armature between which and the field attraction would exist being cut out.

476,347. Electric Motor. David H. Wilson, Chicago, Ill.

476,367. Trolley Support. Spencer C. Crane, Philadelphia, Pa.

476,368. Brush Holder for Dynamo-Electric Machines and Motors. Frank B. Daggett, St. Joseph, Mo.

476,372. Thermostatic Governor and Motor. William E. Eastman, Boston, Mass.

476,376. Electrically Controlled Valve. William B. Fleming, Philadelphia, Pa.

476,388. Apparatus for Closing Elevator Doors. Chas. N. Judson, Brooklyn, N. Y.

476,422. Electric Lighting System. Albert Sechrist, Denver, Colo.

476,425. Electric Arc Lamp. Edward F. Smith, Cincinnati, O.

476,426. Electric Generator or Motor. Elmer A. Sperry, Chicago, Ill.

The invention permits a relative movement of the armature and field magnets, tending to vary the inductive effect.

476,437. Electric Locomotive. Thomas E. Adams, Cleveland, O.

476,463. Electric Chime or Bell. Joseph H. Hunter, Pittsburg, Pa.

476,464. Metallic Circuit Cable. Charles E. Jackson, Boston, Mass.

476,473. Electric Body Wear. Robert S. Mears, Newton, Kan.

476,480. Motor Truck for Cars. William A. McGuire and Moses G. Hubbard, Jr., Chicago, Ill.

476,483. Secondary Battery Plate. Edward C. Paramore, Philadelphia, Pa.

476,484. Electric Cable. William R. Patterson, Chicago, Ill.

An exterior metallic sheath carries interior projecting longitudinal ribs in contact with the core.

476,490. System of Testing for Electric Circuits. Chas. H. Rudd, Evanston, Ill.

A condenser and telephone are connected in the circuit, and means are provided for closing the circuit from different parts of the electric light circuit through the telephone and condenser to ground.

476 492. Circuit for Test Batteries and Cords of Multiple Switch-Boards. Charles E. Scribner, Chicago, Ill.

476,493. Electric Arc Lamp. Charles E. Scribner, Chicago, Ill.

A single electro-magnet in shunt of the carbons acts to form and subsequently to regulate the length of the arc.

476,494. Key Board System for Metallic Circuits. John A. Seely, New York, N. Y.

476,501. Incandescent Electric Lamp. Ephraim E. Weaver and Gustavus B. Manypenny, Philadelphia.

A hollow reflector forms the inner wall of the vacuum chamber.

476,509. Key-Board Circuit for Multiple Switch-Boards. Oro A. Bell, New York, N. Y.

476,527. System of Electric Lighting. Thomas A. Edison, Menlo Park, N. J.

The invention embodies the use of incandescent lamps in multiple with arc lamps in multiple with circuit controllers in each arc light circuit.

476,528. Incandescent Electric Lamp. Thomas A. Edison, Menlo Park, N. J.

476,529 System of Electrical Distribution. Thomas A. Edison, Menlo Park, N. J.

The object of the invention is to protect electrical generators from lightning.

476,530. Incandescent Electric Lamp. Thomas A. Edison, Llewellyn Park, N. J.

476,531. Electric Lighting System. Thomas A. Edison, Menlo Park, N. J.

476,532. Ore Screening Apparatus. Thomas A. Edison, Llewellyn Park, N. J.

476,544. System of Electrical Distribution. Harry W. Leonard, New York, N. Y.

In a system of series multiple electrical distribution, the combination of main conductors, groups of translating devices in series between them, a compensating conductor connected between the translating devices, an electrical generator connected between the said main conductors, and a compensating device of constant difference of potential serving either to receive or produce electrical energy as the excess of load shifts from one side of the compensating conductor to the other, such device being connected between the compensating conductor and one of said main conductors, the compensating conductor being connected with the other main conductor through the translating devices only.

476,570. Fuse Block for Electric Circuits. Elmer A. Sperry, Chicago, Ill.

476,573. Electrical Valve Controller. John V. Stout, Easton, Pa.

476,582. Microphone. Cæsar Vogt, Posen, Germany.

476,583. Magnetic Telephone. Cæsar Vogt, Posen, Germany.

476,603. Conduit for Electric Railways. William Bradley, Fort Wayne, Ind.

476,604. Insulator Bracket. Thomas H. Brady, New Britain, Conn.

476,607. Electric Light Mast-Arm. John H. Caldwell, Philadelphia, Pa.

476,613. Electric Switch. C. E. Davis, Chicago, Ill.

476,618. Apparatus and System for Compound Telegraphy and Telephony. Francis W. Dunbar, Newark, N. J.

By this invention telegraphic and telephonic signals may be simultaneously transmitted over the same circuit.

476,653. Electroplate Attachment. Christian Keck, Cincinnati, O.

476,700. Electric Arc Lamp. Robert H. Thurston, Ithaca, N. Y.

476,717. Mold for Electrotype Shells and Similar Articles. Jacob C. Wolfe, New York, N. Y.

476,730. Telegraph Instrument. Charles B. Carr, St. Johnsbury, Vt.

476,733. Galvanic Battery. Martin M. Clark, Chicago, Ill.

476,739. Electric Street Lamp Post. Thomas Flaherty, Pittsburg, Pa.

11,244. Process of and Apparatus for Bleaching by Electrolysis. Albert E. Woolf, New York, N. Y.

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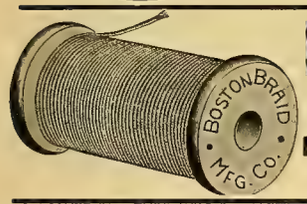

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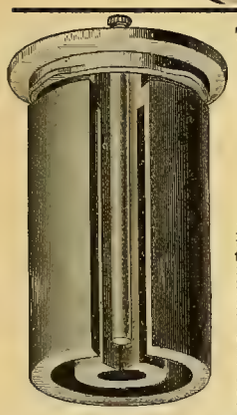

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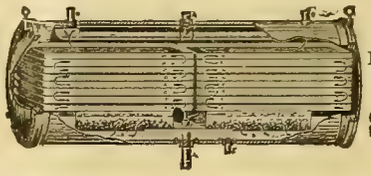

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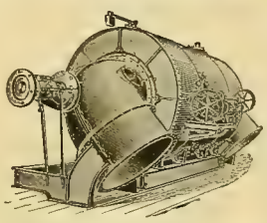

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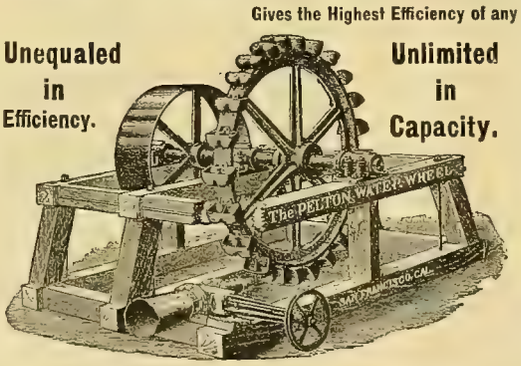

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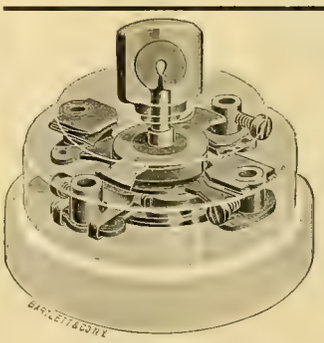

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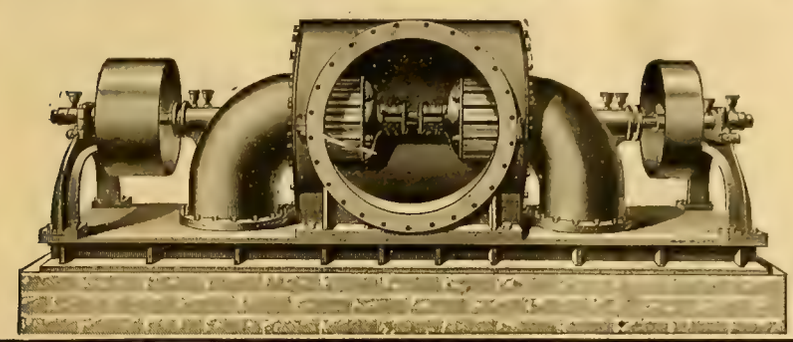

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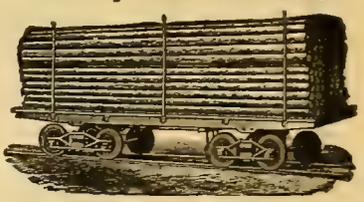

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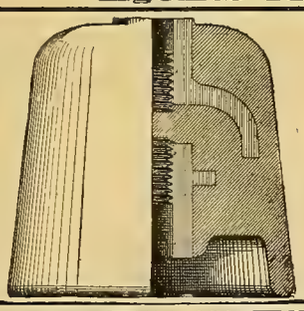

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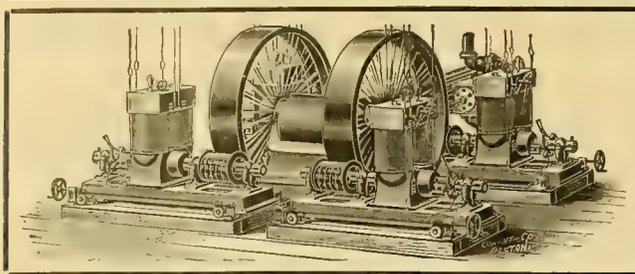

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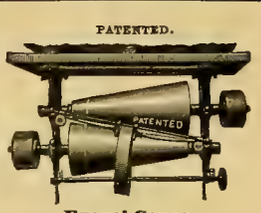

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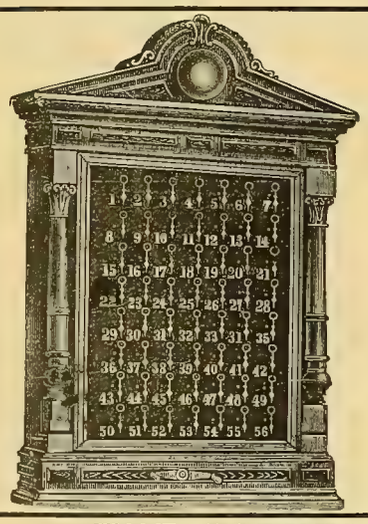

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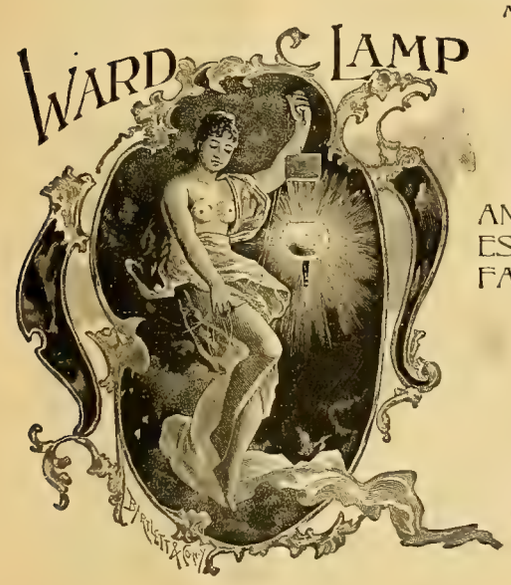

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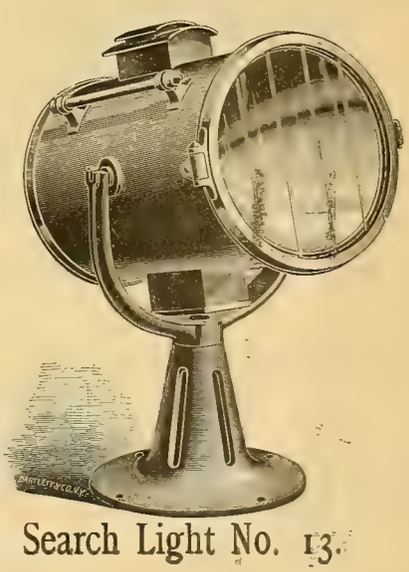

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THE LAKE ERIE ENGINEERING WORKS,

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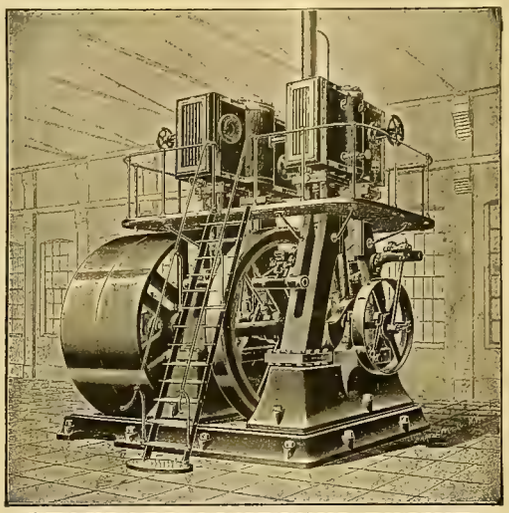
The Lake Erie Engineering Works build Simple, Compound, Triple and Quadruple Expansion Engines, both Condensing and Non-Condensing, from 250 to 8,000 H. P. Especially designed with reference to direct connection to Multipolar Generators.

Best Economy and Regulation Guaranteed.

Also furnish High-Grade Boilers of any class, making a specialty of internally fired boilers of the marine type.



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W. B. Pearson & Company are the Western Representatives of The Lake Erie Engineering Works and all inquiries should be addressed to them.

They are prepared to contract at a reasonable price, for the complete installation of power plants of any capacity, for any service, and at any place.

Plants designed with reference to local conditions and requirements to give maximum economy and safety, with minimum first cost. Write for estimates.

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POWER AND ECONOMY TABLE FOR TRIPLE EXPANSION ENGINES—NON-CONDENSING.

RECEIVER ONLY JACKETED.

Table No. 6.

Size of Engine	Diameter Cylinders inches			Stroke inches	Revolutions per minute	Horse-Power when cutting off at 42 per cent. of stroke in first Cylinder			Horse-Power when cutting off at 50 per cent. of stroke in first Cylinder			Horse-Power when cutting off at 67 per cent. of stroke in first Cylinder			Horse-Power Constant at 1 lb. M. E. P.
	H. P.	I. P.	L. P.			180 lb.	190 lb.	200 lb.	180 lb.	190 lb.	200 lb.	180 lb.	190 lb.	200 lb.	
B	4¾	7½	12	10	370	55	59	64	70	77	84	95	101	108	2.2
C	5½	8½	13½	12	318	70	76	81	90	98	106	120	129	137	2.8
D	6½	10½	16½	14	277	104	112	121	133	145	158	179	191	204	4.16
E	7½	12	19	16	246	136	147	158	174	190	207	234	250	267	5.44
F	9	14½	22½	18	222	195	211	226	250	273	296	335	359	382	7.8
G	10	16	25	20	185	241	260	279	308	337	366	414	443	471	9.62
H	11½	18	28½	24	158	323	348	374	413	452	490	555	593	632	12.9
I	13	22	33½	28	138	433	467	502	554	606	657	744	796	848	17.3
K	15	24½	38	32	120	558	602	647	714	781	847	959	1026	1093	22.3
L	17	27	43	34	112	715	772	829	915	1001	1089	1230	1316	1401	28.6
M	20	33	52	42	93	1048	1131	1215	1341	1466	1592	1801	1928	2053	41.9
N	23½	38	60	48	80	1370	1480	1589	1754	1918	2082	2356	2520	2685	54.8
Mean Effective Pressure . . . . . Lbs.						25	27	29	32	35	38	43	46	49	
Number of Expansions						16			13			10			
Per Cent. of Cylinder Condensation						14			12			10			
Steam per I. H. P. per hour . . . . . Lbs.						20.76	20.06	19.36	19.25	18.21	17.00	17.89	17.67	17.20	
Lbs. Coal at 8 lb. Evaporation . . . . . Lbs.						2.59	2.50	2.39	2.40	2.27	2.12	2.23	2.21	2.15	

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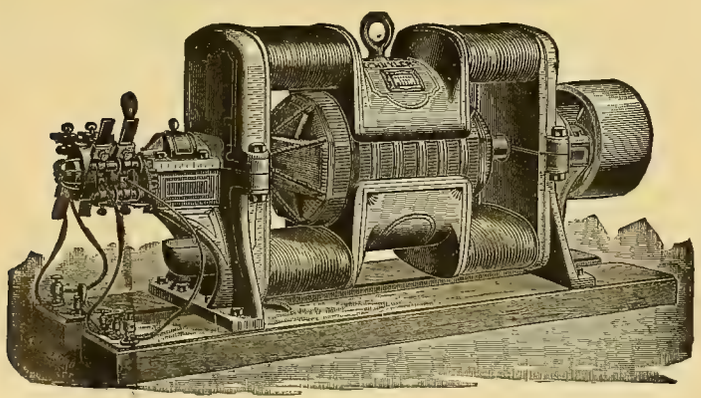
—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



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Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

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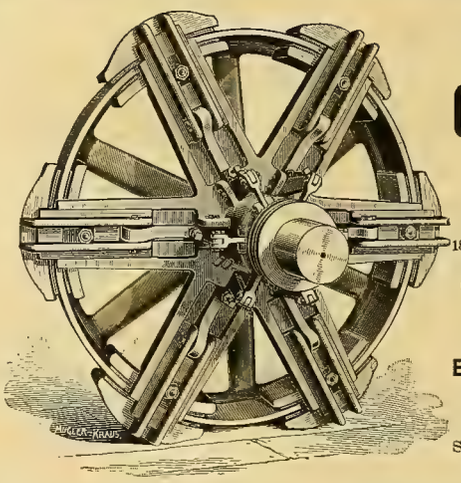

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ALL LEATHER.
NO IRON ROD OR HINGE. OLD STYLE LEATHER LINK AND IRON ROD BELT AND ROPE TRANSMISSION SUPERSEDED.

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BY COVERING YOUR PULLEYS WITH SHULTZ PATENT LEATHER PULLEY COVERING.

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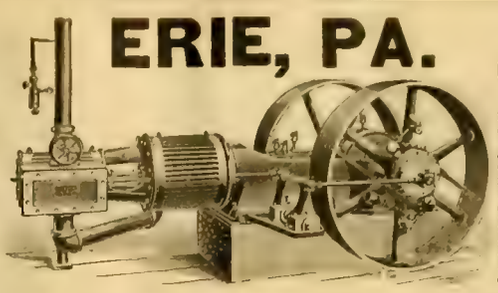
The Best Engine for Electric Lighting and Electric Railways.



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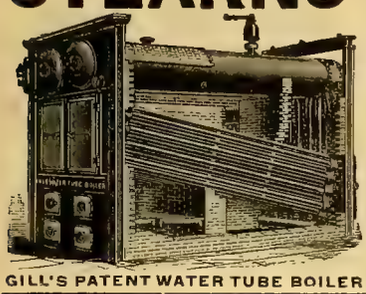

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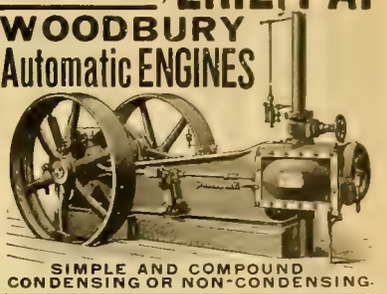

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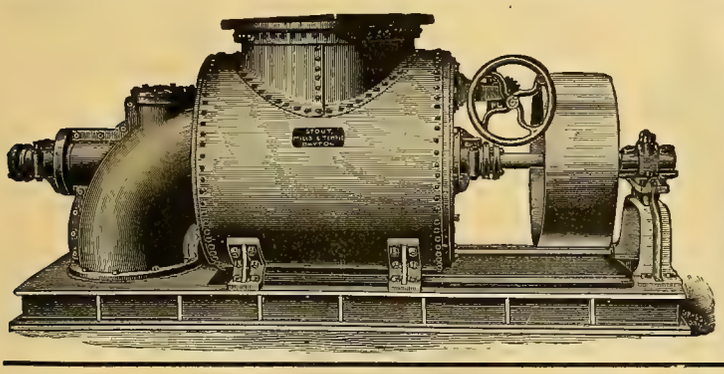
The New American Turbine Water Wheel.



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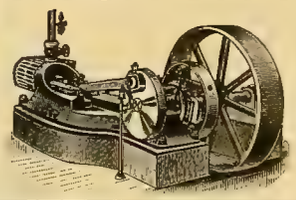

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INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

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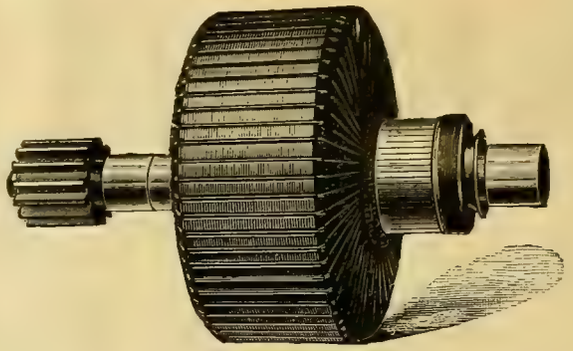
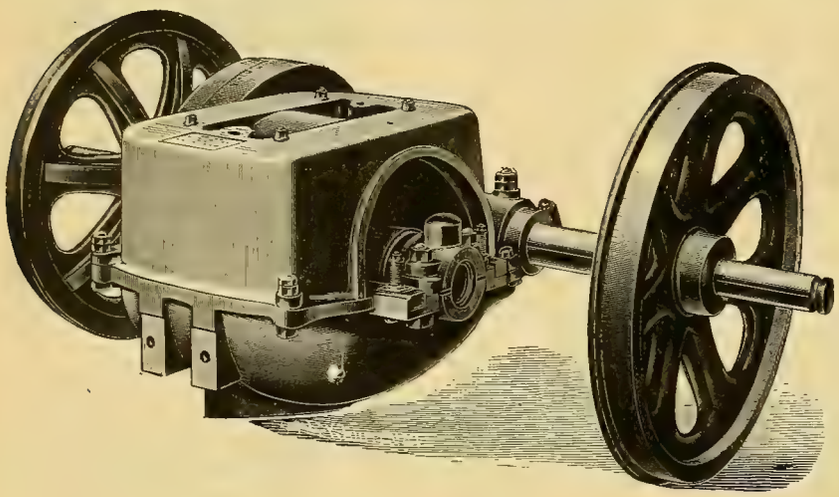


THE THOMSON-HOUSTON ELECTRIC CO.

HAVE PLACED UPON THE MARKET A

NEW STREET RAILWAY MOTOR.



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Cost of Maintenance Reduced to a Minimum.

$10 per Year for Renewal of Pinion and Gear.

3382 Already Sold to Railway Companies.

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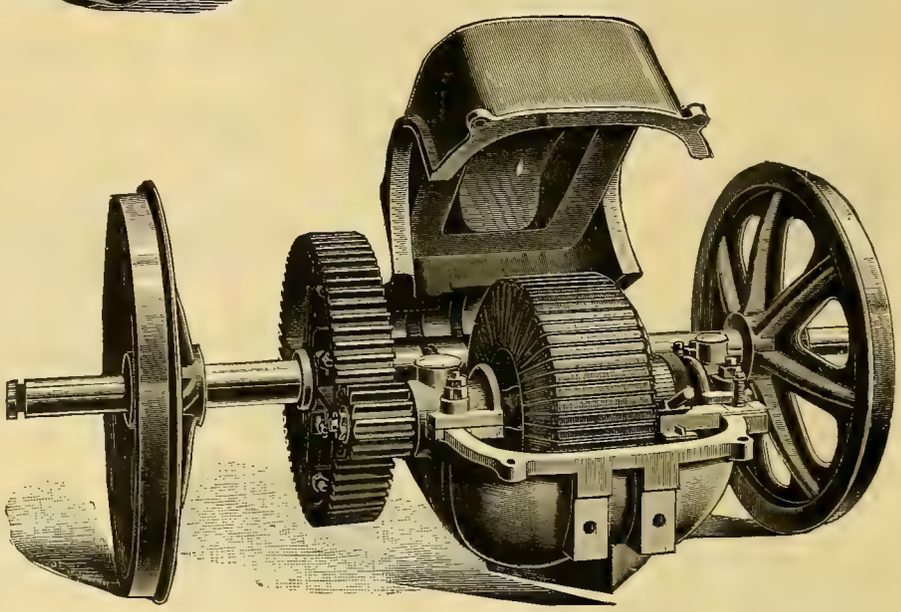
Send to us for Prices and Information.



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PRINCE "SUNBEAM."

The "good old days of long ago,"
How prosy, now, they seem, and slow;
Each phase of life has changed in truth

Since our beloved grand sire's youth
Unceasing search to us has brought
New and maturer fruits of thought;
Bright wills to a purpose bent, may
Evolve new wonders day by day.
Among the grandest gifts of mind
Men have bestowed upon their kind,

Is one that banishes the night;
Need it be named?—Electric Light!
Cast but one hasty glance aback
Along the year's receding track,
Note how the pine-knot's lurid ray
Did service at a distant day.

Ensuing that, the "tallow-dip,"
Snuff burdened and with greasy drip,
Came, and was hailed as queen, till when
Earth gave petroleum to men.

Next, gas was tried, and men believed
That they perfection had achieved.

Last came electric lamps and made
All other light appear as shade—
Mid all the lamps with which we're blest,
Prince "Sunbeam" outshines all the rest.

FATTY—"Who dat tall ge'men jess pas ?
RASTUS—"Huh! dat man? He de bigges' rascal in town, he's a chip offen de old block, suah."
FATTY—"Chip? Wah! go 'long! he done look moah laik a *splinter* to me." —*Electric Spark.*

NEXT WEEK

We will illustrate by photography a sample of "weather-proof" feed (?) wire which was sold to a certain Ohio Electric Railway.

The actual loss of current due to leakage where a "weather-proof" wire is used, will cost, each year, several times the difference in price between such wire and SHIELD BRAND "MOISTURE-PROOF" LINE WIRE.

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For the modern steel ribbed, rock bottomed towers of Babble that are springing skyward in all large cities (particularly Chicago), no Wire has been found so desirable in concealed work as Habirshaw pure rubber covered.

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THE RUBBER USED IN

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IS PURE PARA.

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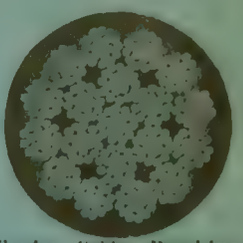
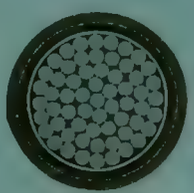
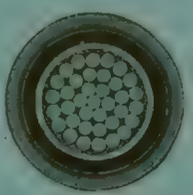
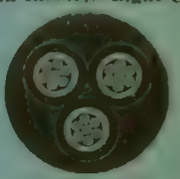

Feeder Cable, Brooklyn Edison Electric Light Co.

Underground Core, N. J. Central R. R.


Feeder Core, Broadway Theater.

Submarine Work, Edison Electric Light Co., Easton, Pa.


Naval Core, United States S. S. "Chicago."


Portable Cable, Broadway Theater.

Marine Core, used on Government Cruisers.

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Adopted by the Navy Department, and thus far employed on board the United States steamships Trenton, Chicago, Boston, Yorktown, Pensacola, Philadelphia, Petrel, Atlanta, Baltimore, Newark, Vermont, Charleston, San Francisco, Concord, Bennington and monitor Miantonomah.

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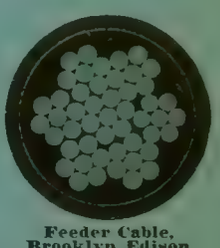
Feeder Cable, Brooklyn Edison Electric Light Co.

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INCANDESCENT LAMPS OF SUPERIOR QUALITY.

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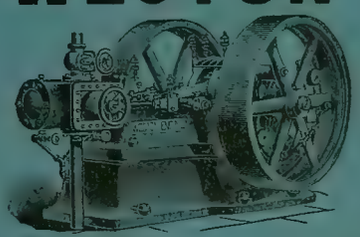

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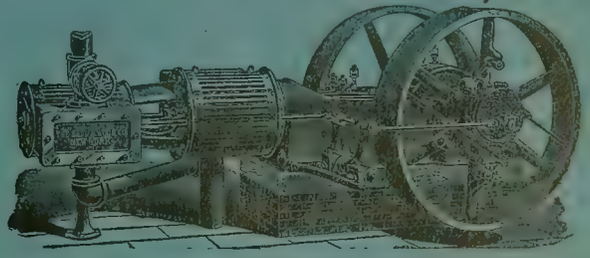

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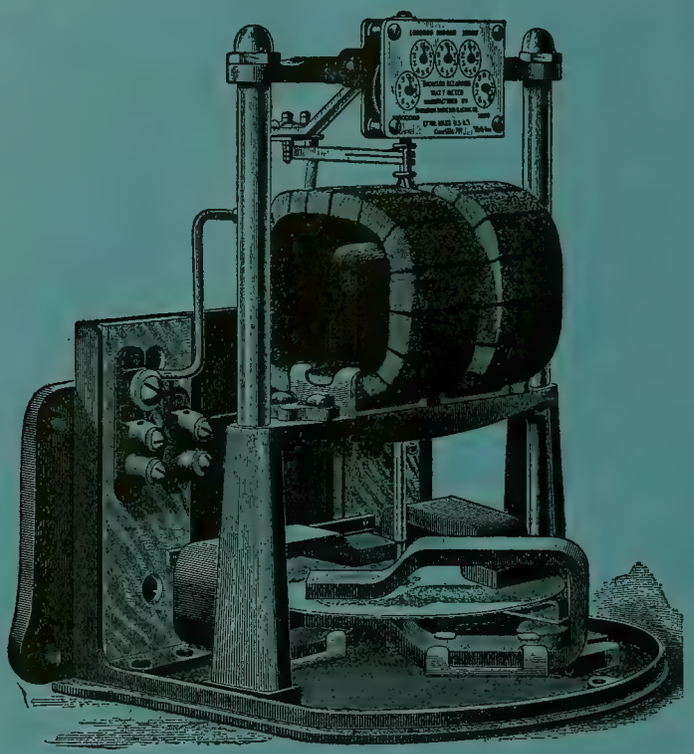

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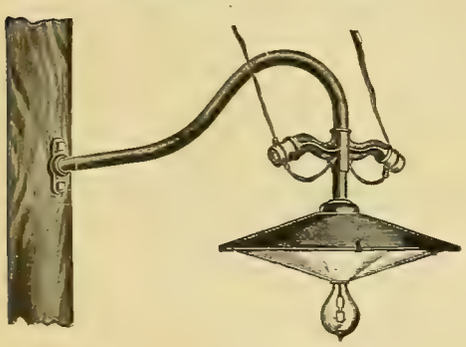

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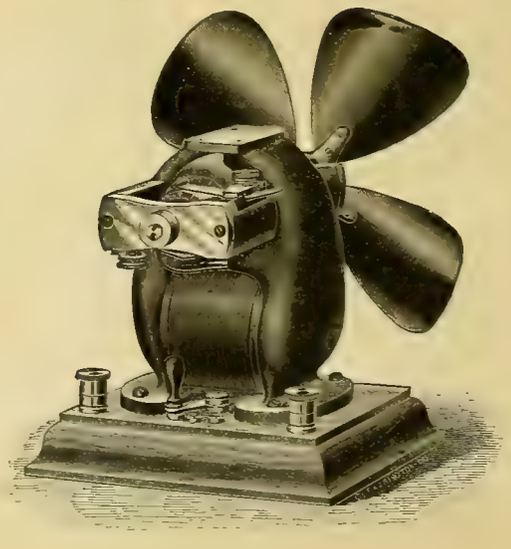

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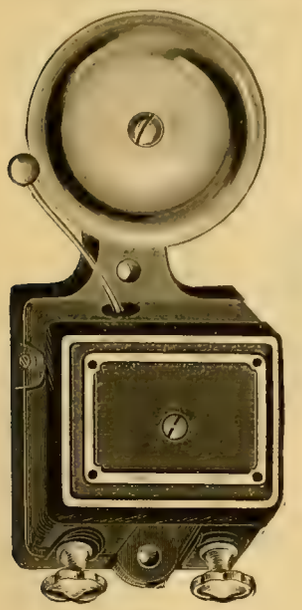

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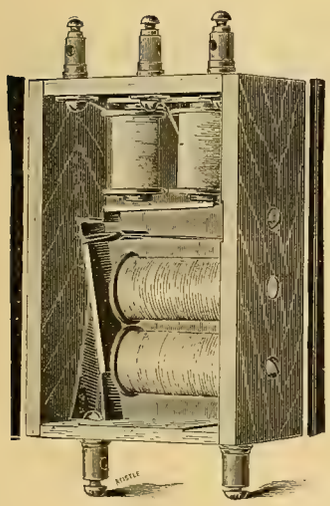

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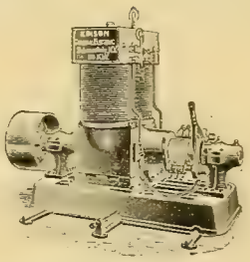

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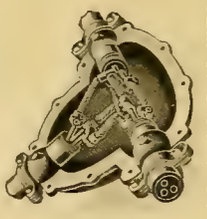

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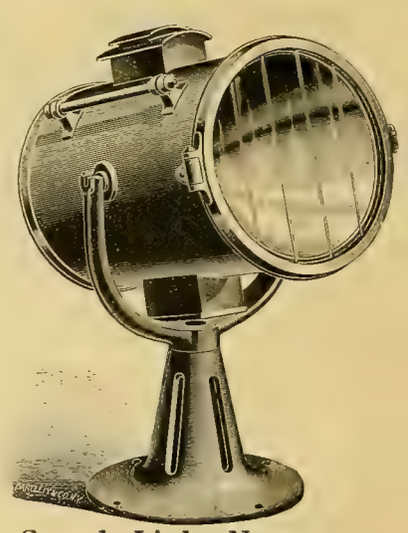

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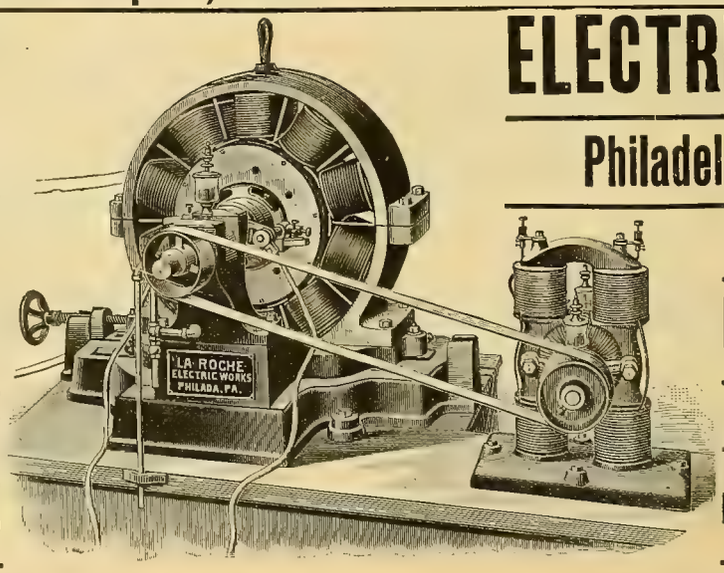

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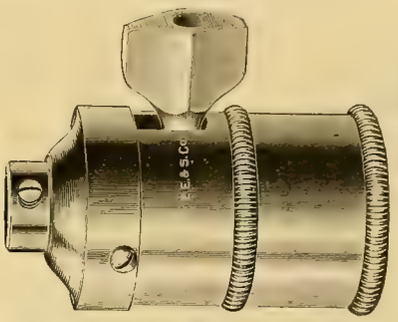

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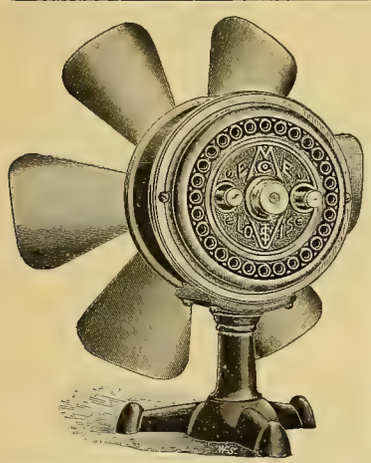

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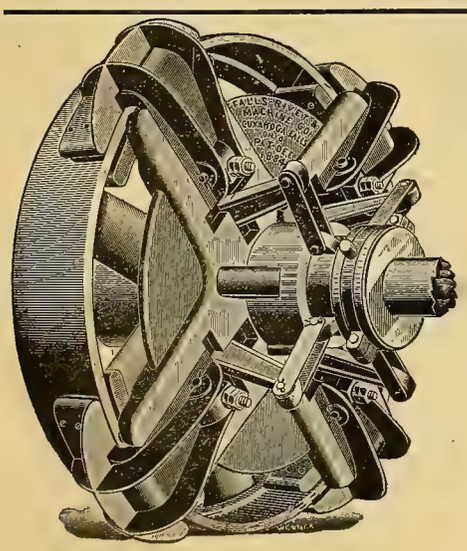

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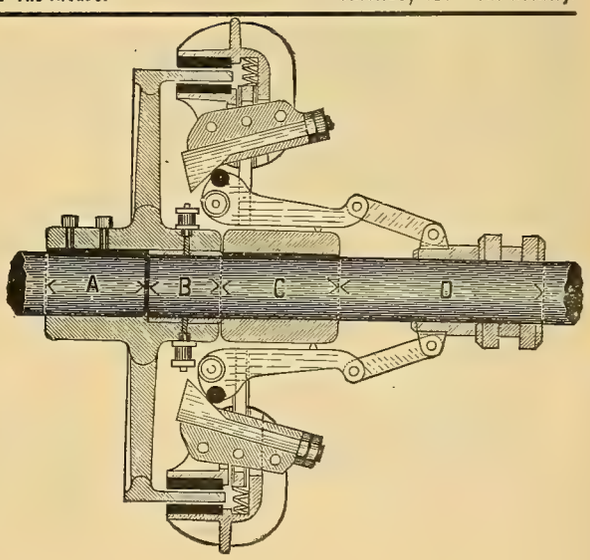

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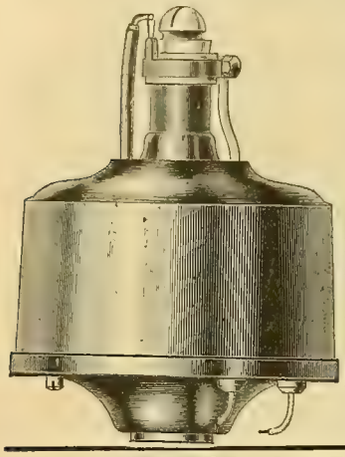

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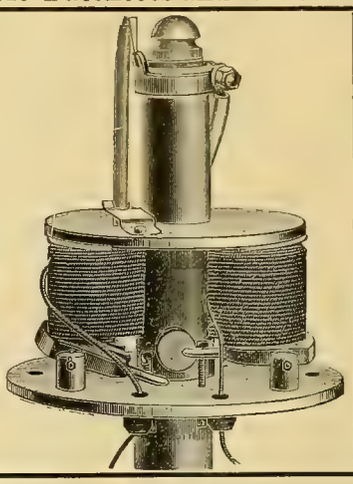

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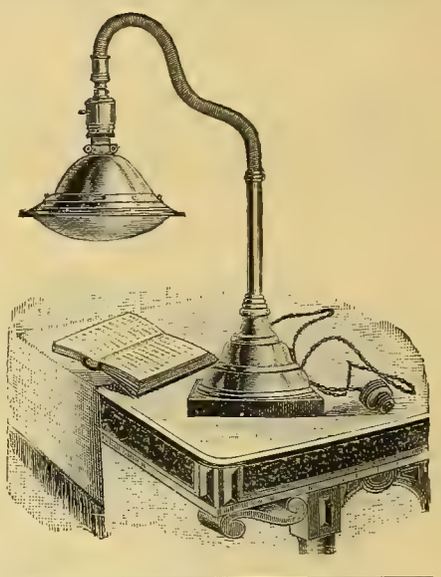

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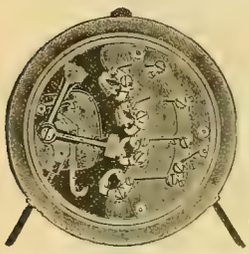

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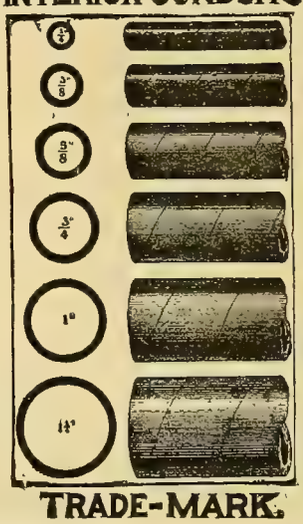

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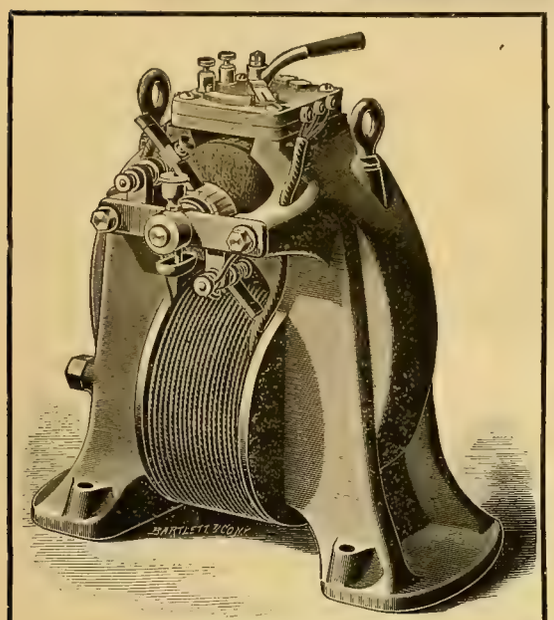

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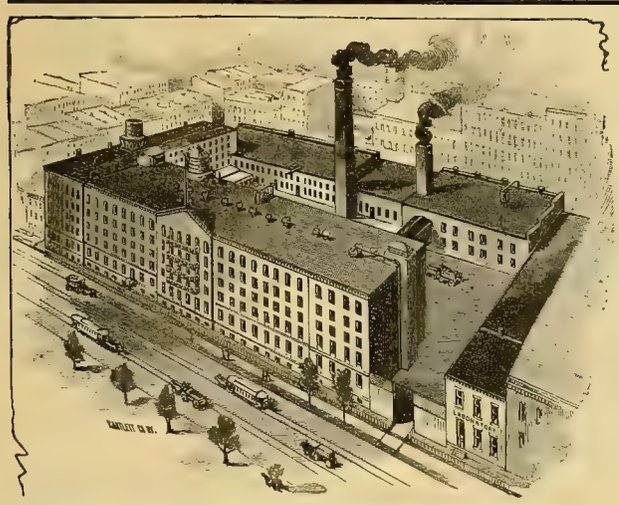

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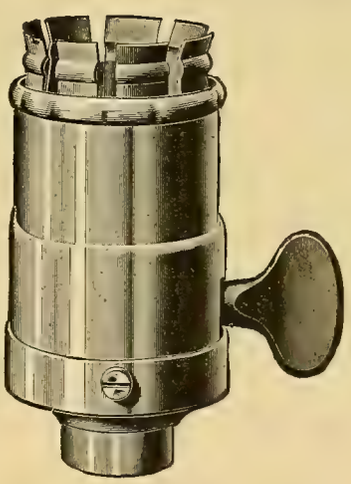

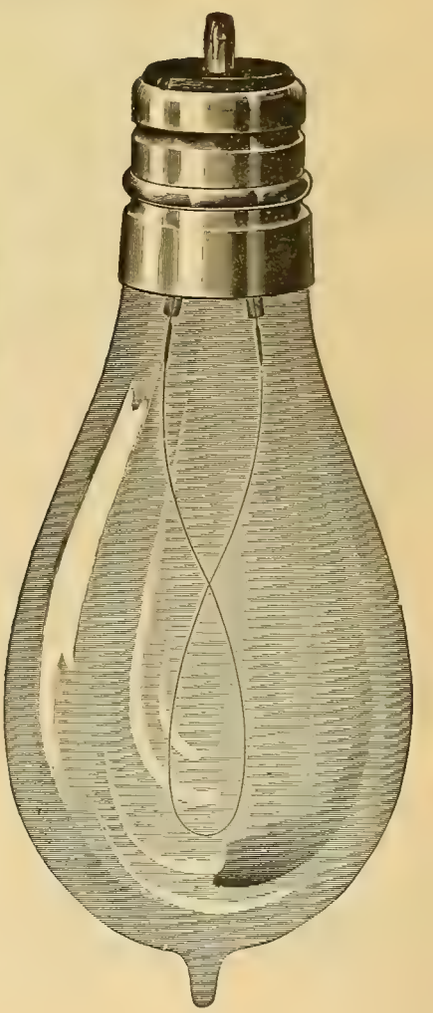

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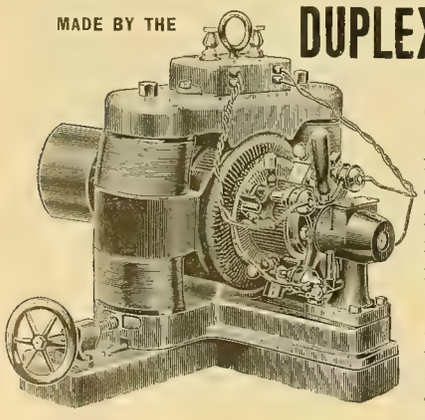

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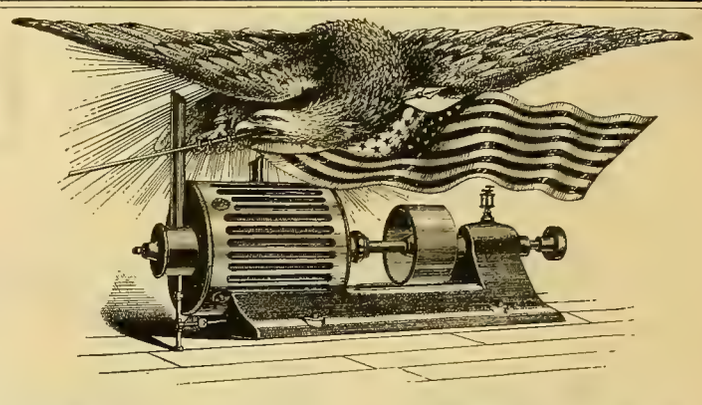

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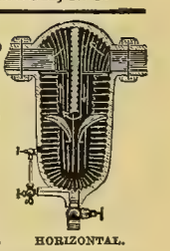

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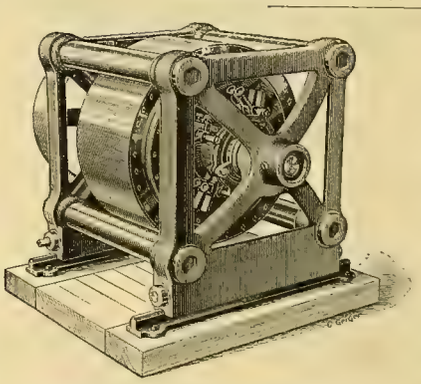

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Vol. X. CHICAGO, JUNE 25, 1892. No. 26

Enterprise in Philadelphia.

It may seem like an exaggeration, but since Chicago was honored by being selected as the site for the greatest of expositions, there has sprung into existence a type of individual who seems to believe that all the push and enterprise for which this country is so justly celebrated is only to be found in one locality. There are some, too, who might be unkind enough to assert that such an opinion was shared by the majority. But while most Chicagoans would be inclined to show preference in designating what they considered to be the center of the universe, there still remain a few who, having traveled without the confines of the "Boundless City," realize that Providence in the dispensation of blessings usually makes the average a very fair one. However this may be, doubtless a number will be interested to learn of a bit of enterprise most commendable on the part of an energetic Philadelphian.

On the line of the Pennsylvania railroad, not ten miles from the city of only one habitable neighborhood, is the picturesque station of Bala. Bala is the center of a most aristocratic neighborhood, and many are the magnates whose carriages await the arrival of the evening trains. Bala boasts of a handsome little church, St. Asaph's, and it was in this church yard that the WESTERN ELECTRICIAN representative witnessed an event that might perhaps convince western hustlers that there are in the city of Brotherly Love several young men—electricians — who can do good work in more than one sense, and can do it in a manner quite in keeping with the western idea of enterprise.

About five years ago, J. L. Stadelman and Geo. P. Roberts, president of the Pennsylvania railroad, decided to give Bala a church of which the neighborhood might be proud. St. Asaph's was the church built, and up to date as much as $60,000 has been spent on the edifice; improvements seem always in order, the parishioners vieing with each other in their efforts for the good of St. Asaph's.

Some months ago the new parish buildings were opened. At a committee meeting it had been decided to make the occasion one of festivity, and, of course, electricity came in as an aid to the cause. This is the way it came about: W. A. Stadelman, a son of one of the founders, offered to light the church with incandescent lamps. How he would do it the worthy Balaians knew not; but of one thing they were certain, and that was that the lights would burn at the appointed time.

Only one glance at the accompanying cut is needed, and the reader will know as much as those in attendance on the momentous occasion when Mr. Stadelman fulfilled his promise.

Any one riding by St. Asaph's on a certain cloudy afternoon would have had his curiosity aroused by the strange spectacle in the field along side the church. It had begun to rain, but everything was in a bustle, for the traction engine had at last arrived. Rain or no rain, those lights had to burn, and all hands contributed to make the occasion successful. During the day L. Knowles Perot had wired the church. Sixty Edison lamps, loaned by Walker & Kepler, had been hung in clusters of ten each in the main building, and a number of five light clusters had been distributed about the smaller rooms. On the outside a string of twenty lamps from the church roof to the hitching shed gave promise of cheer to the late comer. No wires were tacked or cleated, and the No. 4 feeder wires from the La Roche 80-light generator in the field lay on the ground with no other protection than their own insulation. The mains passed into the building through the windows, but in the darkness no one thought of these metallic substitutes for clinging vines.

In the field stood the big puffing Peerless 10 horse power traction engine, and pegged down in front of it on a foundation of strong timbers was the little La Roche dynamo. The outfit was complete, for ammeter, voltmeter and switches also found place by the little machine. Mr. Stadelman's blood was up; time was flying; coal was needed, for as yet no one knew whether or no the little dynamo would play tricks and refuse to "build." The test had to be made, and made soon. At the last moment coal was secured at the Stadelman mansion, and amid much excitement the test was made. The

ENTERPRISE IN PHILADELPHIA.

little machine began to build, and and at about 6 o'clock all hands had the pleasure of seeing St. Asaph's new buildings brilliantly illuminated, and by its own plant, too. Half an hour later, and in a drizzling rain, the strange outfit started on its run. A gum-cloth shed had been arranged over the dynamo, and an effort was made to protect the belt. In spite of all difficulties, the lamps still burned brightly, and at 11 P. M., without serious hitch or stop, the run was over, and so was one gentleman's anxiety.

Electricity at the World's Fair.

The testing of launches for service in the lagoons at the World's Fair grounds has been begun at Jackson Park. But one or two runs have been made as yet, however, and so many difficulties in the way of shallow channels, newly placed piles, dredging machines and the like have been encountered, that it can hardly be said that any satisfactory data for comparison have yet been obtained. Nine boats have been entered for the trial. They are as follows: Naphtha Launch company, one (naphtha); C. P. Willard & Co., two (steam and compressed air); Columbian Launch company, three (one electric and two steam); Electric Launch & Navigation company, one (electric); Meeker, Eckhardt & Coyne, two (electric and steam). Two or three trips have been made by steam and electric boats, but owing to the unsatisfactory nature of the course, which is mainly over water in excavations dug for the lagoons, it is probable that the same boats will be given additional trials when the conditions are more favorable. The test comprises a ten hour trip under all the requirements of the fair, the boat carrying a weight equivalent to 28 passengers and making all the necessary stops.

The construction department is putting in the foundations and ducts for the arc lamps that are to illuminate the grounds Ornamental posts will be employed. About 1 200 will be needed.

The French are determined to make a brilliant display in the electricity building. They have already been allotted 17,000 square feet, and they have applied for more space. It is proposed to decorate the French section in a style worthy of the high standard of the art of that nation. Three gentlemen representing the French government recently conferred with the officials of the department of electricity in relation to the section set aside for France. One was a member of the French commission, another an architect, and the third a skilled decorative artist. They promised a display that will worthily represent the electrical industries of France, with especial decorative effects. The French exhibitors will light their own section and supply power.

Chief Barrett of the department of electricity is sending out a letter to intending exhibitors of which the following is a copy:

Kindly send me at once as complete a list as possible of the articles that will enter into your exhibit in this department. We wish to prepare our applications for final distribution into groups and classes, and must know what will be exhibited. This does not mean that your exhibits will be separated. The reverse is the case, but for the benefit of awarding juries all exhibits must be classified prior to allotments of space. The list now asked to be submitted will not prevent additions or revisions later on.

It was thought that the telegram from Mr. Westinghouse, reciting that he had signed the contract, and that "the surety company" would furnish the security on the $500,000 bond, had settled the long controversy over the incandescent lighting at the World's Fair. Such is not the case, however, and a new difficulty has arisen. It turns out that the "surety company" mentioned by Mr. Westinghouse is the Lawyers' Surety company, and not the American Surety company, as was supposed. The former is a new company, with a capital stock of $500,000. After investigation, the committee on grounds and buildings has decided that this company is not satisfactory. It is an entirely new organization, and the bond given equals the entire amount of its capital stock. Accordingly the committee telegraphed Mr. Westinghouse on Friday of last week that the bond was not acceptable. There the matter rests at present. What action Mr. Westinghouse will now take is not known.

The city of Topeka, Kas., has contracted with the new Topeka Dam company for 350 horse power at the rate of $40 per horse power per year. The power will be used for the municipal electric lighting station.

Electricity in Bituminous Mining.[1]

By Elmer A. Sperry.

Many a traveling Englishman on this side turns his eyeglass upon a swift succession of passing trains laden with barely a day's product from some unheard-of western colliery, and thinks that he instinctively recognizes pit coals from Northumberland or Lancashire. He supposes that "all coals come from Newcastle;" nor is this surprising. The average eastern man may be said to be almost unaware of the existence of bituminous fuel. To him anthracite is coal, and Pennsylvania is the place of its nativity.

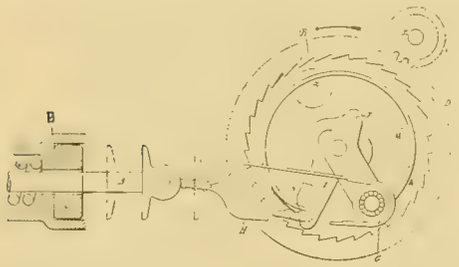

FIG. 1. ELECTRICITY IN BITUMINOUS MINING.

Yet last year 150,000,000 tons of bituminous coal were mined in the United States, principally in the west.

Of the total anthracite product 78.29 per cent. was shipped to Pennsylvania, New York, New Jersey and New England. To one whose attention has not been directed to the coal industry it is a matter of surprise that extensive mining operations in coal are going forward in the Mississippi valley. On one of the affluents of the Mississippi river alone, in 1888, was shipped nearly as much coal as was in that year mined in all the continental countries of Europe together. In this valley there are 152,000 square miles of coal area. Illinois alone has 36,000 square miles. In this state $18,000,000 is invested, $11,000,000 is annually disbursed, and about 40,000 miners employed in bituminous mines. These areas of the West are large when compared with those of the

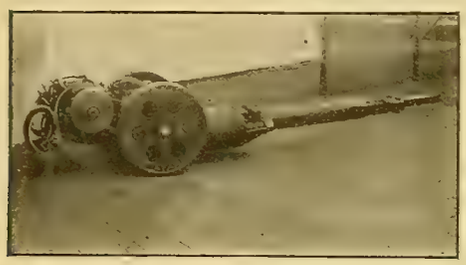

FIG. 2. ELECTRICITY IN BITUMINOUS MINING.

eas'ern states. The coal area of Great Britain is the same as that of the state of Pennsylvania—9,000 square miles. The coal area in the Mississippi valley is 30,000 square miles in excess of the total superficial area of England, Ireland, Scotland and Wales.

England, doubtless, has the honor of being the first to give up this, the most important of the mineral products. Abundant evidence exists that some of the English outcroppings were worked by the Latins during the Roman occupation. Heaps of debris and cinders from the ancient iron furnaces have been found which were worked at that period, so great in extent that modern furnaces are being supplied from them. While it is not clear that coal was used, yet the fact that the Latins introduced the powerful artifical blast renders its use probable and may explain the large coal workings of the period.

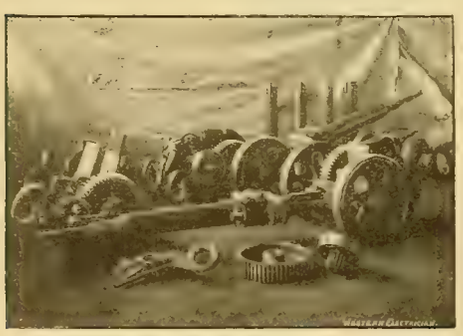

FIG. 3. ELECTRICITY IN BITUMINOUS MINING.

As to implements and machinery, it is true of the various regions and countries of the old world that if you would know the tools used at an early period you have but to study the tools of to-day. The excavations in the most ancient ruins of civilization show implements used by ancient and contemporary artisans to be the same. Moulds sunk in slabs of limestone used by the most ancient Egyptian silversmiths are identical with those used to-day and sunk in the same limestone. The iron and bronze implements shown in the ancient traceries have been exhumed together with the drawings, and compare favorably with the picks and shovels used in their discovery. In Nineveh nearly two tons of iron implements were found, among which were bars, shovels, saws, picks, etc. The picks evince excellent workmanship; they are single and double ended, the double in some instances provided with an edge at one end and a point at the other, the eye well formed with extended lips upon the inside for more firmly securing the wooden handle.

There is no doubt but that the implements and tools seen to-day in use in the Lancashire mines 3,000 feet below the surface are the same as used by the Latins and Saxons in the ancient coal workings. The motive power has remained unchanged during the centuries; the instrument is good; the method of attack is simply perfect, and cannot be improved. The system, however, has radical defects in point of expense, controllability, protracted effort, want of uniformity, deficient and small power units. The tendency of the times is toward centralization, and a large unit will be the integer of the future. While others among the older industries have adopted improved methods, the mining of coal has remained almost stationary. Ore mining has been revolutionized in many respects; extensive plants of machinery being adopted have been found to increase the capacity and cheapen the product. In isolated cases coal mines have been equipped with labor saving machinery, and the enterprising operator has been richly rewarded.

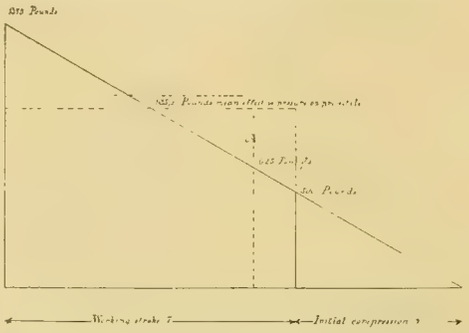

FIG. 4. ELECTRICITY IN BITUMINOUS MINING.

Veins that were operated at a loss have by the use of machinery been enabled to yield profitable results. In this line doubtless the next decade will witness great advancement. The problem of replacing manual labor in coal mining has engrossed the labors and thought of the ablest engineers of the age. Some of the earliest patents granted by the English monarchs were for mechanical mining devices, with an avowed object of superseding manual labor. These machines were driven by animal or hydraulic power, and more recently by steam and compressed air. They sawed, scraped, cut and plowed, but principally struck a blow. Many, even to a recent date, swung a pick provided with the ordinary transverse handle or power connection. Few if any of these machines have been successful under the severe duties re-

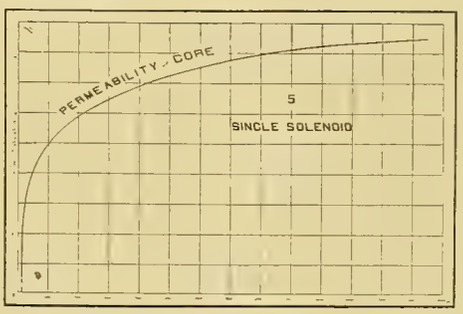

FIG. 5. ELECTRICITY IN BITUMINOUS MINING.

quired, and none has withstood the test of time. Machines generally employing cutting or scraping devices are of limited application. They are worked with success where the vein is clear; but this, however, is the exception. The presence of iron pyrites or other foreign substances in the strata quickly dulls the knives and requires such heavy driving powers as to preclude commercial use. I have witnessed the operation of this type of machine in strata excellently adapted for machine mining except for a frequent deposit of sulphur about the thickness of a silver dime. The cutters being made of the finest Musbet steel, the entire set required changing every 40 square feet undercut. The current readings would show a power consumption on an average of 27 horse power, whereas in clear coal 10.5 horse power only were required, and one change of cutters for each 250 square feet undercut.

With a more or less friable material, and especially where a cubical or angular crystal exists, great dislodgement and penetration is accomplished by the percussive blow. Its amount is proportional to the stored energy in the projectile. If the energizing motor is deficient, the strokes or impulses must of necessity be feeble; but now that almost unlimited power is at our disposal, the force and work possible is only limited by the rigidity and durability of the immediately attacking medium, namely the tool or cutter. With this form of machine, and especially if organized to be manually directable, the penetration may be pushed at a rapid pace, the foreign substances may be cut about, dislodged and removed without the necessity of directly attacking the substance itself.

These foreign substances are the bane of mechanical coal cutting. They exist in the form of thin layers, thick layers, balls and boulder. The various forms are known to the miner as sulphur balls, lime balls, boulders, bone coal, etc. They are of extreme density, and their hardness is so great that even with the diamond drill they are considered the most difficult mineral substance encountered.

In some instances, especially in the deeper mines and often the thinner veins, it is possible to undermine the coal by excavating in the underlying strata, consisting principally of fire clay and sometimes of a dense slaty and rather heterogeneous mass known as "blackjack." In both these materials foreign substances often exist in the form of mineral deposits.

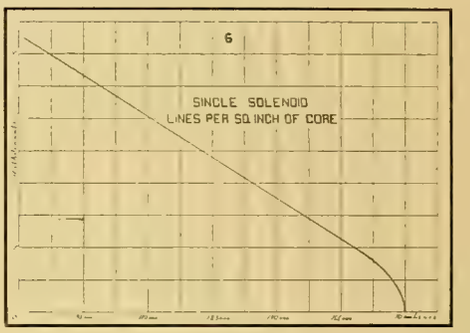

FIG. 6. ELECTRICITY IN BITUMINOUS MINING.

With this foreign matter occurring in irregular forms and in masses of irregular distribution, it will at once be recognized that breakers are ahead of the designer, and that good engineers have been baffled in this field is not a matter of so much surprise.

Successful excavating machinery for bituminous coal is destined to be the product of an evolution, the result of accumulated experiences from various sources and districts, derived principally from the carefully observed action of machines in operation as well as the no less perfect

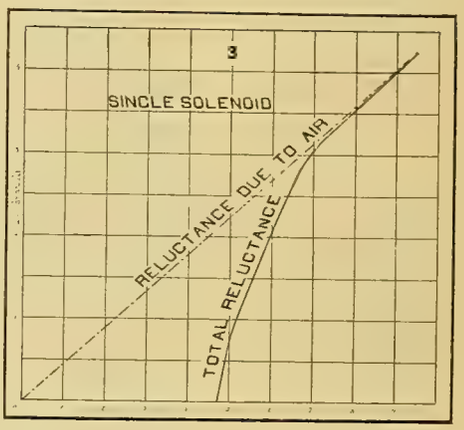

FIG. 7. ELECTRICITY IN BITUMINOUS MINING.

miner, to whose tender mercies the result sometimes of months of work and patience is to be intrusted. This cannot be done by proxy. The environments and conditions are often far from inviting, nor are they entirely free from danger. There seems, however, to be no shorter cut to success. The widely varying systems of mining employed in the different districts still farther renders any single machine which is equally well adapted to all difficult of construction. Such a universal machine is, however, none the less desirable and is doubtless approached most closely by the direct blow or reciprocating action,

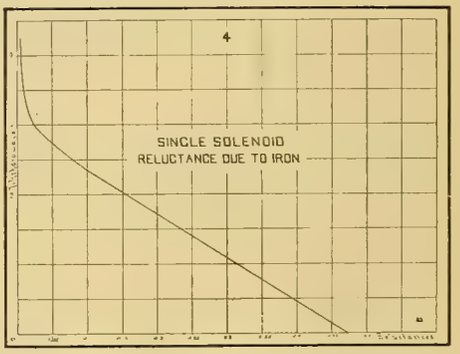

FIG 8. ELECTRICITY IN BITUMINOUS MINING.

imitating in this feature the time-honored pick, placing a force behind it never before obtainable. Such a machine may be perfectly guided and directed while in operation. It is the only machine that may be used under almost any condition or quality of coal, foreign substances, underlying strata, or system of mining. It may be used for entry driving, under-cutting, digging, holing or shearing. It may be well here to give a brief statement of the different systems of operation usually met with in the bituminous mines.

After coal is reached, the slope or shaft is divided for ventilation, the air reaching the vein through one divison and being exhausted through the other. At this point two or three

[1] Read at the general meeting of the American Institute of Electrical Engineers, Chicago, June 6, 7 and 8, 1892.

parallel entries are driven with "break-throughs" at intervals so that the air may be conducted to or near the heading, and at intervals, later als or "butt entries" are driven, usually at right angles to the main entrance. These butt entries are also driven in pairs, and "overcasts" or "undercasts" are used to connect from one of these entries to the remote main entry. Connections are made through the pillar between these entries in the same manner as in the main entries, multiple distribution being employed throughout. From the butt entries rooms are turned

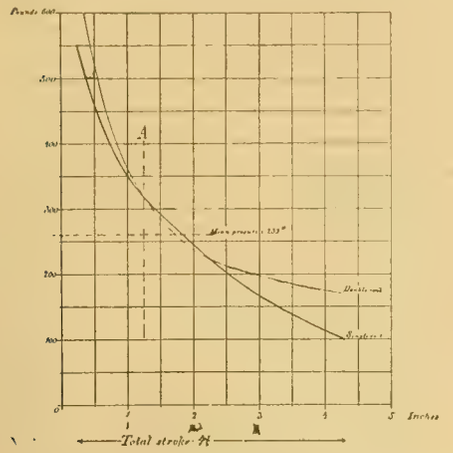

FIG. 9. ELECTRICITY IN BITUMINOUS MINING.

narrow at first, but widening out from 20 to 60 feet, according to the nature of the roof, leaving a solid pillar of coal between the adjacent rooms approximately equal to the width of the room. As the rooms grow deeper the ribs are broken through for the purpose of ventilation, and curtains are hung in the butt entries which force a small amount of air down through one room, and out through the next, etc. Rooms are usually driven to a depth of 100 yards. It is in these rooms that the mining operations go forward. The product is loaded into pit cars and thus reaches the surface. In rare instances the roof will allow of a number of these rooms being thrown into one, giving a long face of several hundred feet. This is called a "modified long wall" system, as a part of the mine is usually worked ordinary "room and pillar," and in a few places the extended facings are found. In some instances the measure is so dense as to render undercutting out of the question. In these mines the coal is blasted "from the solid," as in anthracite mining. This, however, is not considered good practice in bituminous mines as the product becomes "powder-shot." The slack in this method will run as high as 50% of the product, and the lump will not bear shipment or the weather without crumbling.

The system of mining employed at the breast consists of excavations in the coal or in the underlying strata to a depth about equal to the height of the vein, then by boring near the roof holes 7 to 15 feet apart, in which light powder charges are exploded for the purpose of tipping out and bringing down the entire breast, which is still farther broken by picks and loaded into cars. After being undermined, in some instances the coal is difficult of dislodgement owing to adherence to the ribs or lateral pillars of the room. To provide against this machines mounted on high wheels are used to shear in at each side, a depth of 4 or 4½ feet from the floor to the ceiling, so as to entirely separate the portion undermined from the pillars at each side. This operation of shearing is sometimes exclusively employed when the sulphurs are too numerous in the lower strata. The rooms in this instance are sheared in at either end and sometimes in the middle and the the coal is brought down by drilling in at an angle and blasting.

Another system of mining prevalent in the northern district of Illinois, and in isolated cases in Iowa, Missouri and Western Pennsylvania is the "longwall" proper. This is among the modern methods of mining. From the shaft "bottom" single entries are driven in four directions through the vein to a distance of about 100 feet, then laterals are taken off each way and driven until they meet. This leaves

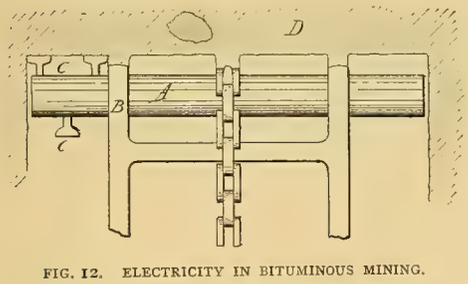

FIG. 12. ELECTRICITY IN BITUMINOUS MINING.

a pillar of coal to support the top works about 200 feet square. This pillar is never interfered with. After the circuit is entirely completed around this pillar the work is pushed forward on all parts of the facing simultaneously, all the coal being removed; no coal being left, the roof is meanwhile supported by props until at last it gives way and gradually settles down crushing the props, no matter how numerous or how strong they may be. At the same time the floor of the mine "heaves" until the roof and floor practically meet. The rock is taken down overhead in the entries, so that the entries practically consist of tunnels excavated in the "top rock." The longwall facing is pushed forward at all points equally distant from the "bottom," the solid vein of coal ahead supporting the roof in the immediate vicinity, but back from the face a few feet the roof gradually descends until the roof and floor meet, crushing as it would seem the forest of props that is used at the face, entirely out of existence.

The ventilation in this system consists in dividing the air in multiple, taking it up alternate entries and after traveling the face bringing it back through others which are brought together near the "bottom" to the upcast, at which point large furnaces or mechanical ventilators are employed for keeping the air in constant circulation.

Roadways driven off from the main entry like the veinlets of a leaf reach the facing about every 50 feet. The distance between any two of these face entries is called a room and is worked by two miners. The rock taken from the roof to gain extra height in the entries is blocked between the floor and the roof near the face, leaving a space for the miners of but from 2 to 3 feet from the face. The extreme smallness of this working space may be well understood when it is considered that the thickness or height of the vein is sometimes as low as 18 or 20 inches. Wherever a point of sight may be obtained from these facings back toward the main entries the roof can easily be seen bending downward. The "top rock" is fractured and must be supported at numerous places by props and cap pieces driven in place by heavy sledges. Back a few feet from the face the crushing effect of the enormous weight above can be seen upon these props. The bodies of oak trees 6 to 8 inches in diameter may be seen forcing themselves into the solid rock and curling over at the extremities, exhibiting graphically the enormous pressure at work upon them. Falls of rock are frequent and constant vigilance is the price of safety at the working face in a mine of this character.

The excavating process consists in under-cutting in the coal or underlying strata of clay to about the depth of the thickness of the vein and allowing the constantly descending super strata to break off the projecting portions of the undermined coal; this occurs from 30 minutes to two hours after the undermining process is completed. This is still further broken up by picks, and loaded as described above. Drilling or blasting is very seldom resorted to in this system of mining.

I have thus briefly pointed out the methods employed that the conditions may be better understood in the discussion now to follow of electrical machinery as adapted for use in such mines. A diagrammatic outline of the direct blow machine is shown in Fig. 1, the completed machine and parts being shown in Figs. 2 and 3. In this form of machine a bi-wheeled truck furnished with handles at the rear is provided with a continuously operating electric motor of about four horse power, connected by gearing to a catch or retractor; a longitudinally moving heavy projectile with a pick secured to its outer extremity is surrounded by a driving spring of about 125 pounds' compression per inch. The line of movement is practically through the center of inertia of the machine. These springs are preferably made in sections, and an initial pressure is given of about 500 pounds. A retraction then takes place of from 6½ to 7½ inches to a pressure of 1375 lbs. whereupon it is released and allowed to make a vigorous forward stroke. This process is repeated from 160 to 225 times per minute. The mean effective of this type of machine is 935 pounds when allowed to strike the cushion, and when striking the work at a distance of one inch from such cushion giving 1,000 pounds mean effective. This is shown in the spring curve diagram, Fig. 4. The mean effective in air machinery employed for the same purpose is between 400 and 450 pounds, a 3¾ inch cylinder being the largest employed. The current required for the operation of this machine is between 10 and 10 2 amperes at 220 volts. The projectile weighs between 100 and 150 pounds in the different sizes of machines. Early in the development of this machine it was found that under the action of the intense concussion resulting from the percussive blows and shattering strains throughout the machine, a motor to last under such conditions must be essentially different in its organization from the ordinary commercial machine. After working along various lines it was at last found that by mounting the driving pinion loosely upon the armature shaft, providing it with wiggle-like projections between which and the armature shaft elastic cushions such as blocks of rubber could be inserted, the trouble could be averted, and when adopted it was found that the repairs on armatures were reduced to a small percentage of their former value. An elastic medium was also employed in the commutator to account for the difference in expansion of the insulated copper segments and the steel commutator shell. Numerous driving keys or fins, consisting of rawhide, were set in the

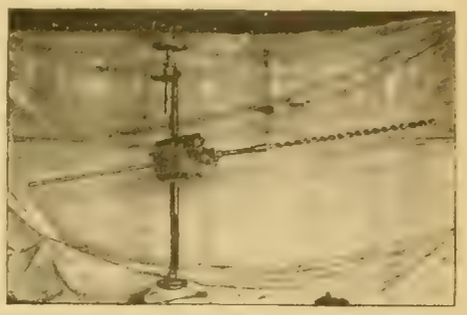

FIG. 11. ELECTRICITY IN BITUMINOUS MINING.

periphery of the armature and allowed to protrude for the purpose of securing the coils against circumferential displacement. The fields were not found to give trouble. With this construction of armature a large number of machines have been made and run successfully in mines in Illinois, Indiana, Ohio and Kentucky. In most instances these machines are run constantly day and night.

A detailed report of each day's work of these machines has been kept from the very first, stating the exact nature of any repairs, the name of the "machine runner," the number of feet undercut, hours of work, etc. These reports are kept on file, and have been of great value in aiding to eliminate the troubles developed. In Ohio alone these reports show that upward of 550,000 square feet of coal strata have been undercut by this type of machine. A somewhat larger amount than this has been excavated in Illinois. In the states of Indiana and Kentucky the operations have not been of so long duration, but at present the daily cutting in the latter states exceeds those in the former.

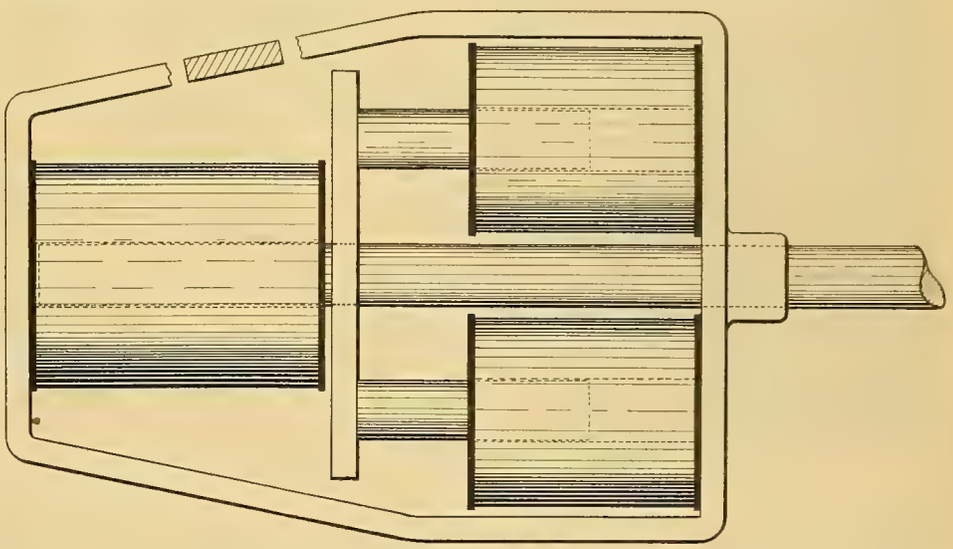

FIG. 10. ELECTRICITY IN BITUMINOUS MINING.

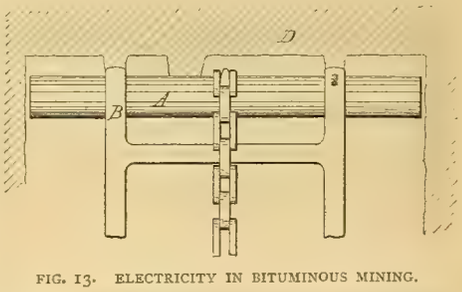

FIG. 13. ELECTRICITY IN BITUMINOUS MINING.

Beside the elasticity introduced in the armature gear, elastic cushions have also been introduced between the retracting device and the main gear, which is found to still farther reduce the shock to the machine. At an early date it was found that a machine capable of storing in each stroke of the heavy projectile as great an effort as is required for rapid and effective cutting must of necessity be heavy to be capable of backing up the blow without serious recoil, yet the machine on the other hand should be light for easy handling and direction by a single operator. With a light machine it is found impossible to allow

the cutter to strike the work sufficiently back in the stroke for its required penetration, without serious effects from recoil. The operator would complain bitterly of the machine running back upon him, jerking him about upon the floor of the mine, making accuracy of direction impossible, and yet lightness of the machine is important. To combine both qualities I devised a cycle of operation shown in the diagram, the object being to immediately start upon the act of retraction at the moment the projectile had been arrested by the work, no matter at what point in the stroke, eliminating thereby the time element necessary for overcoming the inertia of the body of the machine and starting it backward in recoil by the intense backward spring pressures. The details are simple and will readily be understood. The projectile *A* is forced forward by the spring *B*; a cushion *C* relieves the shock when the projectile is not otherwise intercepted. A gear wheel *D* is constantly driven in the direction of the arrow by the motor pinion *E*; this wheel is provided with internal ratchet teeth *R*. A crank *G* is mounted entirely free from the wheel and co operates with a long slotted pitman *H* connected with the projectile for retracting the same. A light steel crank arm is pivoted, entirely free of the wheel *D*, and an auxiliary arm *I* provided with a dog co-operating with the ratchet teeth *R*, is pivoted to the main crank arm at point *J* and connected with the crank arm through the circular steel spring *K K*. When the crank *G*, reaches the back dead center at point *m* a reversal of the strains and a free forward movement occurs in the direction of the rotation of the wheel, but very much faster under the impetus of the heavy compression of the driving spring *B*, the pitman and both portions of the crank moving forward together. Suppose now that the forward stroke was intercepted at the point shown in dotted line near the letter *A*; at this moment the crank *G* would be found in the position *X* also shown in dotted lines, but its momentum and the slot in the pitman would instantly allow it to take up position *Y* also shown in dotted lines, being at an equal angle on the opposite side of the center. Its

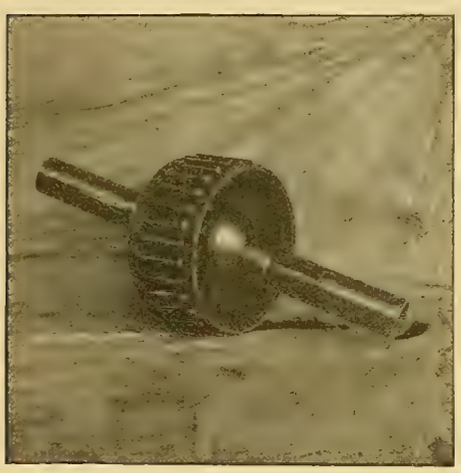

FIG. 16. ELECTRICITY IN BITUMINOUS MINING.

further progress would be intercepted by the remote end of the pitman, and at this instant the dog would instantly fall in the next tooth in the revolving wheel *D*, immediately commencing its work of retraction without the necessity of the full stroke of the pitman being accomplished. The work of the percussive blow is fully accomplished before full retardation, and while being intercepted. Nothing is accomplished by standing and pushing against the face, so that its immediate retraction is not found to interfere in the least with its effective operation, but on the other hand is found to eliminate entirely the serious effects of recoil upon the operator, allowing a light machine to be easily and completely directed while at work. Modifications of the details have been employed, but the general principle has been found to work extremely well in practice. The machine efficiency from the current, on the one hand, and the blow of the pick upon the other has been found to be in excess of 70 per cent.

Another form of the direct blow machine has been constructed operating upon the solenoid plan; two and three solenoids have been employed in various combinations. It has been found that the return of energy was extremely small until an approximately close magnet circuit was reached. Another point found was that the effectiveness of the blow was materially decreased if the magnetic circuit was closed beyond a certain point, the reciprocation of the solenoid core being dependent upon the non-closure of the magnetic circuit. Diagrams are submitted herewith, showing the various mathematical functions of the machine.

In the Figs. 5 to 8 the ordinates show different withdrawals of the core, and the abscissæ show other functions named in the diagrams. The pressures obtained in case of both single and double coils shown in diagram, Fig. 9. Fig. 10 indicates the general arrangement of the solenoid machine. The total weight was about the same as the weight of the spring-actuated machine, and the energy absorbed somewhat in excess. The mean effective pressures, however, are not nearly as great, as diagram

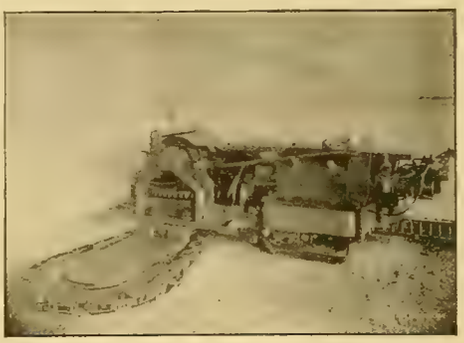

FIG. 14. ELECTRICITY IN BITUMINOUS MINING.

9 indicates; especially is this the case when the work was intercepted, say one inch from the end of the stroke, as at point *A*, in this diagram; the mean effective pressure falls from 259 to 210, decreasing, instead of increasing, as in the case of the spring machine. It was possible to recover in the solenoid machine nearly 10 per cent. of the energy expended during the first few minutes, but the heating effect was found to seriously interfere with its protracted operation.

In drilling holes for blasting, an auger machine is used, used, shown in Fig. 11. In this case the auger is driven by a single reduction motor, the rod holding the auger being provided with a featherway for driving and a screw-thread for the feed. An automatic attachment is placed upon the nut of this screw feed, by means of which, when sulphurs or other foreign substances are encountered, the feed is automatically relieved, the progress being inversely to the density of the strata. The machine is made light, and is usually fastened from roof to floor. One machine will drill about fifty holes 6 feet deep per shift of nine hours. The speed of its penetration in ordinary coal is about 3½ feet per minute. It requires about 3½ amperes at 220 volts. Both this and the pick machine are provided with a starting rheostat combined with or located interior to a cable reel which accompanies each machine. The flexible cable reaches back from the machine to the wires in the entries. The core of this cable is small, and although insulated clamps have been persistently shipped, secured to the ends of the cable for its attachment to the entry wires, it has been found that the miners almost invariably cut them off and prefer to simply bend the end of the cable in the form of a hook, and hang it upon the entry wire. This allows of their being readily pulled off upon the completion of the work without the necessity of going back to the mouth of the room, and at the same time seems to provide all the contact required.

As to other machines it may be stated that they are divisible into two general classes—the revolving cutter and the chain machine. In the former the cutters are secured to a revolving bar, which is forced against the substance to be cut. In the latter the cutters are inserted in a chain running over suitable sprocket wheels fastened to a frame, which extend under the coal supporting the entire cutting organization. The chain as it passes out from the coal goes around a driving sprocket from which the power is obtained. Many attempts at the construction of the former class of machines have been made, which have resulted in entire failure. From my own observation and experience I have found the following to be true with reference to this class of cutters. In Figs. 12 and 13, an outline view of such machine is shown. *A* indicates a rotating cutter bar; *B* the journals of such bar; *C C* the knives or cutters secured to such bar; and *D D* is the coal strata in which the cut is being made. It will be noticed that immediately before the journals, where it is impossible for any cutters to be located upon the bar, there is a solid pillar of coal left. This must be broken up and dislodged by sheer forward pressure of the end of the journal. Furthermore if foreign substances are encountered by the bar the cutters are usually entirely stripped off at this point. This leaves a pillar uncut as illustrated in the figure, which makes further progress entirely impossible until the machine is withdrawn, new cutters inserted and the pieces of the old ones carefully removed from the kerf. If the machine is not of great strength other portions sometimes break on these occasions, and the machine is laid up for a number of hours and even days for repairs. I have found that in using a chain as shown in the cuts of the longwall machine now to be described, if some of the cutters are broken others immediately take their place, and the cutters upon the chain will continue to attack and finally dislodge the foreign substances; in any event the chain will continue to cut so long as any teeth are left upon it, and their absence is easily observed by the operator, inasmuch as all the points in the chain are constantly passing any point of observation outside of the kerf.

The extremely small amount of room between face and props in the longwall mines sometimes precludes the possibility of even using a very short reciprocating machine. I have therefore resorted to another form of machine to be used in connection with this style of mining, consisting of a mechanism about 5 feet in length, about 20 inches wide and 18 inches high, from the side of which protrudes a cutting device operated by an electric motor forming part of the machine. This is organized to travel along the face and undermine to a depth of three feet, usually working in the strata below the coal known as "fire-clay."

A number of these machines are in daily operation in the northern district of Illinois. A single machine has repeatedly undermined as high as 1,500 feet per nine hours. The machine weighs somewhat over a ton and travels upon a rail located at one side, which at once provides support for the machine, means for providing against the twisting strains of the lateral cutting device and providing at the same time for feeding in either direction. These rails are in sections, and are taken up after the machine has gone over them, are passed to the front over the machine on rollers provided for the purpose and are laid ahead. The pintles used to connect the rails form, with the other pintles, members of a series by means of which the feeding along the rail is effected in a simple manner, and one that has proven successful in actual work extending over a considerable period of time. The machines are shown in photographs presented here-

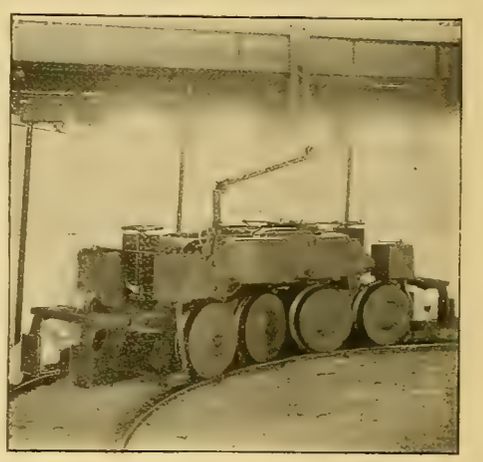

FIG. 18. ELECTRICITY IN BITUMINOUS MINING.

with and have been in use upward of two years. They require 22 to 35 amperes for their operation at 220 volts. Flexible cable of 150 feet is provided, which, being attached to the live wires ahead, allows the machine to cut 300 feet before readjustment is required.

After the product has been loaded and the cars massed in trains, their transit to the surface is a problem that has received considerable attention from the mining engineer. There are three prominent systems of mechanical haulage in operation. One in quite extensive use is the tail-rope system, where a main traction rope leads out from a drum over numerous pulleys and rollers to the front of the train. A tail rope of lighter weight leads from another drum on the same shaft over numerous grooved shives at the side of the track, or suspended from the roof over a "bull wheel" at the farther end of the track, coming back upon the track-rollers and being secured to the rear of the train. Each of the drums is detachably secured to the driving shaft of a powerful engine. The train is only under control of the distant engineer. A trip rider usually goes with the train, and a rather complex system of signals is employed, by means of which he may possibly communicate with the engineer.

Another system of growing importance is the endless rope, which consists of a slowly moving wire cable usually requiring double track and double-width entries, single loaded cars or trains being coupled to the rope by grips at the inner end, which are disengaged at the receiving end and attached to the "empties" standing upon the other

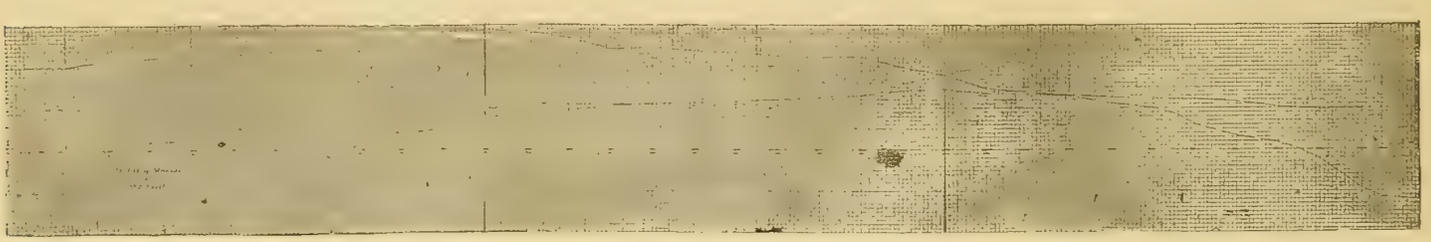

FIG. 15. ELECTRICITY IN BITUMINOUS MINING.

track, and are thus gripped to the outgoing cable and sent on their way back. A large number of extra cars are required, owing to the slow movement of the cable. In some instances trip riders are employed to accompany the train. In some mines grip cars are used. In both of these systems a large amount of power is expended compared to the work performed, and the speed is of necessity limited. Another drawback is the excessive complication necessary in track, innumerable rope sheaves, timbering and entry to provide for turn-outs, crooks, cross-overs, ventilating traps, etc.

Electric haulage has been looked upon by the foremost operators as the coming system, and one which is destined to solve the problem of economical transfer of the heavy product in mines. In studying the problem of electric haulage for mines one is met with the fact that the tracks are poor and light, the road bed is crooked and irregular as to levels and generally of light construction. The curves, owing to the necessity of leaving pillars, and having connected sight entries admit only of small radius curves, and excessive grades are often met with in the dip of the vein, which cannot be obviated by cuts or fills as on surface roads, without great expense, especially if the entries are timbered, which is usually the case in western collieries. Yet a service of the highest efficiency and greatest capacity in speed and tractive power is required. The motor must work double shifts if necessary, and be at all times under perfect control of a motor man receiving $2.25 per day, and never fail for an instant.

After considering the problem I have designed a motor shown in the accompanying photographs. A number of plants containing this motor are now in daily operation in Ohio, Indiana, Kentucky and in this state (Illinois). Two of these plants have been installed in one mine in Illinois. Profiles of the entries in which these cars are in operation are represented in Fig. 15. These show grades as high as 7 per cent., 5 per cent. being not unusual.

The matter of stability of road-bed is a relative one. There are conditions under which a 10 pound rail would be as stable for a light locomotive as the New York Central's 100 pound rail is to the tremendous load per driver in the high speed locomotives recently placed in service on that road. Pounds' pull at the draw-bar is only obtainable by pounds' weights at the rail, yet for a heavy draw-bar pull it is not necessary to have the weight upon any one driver excessive. In designing the locomotive I have employed eight drivers grouped in two swiveling trucks free to turn on the shortest radius curves—as short, in fact, as nine feet radius, measured from the center of the track. A single powerful motor constituting the frame of the car is coupled to all eight of these drivers, the coupling being simple and of such character as not to be interfered with in the least by the change of alignment between the truck and the car body upon irregular track or in making curves. This, while being rather a difficult problem, has been successfully worked out, as shown by the fact that none of the locomotives have ever required repairs as to this portion of their mechanism, although the first has been in operation about two years. Fig. 16 illustrates the central feature. Steel tires of a special grade are employed on all the drivers and the fact that they are driven from a single motor insures absolute uniformity and harmony in their peripheral speed. It is to this fact, as recently stated in a paper before the Chicago Electric club, that I attribute the extremely satisfactory results in traction which have been observed, it being demonstrated both in shop tests and under conditions of actual service that two motors without mechanical coupling do not show results that are at all comparable. In regular service as high as 25 per cent. of the weight of working strain which tends to seriously rack the frame increasing the flange friction and giving uneven wear upon the drivers. With eight wheels, however, I have found it preferable, and in fact this practice is followed in all installations, to sand upon both sides and obtain the "bite" upon the rail through the silicates from at least six drivers out of the eight. The sand, by the time three wheels have passed over it on either side is sufficiently broken up to allow the fourth pair to get a fairly good contact with the rail for electrical conductivity. This is an accidental feature in the use of the eight wheel car which is of great value. The machines themselves are low and narrow, the height being between 34 inches and 36 inches, accommodating themselves thereby to the lowest entries. Three sizes have been built, namely eight, ten and twelve tons, Figs. 17, 18 and 19. The motor of the largest of these is of 125 horse power capacity; 250 volts is the highest that has been used in connection with the machine. The temperature of the machine is very low, not exceeding 60 degrees above the atmosphere on a ten hour run. These machines have been operated on as low a rail section as 10 pounds with fairly good results. The heaviest rail that has ever been employed in connection with them is 20 pounds. This makes an extremely inexpensive track, not only eliminating entirely the light track argument used against electricity by advocates of rope haulage but "goes them one better," in that a single track with the most abrupt curves serves better purpose than double track with rope. In Streator No. 3 shaft of the Chicago, Wilmington & Vermillion Coal company a round trip on a haul of 7,000 feet, including switching at both ends, has been repeatedly run in 8½ minutes, part of the entry being a 3 per cent. grade against the loads. Thirty-seven pit cars of about two tons gross weight have been handled on this grade. The controlling mechanism is extremely simple, a single hand wheel serving the purpose of start, stop, acceleration and reverse. A rheostat and series fields are used. The rheostat is of most durable construction consisting of iron and asbestos. The trolley wire is upon the roof and follows the line of the track at a distance of about six inches outside of the gauge line of one of the rails. Excellent results have been obtained by the use of an elastic medium being located between the trolley wire and the solid mine roof, one form used being among the exhibits. The elasticity prevents concussion of the rapidly moving trolley, obviating thereby the serious sparking often, and most easily observed in mine entries, where nothing but the most intense darkness prevails. To my mind the extreme facility with which electric power can readily be transmitted by the mere contact between conductors has no parallel in any branch of physics. I have often observed the simple contact between trolley wire and wheel while 150 horse power, namely 300 amperes, was being transmitted to the motor, each of the eight drivers slipping vigorously on the sanded track throwing fire which illuminated the surrounding mine walls, while the trolley, with the exception of slight infrequent scintillations, was perfectly dark and of extremely innocent appearance.

A number of special and automatic devices have been employed in connection with the system with excellent results. Powerful electric headlights are used in each end of the locomotive, and in the twelve ton type Fig. 19, the end is carried out providing a cab which entirely surrounds the motor-man with high walls of metal 2 to 3 inches thick, entirely protecting him against collision, piling up of cars, falls of rock, etc. I have operated this motor on tracks which if seen by daylight would be adjudged unsuitable entirely for even the roughest mule service, handling heavy trains at a rate of speed of 2700 feet per minute, being somewhat over 30 miles an hour. The perfect flexibility of wheel base of the motor is doubtless responsible for these excellent results. Compound-wound dynamos of about seven tons weight are used to furnish current for the machine, Fig. 20, These are designed for sufficient excess of capacity to operate other devices in connection with the mine. In one mine at the south we have coupled to a single dynamo and engine one of our eight ton haulage cars, electric lights at all partings and switches, and on top in engine room and at a store, electric mining machines of the direct blow type, and an electric drill for blasting, by means of which the entire machine may be depended upon for draw-bar pull, and considerably over one-half of such weight has repeatedly been shown on the dynamometer. The wheel base is entirely flexible, distributing equal portion of the total weight upon each driver under all conditions of irregular track. The trains hauled by these locomotives frequently have as high as 200 wheels upon the track. The pit car wheels are constantly oiled, distributing an excellent lubricant from one end of the track to the other, and I have found for rapid acceleration work on heavy grades and quick action of the brakes that sand is almost as indispensable as the current itself. In using the rails as return the sand is found to seriously interfere with the proper electrical connection to the rail, especially where four wheels only are employed. It is the usual practice in this case to use sand upon one side only giving a torsional machines the entire product of the mine is taken out. The mine, which was formerly ventilated by a furnace, at present has its air moved by a fan driven by a powerful electric motor, and an electric pump is at present being installed, all of which are operated from the same feeders. In Kansas a mine pump raising water about 800 feet and two very extensive endless rope hauls are operated from the same dynamo as our electric excavating machinery. The pumps are of simple construction, the motor being geared to the plungers by spur gearing. It has been found with the pumps, longwall machines and drills as well as in the case of the percussion machines, that mounting the pinion loosely upon the armature shaft and driving it with cushions, located between it and the armature, has worked a decided economy in repairs, showing its adoption to be along the line of good engineering.

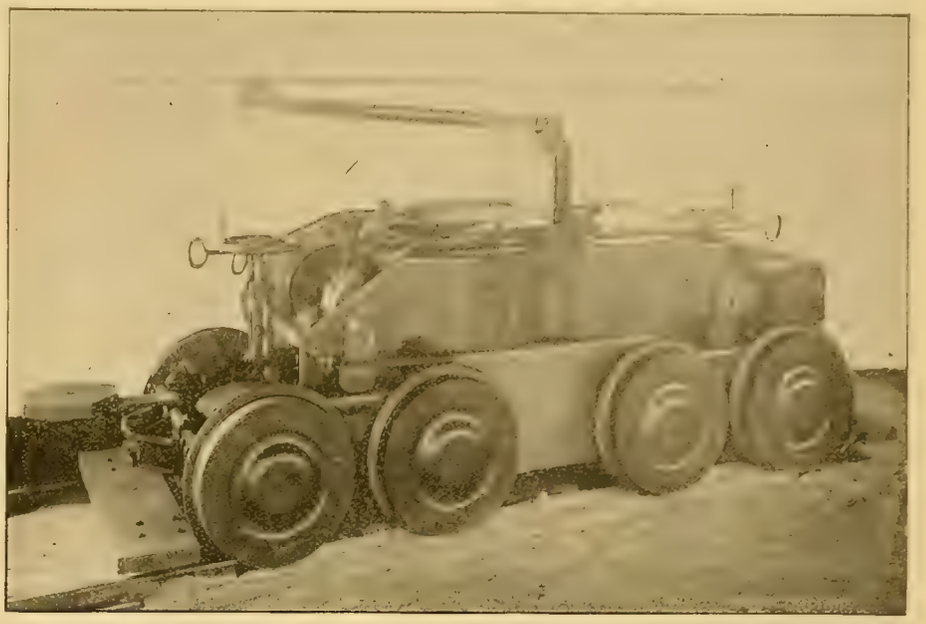

FIG. 17. ELECTRICITY IN BITUMINOUS MINING.

FIG. 19. ELECTRICITY IN BITUMINOUS MINING.

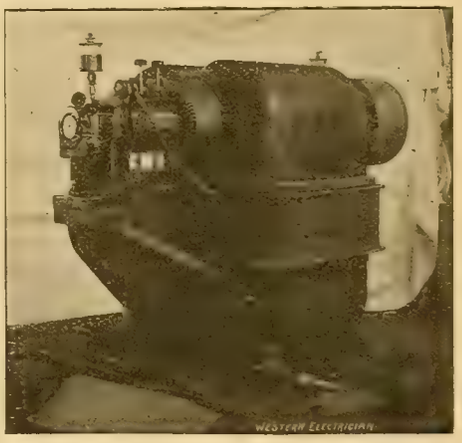

FIG. 20. ELECTRICITY IN BITUMINOUS MINING.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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ELMAR A. SPERRY'S Institute paper on "Electricity in Bituminous Mining" is presented elsewhere in this issue. Few people realize the extent to which electric power has been introduced into the mine, and Mr. Sperry's article will open the eyes of many.

In reading the paper one is impressed with the fact that its author has undertaken the solution of a pioneer's problems. Electricity in mining work was a few years ago unheard of, and after a purusal of the account of Mr. Sperry's labors in what is practically an unexplored field, there arises a wholesome respect for one who has done such excellent work. The paper treats the subject in a thorough but general manner. Doubtless, though, there will be electrical mining engineers who would have been better pleased had Mr. Sperry gone more into details in describing the numerous photographic reproductions that embellish his article. But, apart from this, the paper is a valuable one and ranks as one of the best read at the recent Institute meeting.

THE electric light in churches is not much of a novelty nowadays, but few will ever have a chance to witness the operation of so unique an installation as that represented on the front page of this issue of the WESTERN ELECTRICIAN. A traction engine in a church yard driving a dynamo which fed a temporary wiring system in the sacred edifice—and all gotten together in a marvelously short space of time—speaks well alike for the flexibility and adaptability of an electric lighting equipment and for the energy of the young Philadelphian whose enterprise carried through the interesting undertaking.

THE readers of the WESTERN ELECTRICIAN have all doubtless heard of Mr. Edison's reported statement to the effect that he had devised a trolley that would "pick up" current "through the mud." In another column a trolley is described that, it is fair to presume, is the device referred to. The contacting portion of this trolley wheel, it will be seen, consists of a number of pointed spikes sheathed in the hub of the wheel proper and so arranged each in connection with a spiral spring that as the wheel rolls, the spikes in its under side will be forced down through the mud into contact with the conductor.

If this is the device about which there has been so much gossip, and which, it was understood, was to be used in connection with a system of very low tension current supply, it would be interesting to hear from Mr. Edison as to the efficiency of these pointed spike contacts where they are called upon to conduct very heavy currents.

IT is an old story—the utilization of waste products about the manufacturing plant—but I. H. Babcock in another column points out most forcibly how electric lighting companies could advantageously imitate the business policy inaugurated by the gas companies. These latter concerns, Mr. Babcock reminds us, turn to excellent account their residual or so-called waste products, and he brings once more to the attention of managers of electric lighting stations the fact that exhaust steam might likewise be turned to good account.

Undoubtedly the electric lighting man will, as time goes on, pay more attention to "residuals." The electric lighting business can and does take advantage of the gas man's experience, but it must not be forgotten that from a practical standpoint the sale of the waste products of the gas works is much easier to accomplish than the disposal of exhaust or even live steam that requires for its distribution a special system of its own. Such men as Mr. Babcock, though, deserve credit, and will doubtless profit by their earnest pioneering work in this line.

THE subject of municipal control of street railways is attracting attention in London just now. The South London Electric railway is pronounced a commercial success and other similar lines are projected. It is contended that they should come under the jurisdiction of the county council like other tramways. One of the broad distinctions between a tramway and a railway according to the London *Electrical Engineer* is that a tram stops and starts whenever and wherever a passenger desires to get on or off, whereas a railway stops at and starts from fixed points only. There are many men disposed to look upon the South London line as merely a minature of what is to be. They expect in the near future the ordinary locomotive to make way for the electric motor, and that steam will be as quickly superceded by electricity as coaches were by trains. If their expectations come to pass the county council will have to deal with railways and not tramways. They will advocate compulsory purchase because of the definition "underground tramways," forgetting or ignoring that these tramways will, if the above views are correct, develop into more substantial works.

"Why should the county council monopolize tramways, and not cabs, 'buses and bicycles?" is a question propounded by our English contemporary. Surely one method of locomotion is not more important than another, it says, and we fail to see any reason that can be put forward for compulsory purchase of tramways that is not as conclusive for the compulsory purchase of 'buses. It is believed that if the existing electric railway should prove an absolute commercial success, and if the proposed railways are constructed and prove successful, extensions will undoubtedly take place, and circular systems joining all points of the compass will be developed, and approximate more and more to the ordinary railroad.

IT IS a matter for general regret that another hitch has arisen in the negotiations growing out of the incandescent lighting contract for the World's Fair. When Mr. Westinghouse telegraphed from New York that he had signed the contract, adding that "the surety company" would furnish the bond of $500,000, it was generally believed that the matter was at last settled, and everybody felt relieved. When the bond arrived, however, it was discovered that the company to which Mr. Westinghouse alluded was the Lawyers' Surety company, a new corporation which is said to have a capital of but $500,000, the amount of the bond. The World's Fair authorities did not consider this security as sufficient, under all the circumstances of this remarkable case, and notified the Westinghouse company that the bond furnished was not acceptable. Joel B. Erhardt, the ex-collector of the port of New York, is the president of the new company, and he appeared before the committee on grounds and buildings last Monday and endeavored to convince the directors that his company could furnish gilt-edged security. The committee was obdurate, however, and insisted on another bond. A certain feeling of irritation against Mr. Westinghouse is apparent among the officers of the exposition, owing to the delay in this matter, and there is a very evident determination to press the matter to a speedy settlement.

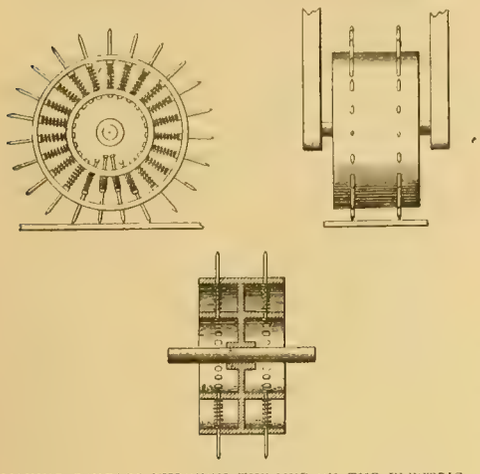
AMERICANS who believe that the cable business of this country should be conducted by American corporations, and that the cables employed for transmitting messages should be manufactured by American workmen in American factories and laid by Americans, look with no little dissatisfaction upon the advancement of Englishmen in this line, while this country is doing practically nothing to control this important department. It is a fact that a great majority of the submarine cables of the world are in British hands. These cables are made by British ingenuity, laid by British enterprise, and owned by British capitalists. They are in the Atlantic, the Pacific, and the Indian Oceans, as well as in the lesser seas, and they make London the telegraphic center of the world. British submarine surveyors have recently found a practicable route for a cable between Japan and the British Canadian provinces on the Pacific coast of North America, thus preparing the way for direct telegraphic communication to the Asiatic continent. The Japanese-Canadian cable will follow in the wake of the new Japanese-Canadian line of steamships. Africa will presently be connected with Brazilian America, and Asia will soon be connected with Canadian America, as Europe is now connected with the United States. For some time the subject of constructing American cables has been under consideration, and it is expected that within the next few years several cables of American construction will be laid. Americans should never again be compelled to send abroad for their cable lines.

SLOWLY but surely NewYork seems to be drifting toward the acceptance of the tunnel plan as the solution of the rapid transit problem. Property owners along the proposed routes have made a strong fight against the scheme, but in spite of these protests the commissioners appointed by the Supreme Court to decide whether public interest requires the tunnel have submitted a favorable report. This report will have to be confirmed by the court, which will hear argument on the subject before rendering a decision. If it is confirmed, the Rapid Transit commission will proceed to perfect detailed plans, specifications and conditions, and will then offer the franchise for the construction of the roads for sale, in accordance with the requirements of the law.

All this bodes good to the electrical fraternity. With the example before them of the conservative Baltimoreans and the confidence of a a great electrical company in the perfect success of the electrical locomotive equipment for tunnel work, New Yorkers cannot do otherwise than give electricity a trial. Once let such a chance be given, and it is easy to predict the installation of a permanent electrical equipment in any tunnels that may be driven beneath the streets of the metropolis. Present appearances are encouraging then. The commissioners have no doubt of the feasibility and desirability of using electricity as motive power, as it would not only obviate all objection on account of fouling the air with smoke and gas, but would materially reduce the vibration caused by running trains by steam power. It is said that all things come to him who waits. Electrical engineers have been waiting, and this time it is to be hoped the "things" will come.

Making Contact Through the Mud on the Electric Railway.

It will be remembered that there was considerable curiosity manifested several months ago in relation to a statement made by Mr. Edison to the effect that he had devised an electric railway trolley through which it was possible to "pick up" current from a conductor on the ground through mud and dirt. At the time referred to no explanation was offered as to how this feat was to be accomplished. Now, however, a patent has been allowed Mr. Edison on a trolley answering the description of that referred to. The accompanying cuts give a very clear idea of the construction of the contact wheel. The operation of this device is apparent. As the car moves along and the wheel turns, the lowermost spikes are in contact with the rail and are pushed in through the wheel-flanges, the springs being compressed and projecting the spikes outwardly against the conductor. The spikes are placed so close together that there is always a sufficient number in contact with the conductor to make a connection of sufficient conductivity for the purpose. The spikes are made preferably of steel, hardened at the ends where contact is made.



MAKING CONTACT THROUGH THE MUD ON THE ELECTRIC RAILWAY.

Electric Companies Should Economize Waste Products.

By I. H. Babcock.

Every city and every village of any pretention has its water supply for domestic and fire purposes. Systems of lighting by gas or electricity from a common center supply another necessity of our modern life. Why should the district system, now so universal and so popular, stop with water and gas? Heat in the northern latitudes for our buildings during eight months of the year is as much of a necessity as is water or light.

Some fourteen years ago Birdsill Holly of Lockport, N. Y., conceived the idea of conveying steam underground in wrought-iron pipes, for distribution to dwellings, stores, offices, churches and public buildings, in the same way that water and gas are supplied. The steam was to be economically made in large boilers at a central station, and a continuous supply furnished from the beginning to the end of the heating season.

Since the initial system was built and operated by the American District Steam Company at Lockport, N. Y., in 1878, there has never been any real question as to the feasibility of the enterprise. In constructing pipe lines for steam some conditions had to be met which do not exist in lines laid for water or gas. The pipes must have reasonably cheap protection to prevent undue radiation; and the contraction and expansion of the iron must also be provided for to prevent buckling and breaking the pipes.

The first desideratum was provided by the use of wood logs, bored to receive the iron, with an air space between the iron and the wood. The iron is thus defended from contact with the moist earth, and the wood under these conditions is found to be almost indestructible. Contraction and expansion are provided for by the patent service "variator," which is placed at proper intervals, and connected with the ends of sections of iron pipe. Service pipes are taken off from the main line at points opposite the buildings to be heated. In each building there is a regulator to reduce the steam pressure for house use, and a meter tells each consumer how much steam he has consumed. The steam is on tap constantly, and the consumer may use it by simply opening his radiator valves.

Some forty or fifty of such systems have been constructed and are now in operation in various parts of the country. This method of supplying heat is popular wherever it is in use, for the reason that the taker of district steam is spared labor and care, risk of fires in the building, and the dust and annoyance incidental to the handling of coal and ashes. The absence of gas from an individual heating apparatus, which usually vitiates the air, and the constantly uniform temperature of rooms heated from a central source of supply are found to greatly promote the health and comfort of the family.

Within the last few years a new phase of district steam heating has presented itself, in connection with the large number of steam power plants which have sprung up in nearly all our cities. With advancing civilization electricity has become a potent factor in the events which make up the history of our every-day life. That subtle fluid not only lights our buildings and our streets, but carries the motive power which propels lines of street cars and other machinery for industrial uses both great and small. The sudden rise of this industry has led to the rapid construction of great power stations, in some cases thousands of horse power being generated under a single roof. In the engine work of these stations it is well known that only about ten per cent. of the heat units of the steam is converted into energy, and nearly nine-tenths is still available for the heating of private and public buildings. Where the station is located, as most of them are, contiguous to business houses or resident sections, underground lines of pipe can be laid and connected with the exhaust pipes of the engines, and made use of to distribute this steam wherever it may be wanted in the district.

Some electrical companies are already deriving a large revenue from this otherwise waste material, and many others are preparing to profit by the application of this method.

Electrical work follows the rule which applies in all other successful enterprises. Close business management and the utilizing of all the forces at command are necessary to financial success, and without financial success, the prosecution of no enterprise can be permanently continued. When the business of the electrical companies becomes as well systematized as is the manufacture and sale of gas, there will no longer be a question as to its success financially. The gas producing industry is not going to be driven to the wall by this new comer; each system will occupy its allotted field, but there will be a wholesome rivalry, in which the new candidate will be obliged to adopt some of the business methods of its older adversary.

The authorities of Cleveland, O., not long ago demanded of the gas company a lower price for the gas supplied. In the investigation in court which followed, Engineer Hyde testified that it actually cost his company 48 cents per 1,000 feet to put gas in the holder, but that residuals are worth 27 to 30 cents per 1,000 feet of gas manufactured, showing that the first cost of gas was reduced 60 per cent. in the sale of by-products. The cost of distribution Mr. Hyde placed at 30 to 34 cents per 1,000 feet, making the total first cost of production and distribution about 82 cents per 1000 feet. Deducting the value of residuals, the net cost to the company was shown not to exceed [illegible] cent per 1,000 feet, or a saving of nearly [illegible] per cent. by the use of waste products.

This data I intend to show to [illegible] in use in a long established business with the view of enforcing the application of similar methods in the affairs of electric companies.

Every 100 horse power of steam used for engine work will heat, after passing the engine, 1,000,000 cubic feet of space in buildings. This exhaust steam is a residual in the same sense as the so called residuals which the gas companies turn into money. In one case these are made to pay dividends, while in the other they are too frequently thrown away. In view of the facts as stated, would it not be wise for many of the electrical companies to imitate the methods and business policy of their older and longer established rivals?

Telephoning Over an Electric Light Circuit.

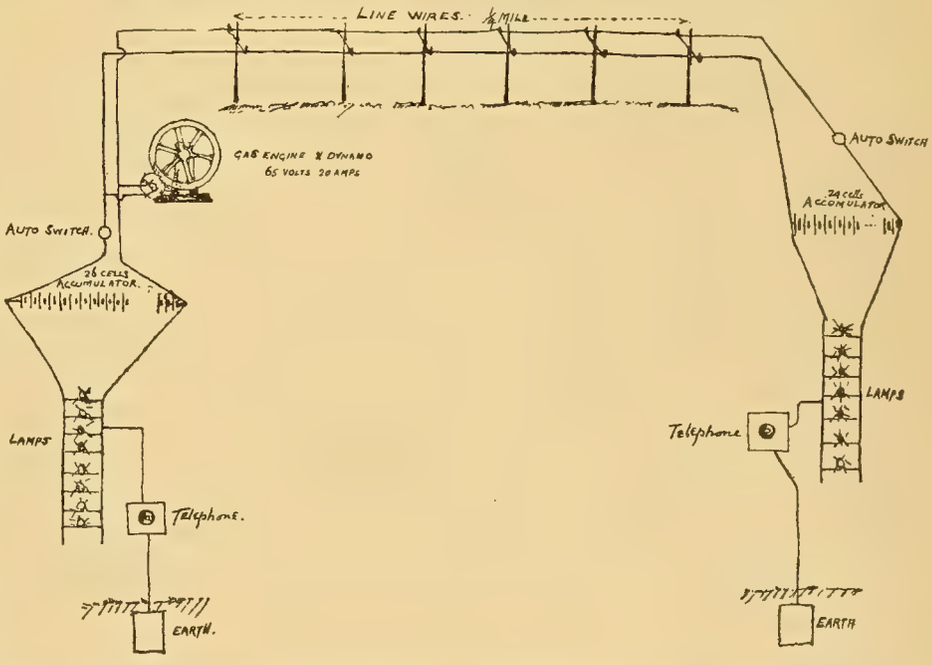
For the last three years there has been working a few miles from London a rather curious telephone line. The novelty of it consists in the use of an electric light circuit for telephonic communications and electric lighting purposes, either independently or simultaneously.

The interference when the two are working, says London *Electricity*, is so slight as to be barely noticeable, and indeed, unless one was told what it was, the slight rustling that is heard when the engine is running would never lead one to suppose a 10 or 12 ampere current was passing along the line, and that the vocal sounds were being produced by a slight variation of the 10 or 12 ampere current, caused by the respective telephone transmitters at either end of the line.

The length of the line is comparatively small, being only a quarter of a mile, between two houses. The gas engine and dynamos are situated some 30 or 40 yards from one of the houses, and the current goes into two sets of accumulators. The fluctuations of the current are considerable, amounting to some two or three amperes, due, of course, to the variable angular velocity of the gas engine fly-wheel. The wires at either end are tapped for the telephone in the particular room required, by simply connecting a short length of wire from the lead to the line terminal of the telephone. The actual connections of the system are shown in the accompanying diagram.

It is believed that the above method can be used for very much larger direct currents and higher pressure up to 1,000 volts, in all probability, without any risk, if slight modifications be made.

One result of the above installation has been that if a fault of any consequence is developed from either wire to earth, the bells at both ends are set ringing and give warning of the fact.



TELEPHONING OVER AN ELECTRIC LIGHT CIRCUIT.

The will of the late Charles Van Depoele was probated on June 10th, in Salem, Mass. Charles A. Coffin, of Boston, of the General Electric company, and Albert Wohl, an attorney of Chicago, were by will and without bond, named as executors and trustees of the estate, which is valued at about $50,000, with large royalties coming in.

The Magnetic Permeability of Special Irons for Electrical Purposes.[1]

By Milton E. Thompson, Percy H. Knight and Geo. W. Bacon.

During the last year or two there has been a marked change and improvement in the qualities of iron used in the construction of electrical machinery. It is now generally well understood that not only are the efficiencies of transformers, dynamos and motors increased by improving the quality of iron used, especially where this iron is subject to changes of magnetism and consequent loss by hysteresis, but also that the capacity of any given machine will be greatly increased by improving the quality of the iron. Thus, in the majority of dynamos, the capacity of the machine is limited largely by the heating of the armature, and the greater part of the heat developed in an armature is usually produced in the core. If the heat developed in the core can be reduced by improving the quality of iron used, enough extra current may be taken from the armature to balance this saving in the core. Again, in a dynamo or motor the principal part of the weight of the machine is due to the field magnets. If the permeability of these field magnets can be doubled by improving the quality of the iron used for their construction, the weight of these magnets may be reduced in the same proportion. In many classes of dynamo machinery, as, for instance, railway motors and marine dynamos, this saving in weight and consequent increase in the capacity of a machine of given weight is of great importance. It has long been known that the magnetic value of wrought iron is several times as great as that of cast iron; but the readiness with which cast iron may be moulded to the desired shape for field magnets has kept it in favor for this purpose, in spite of its low permeability. A demand has arisen for a quality of iron which shall have high permeability and still possess the quality of being easily cast into the proper shapes for field magnets for dynamo machinery.

Many attempts have been made to improve the quality of cast iron, but for the most part with little or no success, and cast iron stands to-day as a metal having nearly the same magnetic value for any and all qualities, though some slight improvements have been effected by some makers, as will be seen later. Attempts have also been made to produce castings from wrought iron, and lately with fairly good success. This is accomplished in general by melting down scrap wrought iron in crucibles, rendering it fluid by the addition of a small quantity of aluminum and pouring as with ordinary cast iron. A great many extra precautions have to be taken to insure sound castings, and as a rule the castings made from this "mitis metal," as it is usually called, are rough and somewhat difficult to work, on account of their toughness. These castings have shown themselves to be of very much higher permeability than cast iron, and have rapidly come into favor, especially in the construction of railway motors. Makers of steel castings have also been experimenting with a view to producing a metal suitable for field magnets of dyanmo machinery. Some of them have been very successful in this undertaking, and steel castings for field magnets are to-day an undoubted success. Manufacturers of sheet iron have also been trying to keep up with their fellow workmen in this line, and not a little experimenting has been done with a view to the production of better qualities of sheet iron.

The writers have recently made, in the laboratory of Cornell University, quite a number of tests of samples of various special irons from different manufacturers through out the country. It was believed that some of the results obtained would prove of interest to the general electrical fraternity. The method used for these tests was a modification of that used by Rowland, the samples being prepared in the form of rings, and wound with two sets of windings, a primary and a secondary. The magnetizing current was passed through the primary circuit and measured by means of a Weston ammetor. A ballistic galvanometer placed in the secondary circuit measured by its throw the magnetic induction due to any given change in the magnetizing current.

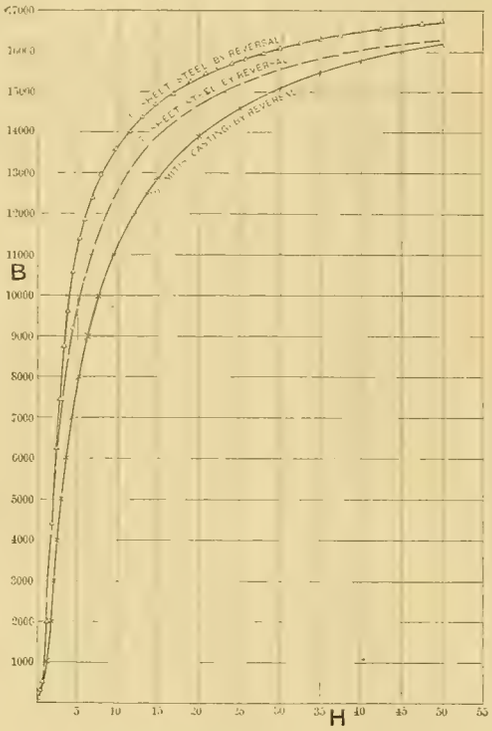


FIG. 3. THE MAGNETIC PERMEABILITY OF SPECIAL IRONS FOR ELECTRICAL PURPOSES.

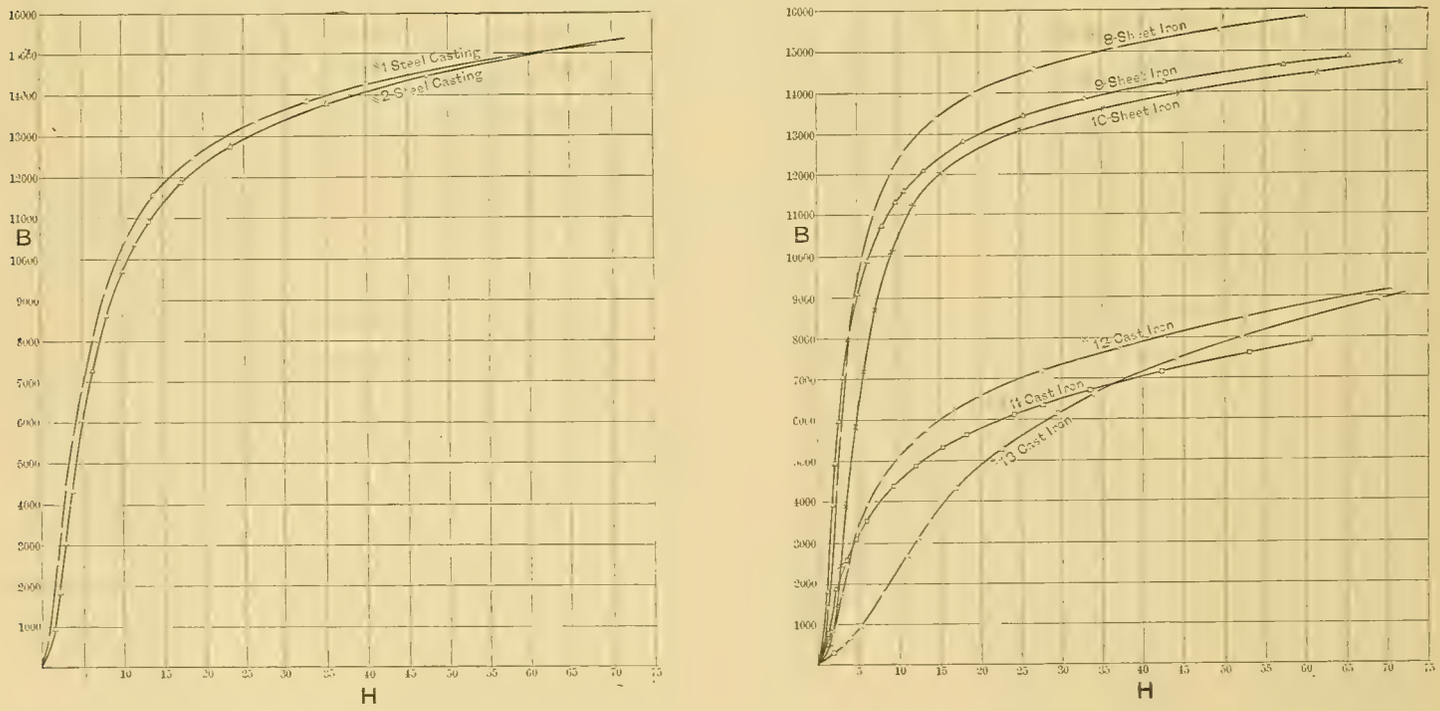
Two different plans were tried in taking the curves and found to give slightly different results. The first was the reversal method, in which the current was commenced at its maximum value, and its direction reversed several times by means of a reversing switch, in order to bring the magnetism up to its full value, the secondary circuit being open during this operation.

The secondary was then closed through the galvanometer, the current reversed, and the induction measured by the throw. The current was then slightly reduced, and reversed several times as before, and the induction again measured on reversing the current. In this way the magnetizing current was gradually reduced to zero, and from the data thus obtained curves were plotted with magnetic lines per square centimeter for ordinates and magnetizing force for absissae. In the other method, which was used for taking most of the curves, and which gives results more nearly like those obtained by Hopkinson, and which are generally accepted as standards for wrought and for cast iron, the sample was first completely demagnetized. In some cases this was done by simply reversing the current through the primary, and at the same time gradually reducing it to zero. By this method, however, no samples except those composed of wrought iron sheets were successfully demagnetized, which might suggest that the Foucault currents set up by the reversal of the magnetizing current tended to keep up the magnetization. An alternating current of both high and low periodicity was also tried without success, and it was only by finally heating the samples to a cherry red heat and allowing them to cool in air, so as not to change materially their softness, that total demagnatization was obtained. The sample being demagnetized, a small current was passed through the primary and the induced magnetism measured by the throw of the galvanometer. The current was then slightly increased, and the deflection of the galvanometer again noted. And so on up to the maximum magnetizing force, the current being gradually increased step by step. The current was then reduced step by step to zero, reversed, and increased step by step to a maximum equal to that of the other direction. This descending and reversal curve was taken simply to serve as a check upon the demagnetization and upon the accuracy of the observations of the ascending curve, and only the latter was plotted. Curves obtained from the same sample by the reversal method and by the step by step method were found to differ from each other by eight or ten per cent. at maximum values, the curves by the reversal process reaching the higher values. The magnetization of field magnets of dynamo machinery would probably reach values higher than that given by either of these methods of testing, for the iron being subject to vibrations from the rotating parts of the machine, and being at the same time under a continuous magnetizing force, would, no doubt, reach as high magnetic values as could be obtained by any method of testing.

The results obtained are embodied in the accompanying curves, which present the results of tests on samples of iron from a dozen different companies, in many cases a large number of samples of the same kind of metal having been tested. Referring to these curves: Fig. 1. presents curves of two samples of steel castings from two different companies. The curves show both samples to be of very good quality, sample No. 1 being slightly the better of the two. Fig. 2. shows two more curves of steel castings, No. 3 being an average curve of about a dozen different samples of steel castings furnished by one maker, and No. 4 being an average curve of several samples of steel castings furnished by another company.

The different samples represented in curve No. 3 did not differ very materially from one another, and there was but a very slight difference in the samples represented by curve No. 4. Curves Nos 1, 2 and 3 were taken by the step by step method, while curve No. 4 was taken by the reversal method, which will account for the high value of this curve, in a measure, though it is very probable that the quality of the steel represented by No. 4 was somewhat better than that of the other samples. The curves on Fig. 3 were all taken by the reversal method. Curve No. 5 is the average of two different samples of wrought iron castings from the same maker, the two samples prepared at different times and from different pourings, showing almost identical qualities. The magnetic value of mitis metal, as shown by curve No. 5, differs very little from that of steel of good quality, as shown by curve No. 4. Curves Nos. 6 and 7 are from two samples of sheet steel of somewhat peculiar manufacture, inasmuch as they are said to contain no manganese, that element being perhaps the most objectionable impurity in mild steel, so far as its magnetic properties are concerned.

The two samples from which the curves were taken were made as an experiment, and by slightly different



FIGS. 1 AND 4. THE MAGNETIC PERMEABILITY OF SPECIAL IRONS FOR ELECTRICAL PURPOSES.

1. Read at the general meeting of the American Institute of Electrical Engineers, Chicago, June 6, 7 and 8, 1892.

processes. They show excellent magnetic values, especially No. 6, and seem to indicate that "wheel" steel may some day come into extensive use for armature cores, etc. Curves Nos. 8, 9 and 10 of Fig. 4 are from three different samples of sheet iron used for armature cores and transformers by three well known electrical companies. Neither of these is up to the values given by Hopkinson for good wrought iron, but the difference in the method of taking the curves may account in a measure for their being lower. Those curves were taken by the step by step method. Curves Nos. 11, 12 and 13 of Fig. 5, are from three different samples of cast iron, used by three electrical companies for field magnets of dynamo machinery. Sample No. 11 is an ordinary quality of cast iron and differs from the values given by Hopkinson for cast iron by only an inappreciable quantity. No. 13 is rather peculiar, in that for high values of magnetizing force it is slightly better than ordinary cast iron, while for low values it is much poorer. Its magnetic properties are more like those of hard steel than of cast iron. No. 12 shows a metal whose magnetic value is from ten to fifteen per cent. higher than ordinary cast iron, the curve still keeping its same general shape. This sample would seem to indicate that there is such a thing as improvement in the magnetic qualities of cast iron. Curves Nos. 14 and 15 represent two different samples of wrought iron, used by two electric companies for field magnets. These curves were taken by the reversal method, and indicate for the metals a value considerably below that of the best wrought iron.

Curves Nos. 16 and 17 are both from the same steel casting, and show the difference between the step by step method and the reversal method. Curve No. 16 is by reversal, and No. 17 by step by step. Curves No. 18 and No. 19 are both from one sample of sheet iron, No. 18 being taken by the reversal method, and No. 19 by the step by step. A similar difference in the two methods is indicated by these two curves. Fig. 6 is an attempt at a comparison of some of the more interesting of the curves mentioned above. Curve No. 20 is Hopkinson's curve for wrought iron. Curve No. 23 is an average curve for steel castings, as made by four different companies. Curve No. 21 is a good quality of steel casting by the reversal method, and No. 22 is an average of mitis metal by the same method. Curve No. 24 is Hopkinson's curve for cast iron, and No. 25 is an extra quality of cast iron, which would seem to show that there is still a chance for the standard of cast iron to be raised. A comparison of curves No. 20 and No. 23 shows that the magnetic value of the average steel casting is only about 8 per cent. below that of the best wrought iron, and from curve No. 21 we might infer that it would be perfectly safe to use for the best steel castings the magnetic values given by Hopkinson for wrought iron. Comparing curves No. 21 and No. 22, we see that there is practically very little difference in the magnetic values of steel castings of the best quality and mitis castings, and there seems to be no good reason for believing that the former cannot be made of quite as good quality as the latter.

Comparing both of these metals with curve No. 24, their magnetic values are so far superior to that of cast iron that it seems quite certain that only the cost of production can stand in the way of their rapid and almost universal introduction for field magnets of dynamos and motors. When we consider that the cost of steel rails is but little different from that of cast iron, it seems reasonable to suppose that when the art of making steel castings comes to be better known and more fully understood, and better facilities are provided for their manufacture, such castings can be produced at a cost but little in excess of that of cast iron. Considering, then, the great superiority of cast steel over cast iron for electrical purposes, it seems safe to predict that the day is not far distant when steel castings will almost entirely replace cast iron in the construction of dynamo machinery, and the improvement in such machinery resulting from this change will be, perhaps, one of the greatest steps that have ever marked the progress of the electrical industry.

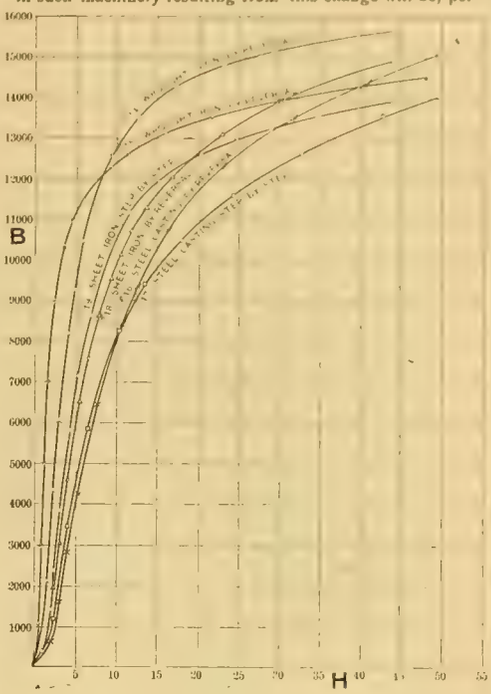


FIG. 5. THE MAGNETIC PERMEABILITY OF SPECIAL IRONS FOR ELECTRICAL PURPOSES.

Central Station Practice in Colorado.

When the electric lights go out in a Colorado mining town the citizens insist on knowing the cause of the trouble. The *Miner* of Fremont, Colo., thus describes an incident of this character:

The electric lights went out at the Buckhorn about midnight last night, and an employe was sent down to the works to get some one to start her up again. Not finding any one around the building, he hunted up the rope attached to the lever of the whistle and yanked it for keeps. The noise had the desired effect—all the employes of the electric plant were soon on hand, and the Buckhorn man sheepishly explained to the excited men the cause of the alarm. Several hundred of our citizens who had been reading the account of the great fire at Creede at once imagined that a like catastrophe threatened us, and pulling out their guns began [illegible] as has not been heard in the state since the late Indian war in which our militia burned so much powder. Cries of fire rent the midnight air, and people began running in every direction. Down-towners said it was on Main street. Up towners rushed frantically to Bennett avenue. The only fellow who was not excited about the matter was the fellow who pulled the whistle rope. He sighed, but said nothing. We still live and hope we shall be permitted to retain our building until we shall have formed a civic government and purchased a chemical engine or two.

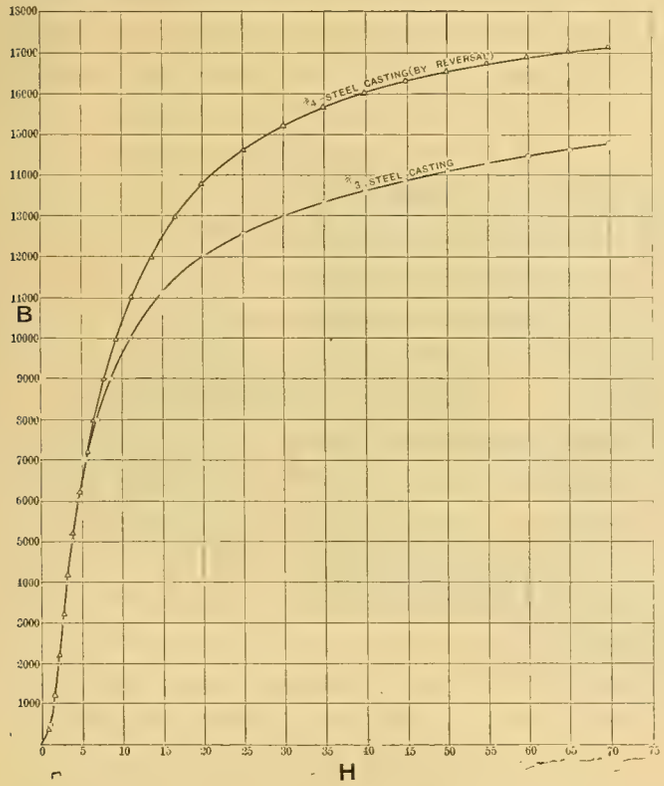
Association of Railway Telegraph Superintendents.

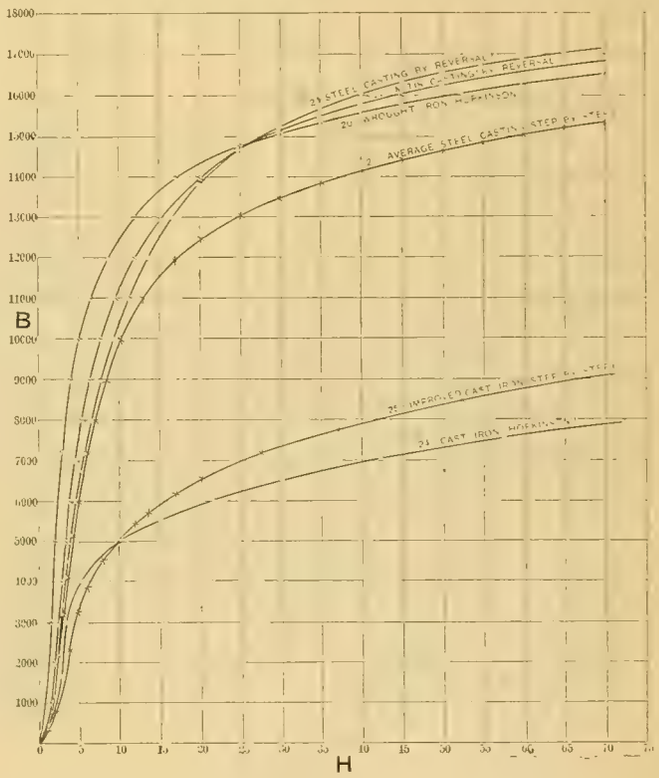
The annual meeting of the association of Railway Telegraph Superintendents was held in Denver last week. There was a large attendance of telegraph superintendents and their wives, and many papers of interest to the profession were read. After the convention adjourned on Friday a committee waited upon A. R. Swift of the Chicago, Rock Island and Pacific, the road which brought the eastern delegates to Denver, and presented himself and wife with a magnificent silver table service, on which the inscription was engraved: "Presented to Mr. and Mrs. A. R. Swift, in loving remembrance of their kindness, by the ladies and gentlemen of the Railway Telegraph Superintendents' association, Denver, June 16, 1892."

Recent Freaks of Lightning.

The recent severe storms have brought in their train many reports of injury to life and property by lightning. In Chicago, on June 16th, three persons were killed and a large number more or less injured by lightning at Lincoln Park. A throng of people had taken refuge from the storm in the masonry arches under the bronze statue of Grant when the shock came, and the result was as stated. It is presumed that the metallic figure attracted the electricity, although neither it nor the pedestal was injured. The track of the current was plainly marked.

The Chicago Edison company's station on Adams street was struck during the tornado of the 13th. No damage was done, save burning out the fuses on the house circuit. The sudden extinguishing of the lights at a time when all the energies of the force at the station were directed





FIGS. 2 AND 6. THE MAGNETIC PERMEABILITY OF SPECIAL IRONS FOR ELECTRICAL PURPOSES.

toward providing for the greatly increased load thrown on the plant by reason of the sudden darkness was very annoying, but the trouble was quickly remedied.

In Rochester, N. Y., Miss Libbie Sherman, living at 74 Lewis street, received a shock, from the effects of which she was unconscious for several hours. At the time the windows and doors of the house were open, and the current of electricity struck Miss Sherman, who was almost directly in the draft of two open windows. When struck

she uttered a piercing scream and bounded convulsively into the air. She quickly gained her feet and rushed for the open door. Her sister caught her and succeeded in holding her until assistance came. For two hours the stricken girl continued in severe and violent muscular convulsions. It required the united strength of two men to keep her in a chair. When Miss Sherman regained con-

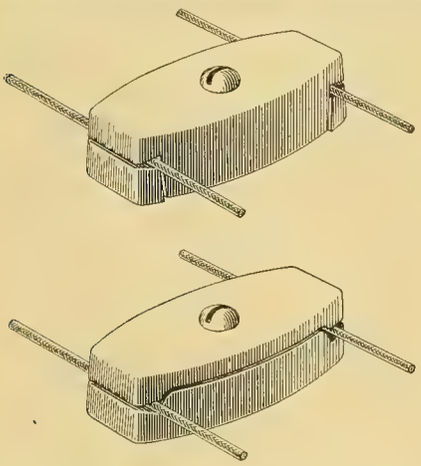
FIG. 2. SECHRIST'S METHOD OF CONTROLLING ELECTRIC LAMPS.

sciousness she could give no account of her experience, saying that all she could remember was a peculiar sensation—that her fingers and toes were curling up. She complained of severe pains in her head, her eyes were both blackened, and the muscles of her left cheek were contracted, drawing down that side of her face.

A dispatch from Madrid, Spain, reports that on June 12th ten persons were killed by lightning at Melias, Province of Orense, and five at Mucientes, Province of Valladolid. Strangely enough, each catastrophe happened to worshippers in the village church. Twenty-eight persons were injured at the former place and ten at the latter.

A New Cleat.

The "Security cleat" is the name given to its new porcelain two-wire cleat by the Security Insulator company of New York. The construction of this device combines neatness and utility with strength and economy. It is intended for use in incandescent wiring, and will hold securely wires of only ordinary diameter. By its use the

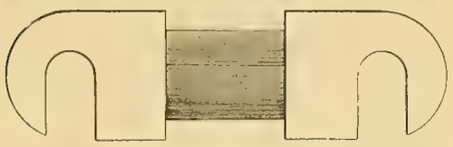


NEW CLEAT.

insulation is not harmed, neither is any kink made in the wire. The accompanying cuts show both front and back views of the cleat and are about one-half of the actual size. The cleats are manufactured either glazed or unglazed.

The Billberg Fuse.

The accompanying illustration shows the Billberg fuse, which is used in connection with the Billberg motors, generators, electric drills, etc. This fuse is made of two brass terminals connected together by means of strands of German silver wire. Each wire in the fuse is of a certain carrying capacity, so the total capacity of the fuse may be gauged by the number of wires in it. By this arrangement a perfect homogeneity is secured, and by the use of



BILLBERG FUSE.

wire strands there is obtained, it is claimed, an equal distribution of heat throughout the fusible portion of the strip.

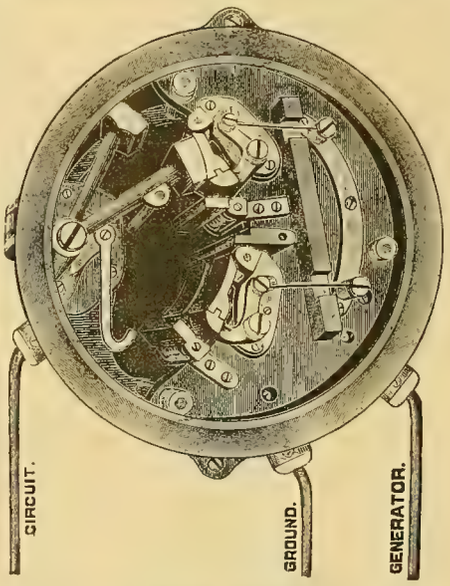
Thos H. Dallette & Co., New York, make these fuses of such size and style as to suit any cut-out or switch.

It is said that the Rome, N. Y., City Street Railway company may use electric power. In that event, it would be the intention of the company to become a competitor for the arc street lighting contract at the expiration of the present one, as well as to supply an incandescent service to those desiring it.

Sechrist's Method of Controlling Electric Lamps.

This system is especially adapted for operation in private residences, and the modern house electrician who seeks to satisfy the demand for convenience of arrangement in residence lighting will find that this method fills a long felt want. The arrangement and control of electric lights in modern houses is so little understood by the public that they depend almost entirely upon suggestions from the electric construction company which do the work, and such concerns will, therefore, find of interest the following description:

With the use of this system of lighting, which is the invention of and is being exploited by Albert Sechrist of Denver, Colo., a person may have absolute control of any or all of the lights from any part of the house; that is, a



LIGHTNING ARRESTER.

person may pass through the house in any direction without the necessity of ever being in the dark. By simply touching a button here or there one is enabled to turn on the lights ahead of him or extinguish lamps the light from which is no longer needed. The same lights, also, may be controlled from any number of different points. From the above it will be readily understood the arrangement is an excellent burglar alarm.

Mr. Sechrist's system consists in the simple combination of an automatic switch and push buttons, together with an ordinary battery or shunt off the electric light circuit. The push buttons employed are the same as those now in use to control ordinary electric gas lighting apparatus. The main feature of the system is the use of a peculiar style of automatic switch. This switch, which is illustrated in Fig. 1, is contained in a porcelain case, and answers the same purpose as an ordinary switch, but instead of its being operated by hand it is moved and controlled by means of push buttons, such as are indicated in Fig. 2.

By touching the white button one electromagnet, Fig. 1, attracts the armature, which closes and locks in place the electric light switch. A push on the black button brings into play the other electromagnet, and the action of this last named magnet serves to unlock and open the switch.

In installing the Sechrist system any number of push

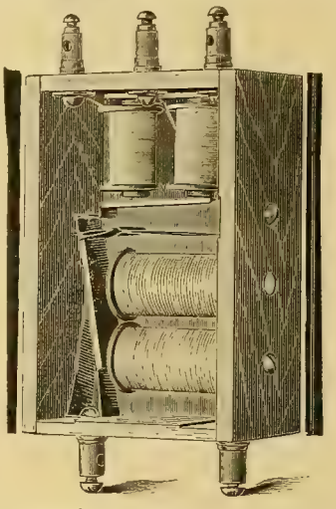


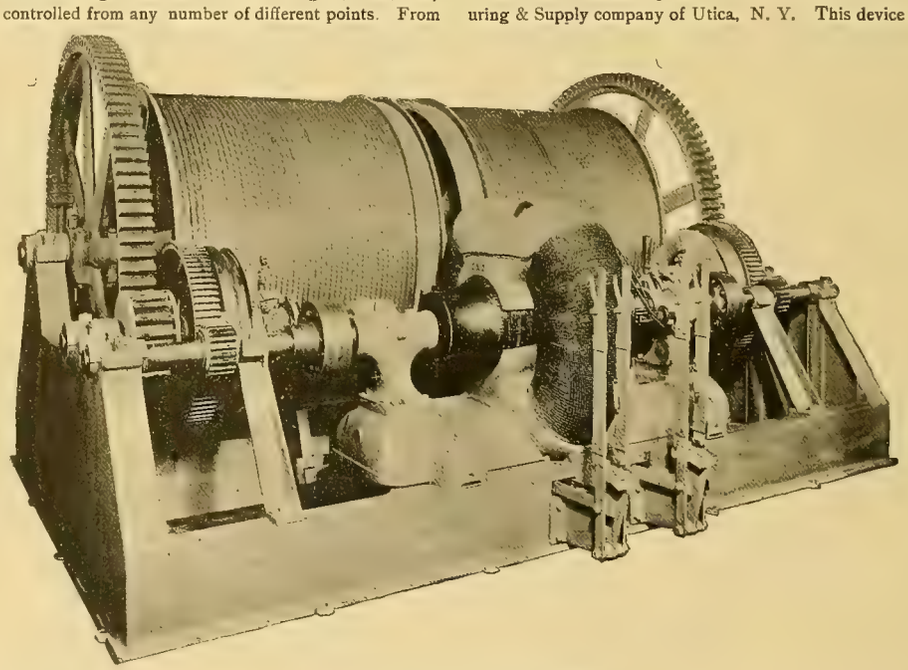
FIG. 1. SECHRIST'S METHOD OF CONTROLLING ELECTRIC LAMPS.

buttons may be located at different points to control the same switch. As will be seen, the switch is very simple in its construction and requires no adjusting. The switches may be located out of sight in any part of the house. The device may be applied to an ordinary lamp socket or it may be placed in the canopy of a chandelier; the location of the switch is immaterial; it may be placed to suit the convenience of the work.

It should be mentioned that although the Sechrist system has only been in use six months, over fifty residences in Denver have been equipped with it. It is understood, too, that prominent architects of Denver are naming the Sechrist switch in their specifications.

Lightning Arrester.

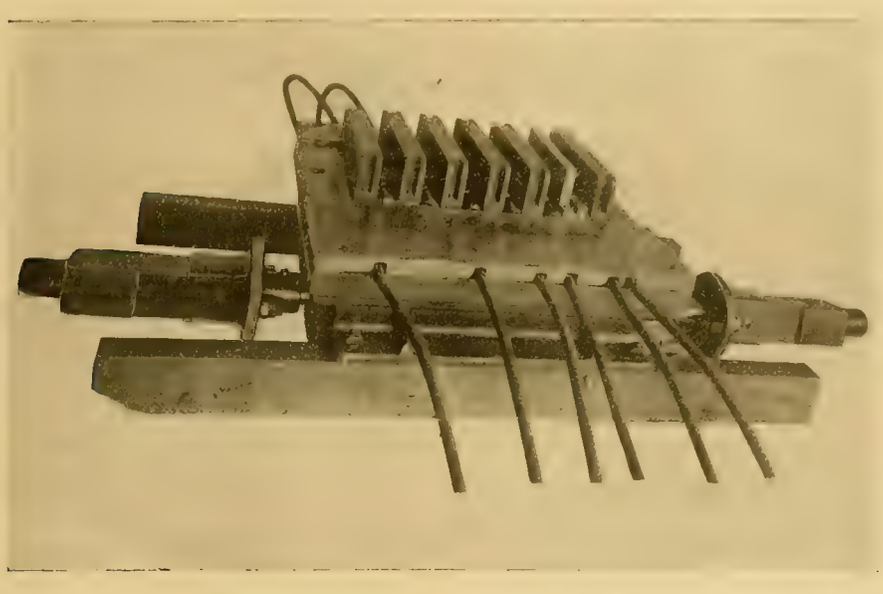
The accompanying cut shows the quadruplex lightning arrester manufactured by the Utica Electrical Manufacturing & Supply company of Utica, N. Y. This device is similar in construction to the Utica company's simplex and duplex arresters, and is designed for street railway, light, and power plants. The device illustrated, it is claimed, will take care of four lightning bolts in succession before requiring attention, and all the damage the lightning can do is the melting of a fuse wire which can be readily replaced. The contacts of the arrester are made of bronze metal and are very heavy. They are mounted on slate and are inclosed in a water-tight iron case, which is provided with porcelain bushings for the entrance of wires. No magnets being used in this arrester, it is equally suitable for either alternating or direct current circuits.



C AND C. ELECTRIC MINE HOIST.

New Thomson-Houston Controller for Car Motors.

The Thomson-Houston Electric company has for a long time been experimenting with the view of developing a controller for railway motors that would be an improvement on those now generally used. It is well known that the regulation of motors by means of a resistance only is decidedly wasteful as well as troublesome. It, in fact, involves the consumption of nearly as much energy when the motor is running at a slow speed as when running at a high speed, although the work given out by the motor in



NEW THOMSON-HOUSTON CONTROLLER FOR CAR MOTORS.

the two cases is very different. It simply means that the energy which, in the one case, drives the motor at a high speed is, in the other, partly expended upon the resistance, and the remainder only, is used to drive the motor. It has been customary to modify this method of regulation in well designed plants by providing, in addition, a device for changing the field magnets of the motor so that the counter electromotive force for a given speed will be greater, and permit, in consequence, of the use of a smaller amount of resistance. In some cases these two methods of regulation, by means of resistance and alteration in field magnet strength, have been combined in a system of commutating sections of the field magnet coils, by which the coils themselves offer a greater or less resistance to the passage of the current, and at the same time have a variable effect on the field magnet strength. In other cases the combination of the two methods has been effected by having a separate resistance external to the motor, and then in addition, providing a switch to cut out a section of the field magnet coils or "loop" as it is often called, or to shunt a portion of the current around them for highest speed.

These methods have served a most excellent purpose, but it has long been the belief of Thomson-Houston engineers that a new method of motor control would be eventually developed which would secure as nearly absolute economy as possible, and at the same time be free from the troubles inherent in the use of resistance and commutated field circuits with the sparking at the commutator which ensues where such commutation is carried to an excessive degree. After a long series of experiments the Thomson-Houston company is now placing on the market a controller which, it has satisfied itself, is thoroughly practical, and which at the same time accomplishes, it is believed, almost a perfect theoretical economy in regulation. In a number of instances where this regulator has been used for some time, the company claim a saving of thirty per cent. in consumption of current has been effected.

The principle upon which the new controller is based is the shifting of the connections of two motors from series to multiple, so that for slow speed the two motors will be in series, giving in consequence a high counter electromotive force at a low rate of speed, while for higher speed they are connected in multiple, in which condition highest speed and power are obtainable with equal economy.

In the accompanying illustrations the general form of the apparatus which the company has adopted for effecting these changes is disclosed. They shows a top view and a bottom view of the new type "T" controller. As will be readily understood from an inspection of the cuts, the apparatus consists of a longitudinal shaft acting upon a series of switch levers to produce the various connections necessary to place the motors in series or in parallel. This controller is to be placed at any point beneath the car and operated by a mechanical connection from either end of the vehicle.

A Graceful Acknowledgment.

By an inadvertence the *Scientific American* recently reprinted an article first published in this journal without giving credit. Under the caption, "The Telephone in New York," it now makes the *amende honorable* in this generous fashion:

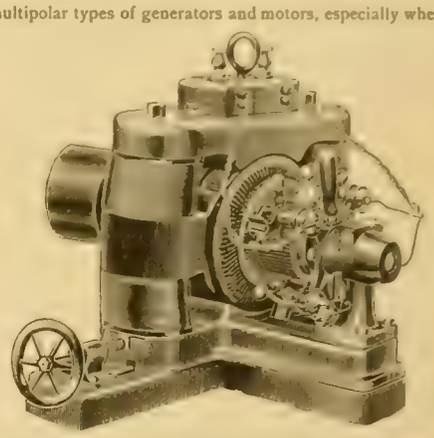
We are indebted to the WESTERN ELECTRICIAN for the interesting report under the above heading we recently gave, describing a visit of the members of the New York Electrical society to the premises of the Metropolitan Telegraph and Telephone company. Due credit should have been given at the time. The WESTERN ELECTRICIAN is one of the most enterprising and successful electrical publications in the world.

C. & C. Electric Mine Hoist.

The illustration on page 382 shows an electric mine hoist recently installed by the C. & C. Electric Motor company, New York, in a mine at Corbin, Mont. At a rope speed of 400 feet this hoist lifts a weight of 5,000 pounds. There are two drums to run either separately or together, independently geared by two reductions to each end of the motor shaft. Each drum is five feet in diameter and forty inches long. The motor pinions are rawhide and their motion is transferred to the intermediate shafts by means of two Frisbie friction clutches. The motor is 65 horse power, and is reversible. The reversing and speed regulating switch, which is not shown, is placed conveniently near the operator of the four levers, which do appear. Two levers are for throwing the clutches in and out, and two are for applying the brake band on the inner peripheries of the drums. The bearings have ample length, and the whole machine is substantially made. It occupies a floor space of about ten by thirteen feet and has a total estimated weight of sixteen tons.

The Duplex Quadrupolar Generator and Motor.

Foreign electrical manufacturers have for some time been constructing multipolar dynamos, but American designers have done more work in the line of bipolar machines. There is a general disposition, though, at the present time among engineers on this side of the water to construct multipolar types of generators and motors, especially where



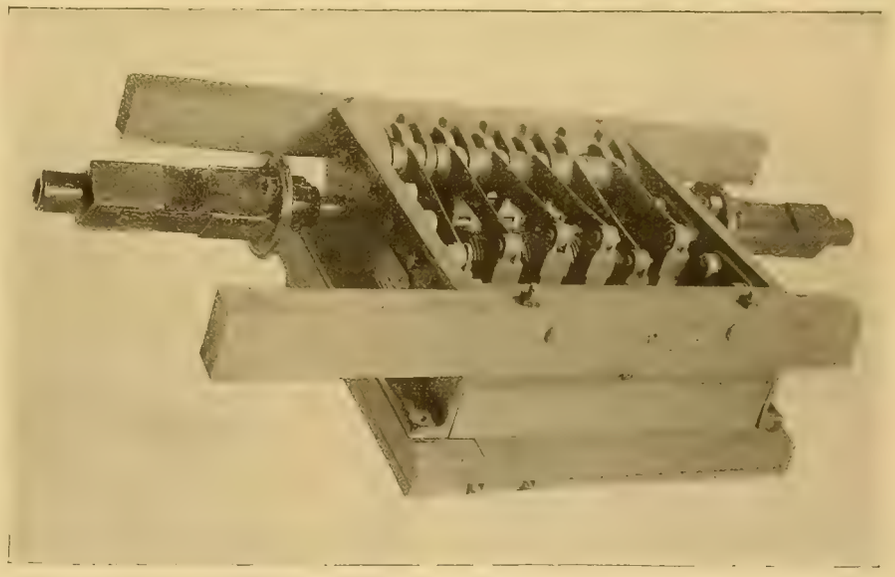
THE DUPLEX QUADRUPOLAR GENERATOR AND MOTOR.

the machines called for are of the larger sizes. The cut presented herewith represents a machine that might be referred to as an illustration of this tendency.

This machine may be taken as the type of the new dynamos and motors which the Duplex Electric company (limited), Corry, Pa., is now exploiting. As will be seen from the cut, the machine is quadrapolar. It is built to run at slow speed, and may be wound and connected for incandescent dynamo service or motor work. The machine takes up a very little floor space, and for its capacity is of small size throughout. Like the bipolar generator made by the Duplex company, these machines are thoroughly automatic, and no rheostats are employed in connection with them.

A Startling Project.

C. A. Münster, a scientist of Christiania, Norway, proposes to reclaim the gold and silver in sea water by electrolytic action. He suggests that a channel about 60 meters wide between two small islands, well sheltered from sea and wind, where there is a current of about four meters per minute, should be selected for experiment, such rocky islands being common off the Norwegian coast. Across this channel 60 plates of galvanized iron, each two meters by three meters, should be arranged at an angle of 30° with the stream, and an electric current be sent through the series to precipitate the precious metals. The power required theoretically for this purpose is calculated by Münster at only ½ horse power, and he thinks that "to produce a current of such trivial potential difference in practice would only require a motive force which could be cheaply obtained from water power, wind, or even by the thermo-electric principle, utilizing the difference of temperature between the sea and air. The large anodes re-



NEW THOMSON HOUSTON CONTROLLER FOR CAR MOTORS.

quired could be cheaply prepared from wood, impregnated with graphite and tar, and carbonized, high conductive power not being required for such a feeble current." The exploiter of this project says that the cost of the installation would be trivial; he calculates that over £300,000 worth of gold and silver would be obtained per annum, and that "if only one hundredth, or even thousandth of this amount were obtained, it would still pay well."

The Burlington Arrangement.

As the result of the contest over electric lighting in Burlington, Ia., a rather peculiar franchise has been granted the Thomson-Houston company. On May 9th a city election was held to determine the question "whether the city will authorize the erection of an electric light plant." This was decided in the affirmative by a vote of 2 350 "for" to 83 "against." In consequence, the Thomson-Houston company, by an ordinance finally approved on May 28th, was granted all the rights and privileges necessary for the operation of a central station plant, with overhead construction. By the terms of the franchise the company is required to erect a plant of sufficient capacity to furnish all light, power and heat demanded of it from time to time for public or private use. Work must be commenced within twenty days from the date of the adoption of the ordinance, and the plant must be in full operation by August 15, 1892. The section of the franchise in relation to prices to be charged for lights is unusual, and is reproduced entire:

Said company, its successors or assigns, shall keep the said plant in operation at all times, and furnish electric light, power and heat to all applicants therefor upon the following terms and conditions, to wit: To any inhabitant desiring light, power or heat, within a radius of one and one-half miles, taking the intersection of Jefferson street and the river as the center, at not to exceed regular commercial rates, provided, however, that said company shall not be required to wire for any consumer whose bill shall be less than one dollar per month, including meter rent. Said company shall furnish the aforesaid service outside of said radius and within the limits of the city of Burlington, as now or hereafter fixed, at like rates, provided, however, that said company shall not be required to make any extension of feeders outside of said radius unless the aggregate revenue from such extension shall average ten dollars per month for any one line.

"Regular commercial rates," as used in this ordinance, shall be construed to mean the average of the price charged for like service in any six cities in the states of Iowa and Illinois, whose population, according to the then last official census, state or national, is not to exceed seven thousand more or less than the population of the city of Burlington, Ia., at the time or times of fixing said rates; three of said cities to be selected by the city council of said city and three by said company, its successors or assigns; provided, however, that the price charged for sixteen candle power incandescent lamps shall not exceed one cent per lamp per hour.

The franchise is for twenty-five years, and after fifteen years the company must bury its wires, if required by the city, provided that all other companies be required to place their wires underground at the same time. The company agrees to light the city hall free, and to furnish lights for other city buildings at a reduction of 25 per cent. from the regular commercial rate.

Louis A. Ferguson Married.

Louis A. Ferguson of Chicago was married on Tuesday, June 21st, to Miss Martha A. Jenkins at Dorchester, Mass. Mr. Ferguson was given a complimentary dinner by his associates of the Chicago Edison company before his departure for Boston. He was also presented a very handsome clock. Mr. Ferguson will return to Chicago after his wedding trip and will make this city his home.

The Telephone in the Weather Signal Service.

The weather bureau has been making a thorough study during the past few years of the subject of thunder storms as distinct from general storms, and has at length arrived at a point where it is hoped some definite good to the public may be realized. Norman B. Conger, who was formerly located in Detroit, has been given charge of the work for Michigan, and an arrangement has been made with the Michigan Bell Telephone company, whereby information of such storms can be telephoned by voluntary observers and attaches of the telephone company in the weather office in Detroit in time to give a forecast to the state at large in advance of the storms.

"This class of storms," said Mr. Conger in the *Detroit Tribune*, "is much more erratic in movements than storms generally, but in this state they generally appear from a southwesterly direction and move towards the northeast. We have telegraphic arrangements outside of the state, but within the limits of the state as soon as a storm appears we will hear of it by telephone. A number of central stations have been arranged for, and the various observers will let them know at what time the storms reach certain points. Their velocity can thus be determined, and we can fortell with accuracy at what time the storms will reach other places. The ordinary rain signals will be used, and warning of six or seven hours may, in some cases, save much property. The system is being carried to a much greater state of perfection in Michigan by the bureau than in any other state."

CORRESPONDENCE.

New York Notes.

NEW YORK, JUNE 18.—Perhaps it was the weather, perhaps not, but whatever it was the only class of electrical workers that could furnish news this week were the railway men.

The Rapid Transit commissioners, appointed by the Supreme Court to determine the advisability of constructing and operating the underground railway, have at last filed a report of their investigations. The report, with one exception, confirmed the work of the regular commissioners, and agreed fully as to the practicability of an underground road from the Battery to Yonkers.

New York property holders will be interested in the following excerpt from the report: "The construction from South Ferry to Thirty-fourth street must be made by tunnelling, and that all buildings whose foundations did not extend below the bed of the tunnel should be sustained. The tunnel is to be constructed between the curb lines as follows:

"From Whitehall street, near South, under Battery Park and State street, forming a loop up Broadway and under Union Square to Fifty ninth street, thence to the boulevard across the government ship canal to Spuyten Duyvil Creek, then to the city limits. A loop will run from Broadway and Mail street to Park row, to Chambers street, to Broadway, and another branch from Union Square along Fourth avenue to Forty-third street.

"The tunnels will be eleven feet, eight inches high, and each track will be allowed eleven feet. There will be iron columns between each track for supporting the roof of the tunnel, which will be as near the surface of the street as possible. Across the Government ship canal and the Harlem river there will be double track drawbridges fifty feet above high water. All the tracks north of the Harlem River are to be on a viaduct.

"Electricity, or some motive power not requiring combustion, must be used able to make forty miles an hour exclusive of stops."

On June 29th a motion will be made to confirm the report.

W. F. O.

San Francisco, Cal.

SAN FRANCISCO, June 18.—That the institution of the General Electric company on the Pacific coast is at last a fact is now being evidenced in the changes underway about the San Francisco offices of the old Thomson-Houston Electric company. Previous to the present month the San Francisco offices of the Thomson-Houston company were located at 15 First street, occupying only the second floor of the building. Now the entire building, consisting of four stories and basement, is being remodeled, and by the first of July the place will be ready for occupancy. Only a few months ago the Pacific Coast District of the Edison General Electric company secured a five-year lease of the premises at 221–3 Pine street, consisting of the basement and three lower floors of a portion of the old telephone building, but how this lease is to be disposed of remains to be seen. In the new quarters of the General Electric company the first floor is to be generally occupied as a storeroom, but the offices of the accountants and selling agents will be located there also. The executive offices of the district will occupy the entire second floor while the floor above will be used as warerooms. In the front portion of the upper or fourth floor will be located the draughting room, and the rear of the floor will be used as a general repair and work shop.

It is now known that the general managership for the Pacific coast office of the new company has been conferred upon Dr. Thomas Addison, formerly of the San Francisco Thomson-Houston company, and the remarkable success which has attended the two years of Dr. Addison's administration with the old Thomson-Houston company augurs well for the future prosperity of the district. Louis Glass, formerly district manager of the Edison General Electric company, will, it is stated, probably take charge of the mining and long distance power transmission departments, and owing to his long and practical experience in mines and mining in California and Nevada a more fortunate selection for this department could not have been made. H. A. Russell of the Thomson-Houston company will perhaps have charge of the sales department, though he may possibly be assigned to duty as traveling agent. The electric railway department is to be under F. F. Barbour, formerly electric railway engineer of the Thomson-Houston company, while J. A. Lighthipe, district engineer for the Edison General Electric company, will be placed at the head of the department of lighting and stationary motor work. With each department under such thoroughly capable heads it would appear that Dr. Addison's corps of assistants will prove invincible.

S.

Western Canadian Notes.

WINNIPEG, June 18,—The Winnipeg Street Railway company has notified the Electric Railway company that it intends securing an injunction to prevent the latter company from paralleling its tracks on Main street. The electric company has the grading already finished to the exhibition grounds and is endeavoring to have that portion of the road completed for the exhibition. The company has given an order for cars to a Toronto firm, and will in the meantime use the power from one of the electric light stations, as it will not erect its own power house until the road is nearer completion.

The Citizens' Telephone & Electric company of Rat Portage has received a charter and elected officers. The officers are F. Gardner, president; H. Rideout, vice president; A. Carmichael, treasurer; and J. A. McCrossan, secretary and manager. Tenders have been received from several electrical houses and the contract will doubtless be let in a week or so. The company intends utilizing a water power which is within a half-mile from the center of the town. This power has a 17-foot head. It propose putting in a 1500 incandescent plant, a 50 arc light plant, and probably some generators for power circuits during the day.

PERSONAL.

Nelson W. Perry has resigned his position as editor of *Electricity*.

James F. Kelley, of the Edison General Electric company, New York, was in Chicago last week

W. T. M. Mottram, representative of the General Electric company at Dallas, Texas, was in Chicago last week.

Ralph W. Pope, New York, stopped in Chicago a few hours last Tuesday while returning from the Denver convention of railway telegraph superintendents.

C. Lee Abell, manager of the Thomson-Houston Electric Light & Power company, Buffalo, has been in Chicago during the last week attending the Democratic convention.

General Manager F. S. Minott, of the National India Rubber company of Bristol, R. I., was a visitor at the New York office of the WESTERN ELECTRICIAN last week.

C. J. Swift, secretary and general manager of the Duplex Electric Manufacturing company, Corry, Pa., arrived in Chicago on Monday last and remained during the Democratic convention.

Charles M. Howell of Bessemer, Mich., president of the Illinois Electric Lamp company, 173 South Canal street, Chicago, has been in the city for some days during the last week.

The *Sentinel* of Fort Wayne, Ind., says: "A report has reached this city that our fellow townsman, J. J. Woods, of the electric light Works, was robbed at Minneapolis of $1,000 in jewelry and $2,000 in cash."

Maurice E. Bates, formerly manager of the Western Electric Construction company of Kansas City, is now superintendent of construction of the National Electric Manufacturing company of Eau Claire, Wis. Mr. Bates was in Chicago on Saturday.

E. V. Cavell, general manager of the *Street Railway News*, New York city, died at Nassau, N. P., June 7th. Mr. Cavell had been in Nassau for his health several months. He was an Englishman by birth, 34 years of age, and leaves a wife and one child. Mr. Cavell at one time was editor of the *Street Railway Gazette*, Chicago.

NEW INCORPORATIONS.

Cadiz Electric Light & Power company, Cadiz, O.; capital stock, $15.000; furnishing electricity for illuminating and mechanical purposes; Milton Taggart, Cadiz, O.

Amethyst Electric Light & Power company, Creede, Colo.; capital stock, $200,000; to erect an electric plant in the town of Creede for light and street car service, etc.

Village Electric Light company, Greenbush, N. Y.; capital stock, $25,000; to manufacture electricity for light, heat and power in the villages of Greenbush and Bath.

The Electric Railway & Power company, Tiffin, O.; capital stock, $50,000; constructing and operating electric street railway, furnishing power, etc.; J. M. Naylor, Tiffin, O.

New York Electric Equipment company, New York City, N. Y.; capital stock, $200,000; to manufacture and sell electric apparatus for the production of power and

illumination and to equip plants for producing light, heat and power.

Passaic & Newark Electric Railway company, Passaic, N. J.; capital stock, $100,000; to operate a street railway for the transportation of passengers, etc.; B. W. Spencer, Passaic, N. J.

Neenah & Menasha Electric Railway company, Menasha, Wis.; capital stock, $150,000; building and equiping street railways; Neenah & Menasha Electric Railway company, Menasha, Wis.

MacLaughlin Motor company, Chicago, Ill.; capital stock, $1,000,000; to manufacture, promote and operate motors and cars and deal in patents; Orlando Briggs, 1048 Unity building, Chicago, Ill.

Bayard Building, Loan & Improvement company, Bayard, W. Va.; capital stock, $25,000; erecting and operating hotels and operating electric light plant and water works at Bayard, W. Va., and elsewhere; R. Workman, Bayard, W. Va.

K. & W. Electric company, Bridgeport, Conn.; capital stock, $10,000; to buy, sell and manufacture all kinds of electrical appliances; to own and use inventions secured by patents pertaining to such appliances, etc.; Seymour & Knapp, Bridgeport, Conn.

ELECTRIC LIGHTING.

The electric light station at Rockport, Ind., was recently destroyed by fire.

A municipal electric lighting plant is to be established at Wyandotte, Mich.

It is rumored that the two electric light companies at Trenton, N. J., may be consolidated.

By a vote of 232 to 84 the electors of Sharpsburg, Pa., have decided that the borough shall be lighted by electricity. The plant will cost about $15,000.

The city council of Lansing, Mich., is considering a proposition to purchase an electric light plant and to do commercial as well as municipal lighting.

A long tunnel near Paris has been lighted in a novel way. Reflectors throw the light from many electric lamps sixteen feet above the rails to the side of the tunnel, where it is again reflected by burnished tin, covered with glass, into the coaches, making a soft and agreeable light. The trains automatically turn the current on and off in entering and leaving the tunnel.

The Galena, Kan., Light & Power company has been granted a franchise for the installation of an electric light plant. The company will put in both arc and incandescent lights. The contract with the city of Galena calls for the completion of the plant in ninety days to furnish street lights. John W. Brewer of Pittsburg, Kan., is president of the company, and J. A. Bendure, also of Pittsburg, will superintend the construction of the plant.

"The electric lights, so far as they go, are all that could be asked for," says the Avon, Ill., *Review*. "But the board of trustees has made a mistake by contracting for only a 10 o'clock run. This is too early for the summer months, especially. The board should arrange at once with the company to continue the lights later—at least until after the night trains pass. This would necessitate only an hour's longer run, and would be much more satisfactory all around. A midnight run would be better still."

Rudolph Kleybolte, of Cincinnati, has completed negotiations for the electric lighting reorganization in Louisville. The plan is to recapitalize and improve the Electric Light & Power company. The present capital is $135,700 divided into 1,357 shares. The capital of the new concern will be placed at $500,000 and divided between gold 6 per cent. 30 year bonds and preferred 7 per cent. cumulative stock. This latter will go to the present holders in return for their old certificates. Some of the oldest and most substantial citizens of Louisville are deeply interested in the success of the enterprise, and there is every chance for future enlargement.

In Jamestown, N. D., the arrangement in relation to the arc lights used on the streets will expire on June 24th. The town has been paying $95 per month for each light, but now the company demands $150. This the town authorities consider too high, and the contract will terminate at the time mentioned. The village council has directed the village attorney to notify the electric light company that on and after July 15th the village demands $75 per month indemnity from the company for the privilege of maintaining its poles, wires, etc., on the streets, and that if the company refuses to pay such indemnity, it shall be compelled to forthwith remove all of the poles and wires now in use.

It is reported that all the lighting interests of Kansas City will be consolidated under the name of the Kansas City Gas and Electric Light company, with George H. Nettleton, J. S. Chick, E. H. Allen, S. B. Armour, M. J. Payne, E. R. Weeks, E. L. Martin, George Kumpf, Randal Morgan and S. T. Bodine as incorporators. It is said that the object of the organization is to acquire the properties of the Kansas City Gaslight and Coke company, Kansas City Electric Light company, the Edison Electric Light and Power company and the American Electric Light company, and bring them in under one management. It is believed that by this plan the lighting arrangements of the city can be managed with more economy, and that such saving of expenses in its management may be had as will enable the new company to compensate the city by a percentage on its gross business for a franchise.

A call has been issued for a meeting of the electric light owners of Alabama, to be held in Birmingham on June 28th, for the purpose of organizing a state electric light association. The call is signed by the Consolidated Electric company of Birmingham, the Queen City Electric Light company of Gadsden and the Tuscaloosa Electric Light company. The signers state that "the late rulings of the Southeastern Tariff association, the exorbitant prices of material and supplies purchased, and many other things too numerous to mention, seem to demand our attention. When we are properly organized we can be heard and recognized, and without organization we are powerless. These things can all be discussed at our meeting, together with the cost, and the best modes and machinery for manufacturing electricity."

TELEPHONE.

A metallic circuit telephone line is to be rebuilt between St. Paul and Stillwater, Minn.

Some of the new poles that the Hudson River Telephone company is erecting in Albany, N. Y., are over 80 feet high.

The central division office of the American Telegraph & Telephone company, situated near the East Onondaga Valley postoffice, N. Y., was burned on June 4th. All the telephones and telegraphic instruments were lost, except one switch-board and some testing instruments. The house was completely destroyed. It was owned by the American Telegraph & Telephone company, and was valued at $1,500

ELECTRIC RAILWAYS.

In a short time the electric car service between St. Paul and White Bear, Minn., will be completed. The cars on this line will run as fast as the ordinary passenger train.

The Edison General Electric company has brought suit against the Port Townsend Belt Railway company to recover an alleged debt of $51,174.18. The plaintiff claims that this amount is due on a contract for constructing an electric railway station with car and line equipment. Only $4,000 of the cost has been paid and the suit is brought for the balance.

The Farmington & Doe Run Railway company, Farmington, Mo., is preparing to build and operate between De Lessus station, on the Belmont branch of the Iron Mountain railway, and the town of Farmington, a standard gauge electric road for freight and passenger service. The line will be 4⅜ miles long, laid with 52 pound rails. The power station will be about equi-distant from the terminals, and, in addition to operating the road, will light the city of Farmington and shelter an ice factory.

MISCELLANEOUS.

The graduating class at Cornell this year included 43 electrical engineers.

The electric wires in Pittsburg are to be buried within four years, at the rate of 25 per cent. each year. The agreement goes into effect August 1st.

A dentist of Portland, Me., who has been making some experiments with a sparrow, advocates the use of aromatic spirits of ammonia in case of electric shock.

L. C. Gilbert and other capitalists of Exeter, Neb., have organized a company to run a line of boats from the depots to the race track. A trolley wire will be put up and the boats will be propelled by electricity.

The Electrical Digest Publishing company is the name of a new concern organized in New York with Ralph W. Pope as manager, for the purpose of publishing an illustrated monthly entitled *The Digest of Electrical Patents*." This little publication will give a synopsis of each patent. No advertisements, editorials, or comments will be published and entire dependence is placed upon the subscription list for expenses. Without doubt the *Digest* will find a place in almost every electrical man's library.

An interesting account of the completion and successful operation of a great government work in Japan has just been received. Lake Biwa, having an area of 500 square miles, is located seven miles from the city of Kioto and at an elevation of 143 feet. A navigable canal has been cut from this lake to Kioto involving two miles of tunneling and an aqueduct of considerable length. At the eastern extremity of the city, to which point the canal has been brought, there is a sharp decline of 118 feet, from the base of which the canal is continued to the sea. This difference in level is overcome by inclined plane ways 2100 feet in length on which boats are raised and lowered from one canal to the other. These ways are operated by electric power furnished from a Pelton water wheel connected with a Sprague motor. The fall also affords a very valuable water power, a part of which has already been utilized for various mechanical purposes by means of electric transmission. The power station is located at the foot of the incline and consists of three 8-foot and two 6-foot Pelton wheels aggregating about 600 horse power which are supplied with water from the high level canal by three lines of 36-inch pipe 1300 feet in length, delivering water to the wheels under a head of about 100 feet. These wheels are at present operating three Edison dynamos of 80 kilowatts each, the power from which is distributed about the city within a radius of two miles, running rice mills, spinning mills, a watch factory and various other machinery. One Thomson-Houston alternating current dynamo of 2000 volts supplies the city with 1300 incandescent lights as well as many arc lights. These works involving an expenditure of $1,500,000, were planned by and executed under the direct supervision of S. Tenabe, an eminent Japanese engineer, and their operation is said to be a great success both from a mechanical and financial point of view.

TELEGRAPH.

The report of the Western Union Telegraph company for the quarter ending June 30th, partly estimated, shows a surplus of $429,651, after the payment of the dividend, as against $179,702 one year ago and $429,462 two years ago. The report for the year ending June 30th will show a surplus of about $2,000,000, as against $1,364,758 for 1891 and $1,408,978 for 1890.

TRADE NEWS.

The "Acorn" lamp is a specialty of the Sunbeam Incandescent Lamp company, Chicago.

The Eastern Electric Supply company of Boston has moved into new quarters at 77 Franklin street.

The Mather Electric company, Boston, is now at work upon the dynamos which are to be placed in the Columbian exhibition.

The Bernstein Electric company, Boston, is running on an average of 15 hours per day to meet the demand for fan motors.

The Electric Gas Lighting company of Boston recently received an order for 2,500 cells for immediate shipment to a point on the Pacific coast.

Gould & Watson, Boston, general selling agents for the Whitney volt and ampere meters, report that this branch of their business is booming.

Whitmore & Robinson of Boston have recently completed a "dimmer" for electric lights, to be used in theatres and other places of amusement. This device is attracting considerable attention.

The Redding Electric company of Boston has been very much gratified by a rapid increase in the demand for its watchman's register, eighteen orders having been received last week, three of which were from Mexico.

The WESTERN ELECTRICIAN has recently published a complete catalogue giving the name and chapter heading of every book on electricity published to date, which will be sent free on application. Address, WESTERN ELECTRICIAN, 6 Lakeside Building, Chicago.

The American Circular Loom company of Boston is about to add several thousand dollars' worth of machinery to its already large plant. The success of this firm in taking up several branches of the wire business argues well for the production of first-class goods.

G. H. Poor, general manager of the W. S. Hill company of Boston, reports a good demand for the company's new cut-out switch for use on high potential circuits; also for the single and double throw station switch. The company's new revised catalogue is now ready.

The handsome catalogue of the Jones & Lamson Machine company of Springfield, Vt., from the press of Bartlett & Co., New York, has been received. This little pamphlet is of very unique design, having an embossed cover, upon which there is shown a large planer in all its detail. This catalogue is undoubtedly one of the finest in the line of embossed work.

F. J. Cram, general agent of the Electric Engineering & Supply company, has closed a contract for a 750 light municipal plant at Orange City, Ia., the apparatus to be of the type made by the National Electric Manufacturing company, Eau Claire. The National company has received several other fine orders so far this month, and business is reported as unusually good for this season of the year.

General Manager E. R. Rand of the Newton Rubber company, Boston, reports the general outlook for business in the storage battery line as being better than at any time since the company started to manufacture cells. This concern has made a specialty of rubber cells for storage batteries, and having carefully looked into the wants of the trade, is recognized as one of the authorities on this subject.

J. L. Bunce of the Perkins Electric Switch Manufacturing company of Hartford, Conn., in conversation with a representative of the WESTERN ELECTRICIAN during a brief stop in New York on his recent southern and western tour, stated that the company was now very busy manufacturing switches and dovetail ceiling rosettes. Mr. Bunce expects to visit before he returns Philadelphia, Baltimore, Pittsburg, Cincinnati and Chicago.

The Evans Friction Cone company, of Boston, Mass., is sending out its catalogue for 1892. Among the illustrations which the book contains are several showing how and where its friction cone can be advantageously used. The catalogue also includes a number of testimonial letters and a very long list of prominent manufacturing machinists who have these cones in successful operation. The device is very simple. It may be mentioned one of the Evans fric-

tion cones is in use and doing excellent service at the works of William Sellers & Co., Philadelphia. This firm uses the friction gearing in machine testing where a great variety of speeds is required and charges must be made quickly. The Evans company has recently received, too, the contracts for placing its apparatus in the Vanderbilt and Jackson buildings, New York.

The Waddell-Entz Electric company of New York will hereafter be known as the Waddell-Entz company The headquarters of this concern are in the *Mail and Express* building, 203 Broadway, having recently been moved from the old quarters in the Produce Exchange building. This company has made an increase in its manufacturing facilities in order to meet the increasing demands for its well known apparatus, which is in use very extensively both in the South and West.

The Electric Heat & Alarm company, Boston, has just received a very flattering testimonial in favor of its heat alarm service from Secretary C. N. Goddard of the New England Insurance exchange. Mr. Goddard pronounces this alarm the best thing of its kind that has ever been offered, and he recommends the use of this system where rapid machinery is in operation. The Alarm company, in response to a number of requests, is about to establish agencies through the South and West.

The Germania Electric company, Boston, is to be congratulated upon securing the services of F. A. C. Perrine, formerly in charge of the wire department of the John Roebling's Sons' company. Mr. Perrine has already demonstrated his fitness for the new position by making a number of changes which have been very beneficial to this concern. The Germania company is now occupying the new works at Marlborough. At a recent meeting L. Schlegelmilch was elected president and Mr. Perrine was made treasurer of the company.

A circular has just been issued from the office of the Sioux City Engine Works announcing the appointment of W. I. Brock as a special agent, with headquarters at 513 Security building, St. Louis. Owing to the rapidly increasing demand for the Corliss engine made by this company, the opening of a salesroom for the southern territory has become a necessity. These engines have been redesigned, and are now made in sizes from 75 to 1,500 horse power, either simple, compound, or compound condensing and are especially adapted to the heavy duty of electric light and power service.

The Eastern Electric Cable company, Boston, reports that it is now in a position to meet the rapid growth of its business, which has very nearly trebled during the past year, and that it has added vlay largely to the capacity of the works by the installation of new machinery and the erection of two large buildings President Henry A. Clark, who is very well known to the electrical fraternity, has been connected with this company nearly eight years, and has given his entire time to the development of the concern. From a building 23x50 feet the works now cover 32 000 feet of land, and the company manufactures almost every kind of wire and cable for electrical purposes.

The immense new pulp and paper plant of the Cliff Paper company at Niagara Falls is to be supplied with late new designs of the horizontal shaft double discharge James Leffel wheels, built by James Leffel & Co, Springfield, O. Each of these turbines is to be 1,100 horse power capacity. They will connect directly to the ends of the pulp grinder shafts, at each end of the wheel shafts, without belts or gearing. This water wheel company has celebrated its thirtieth year of continuous business in this line of work. It has added many improvements to the James Leffel wheel in the past two years, and has designed a large number of new styles, incorporating in them the best ideas of its large experience. The manufacturing plant of this company has also been recently greatly extended, and various pieces of new, improved and heavy machinery added, all adapted to heavy water wheel work that it is now manufacturing. One wheel was shipped a short time since weighing forty-five tons. Another order of nineteen large James Leffel wheels for one company was also shipped recently.

BUSINESS.

The Elektron Manufacturing company of Springfield, Mass., has recently installed a new trolley for moving about heavy apparatus in the erecting shop. The company has also recently placed a motor in connection with a stone sawing machine. This application of electrical power, it believes, is the first in this industry.

The Massachusetts Electrical Engineering company, Boston (Stone & Webster), which has hitherto operated more extensively in the East and South, has decided to enter the western field and has appointed Philip Harvey, Chicago, as western representative. The company has established a temporary office at 201 First National Bank building, Chicago.

The Shawmut Fuse Wire company of Boston recently absorbed the business of the Massachusetts Electrical Engineering company, and Manager Russell Robb has already begun demonstrations that reveal that his experience in this particular line of business makes him eminently suitable for this position. The company is even now considering the advisability of adding new machinery.

Some manufacturers of incandescent lamps for railway service make a lamp in which vibration of the filament is prevented by means of stops set in the globe. Another way to check vibration is that employed by the Sunbeam Incandescent Lamp company, Chicago. In the special "Railway Sunbeam" there is no anchored filament; toughness and strength in the carbon are the essentials relied upon, and from a recent conversation with Secretary A. S. Terry, of the Sunbeam company, this feature in the construction of the lamp is meeting the approval of railway men, as evidenced in the number of orders received.

Desiring to be in closer communication with the electrical trade G. Siebert, of Hanau, Germany, has established an office at 171 and 173 Greene street, New York. It is said that Mr. Siebert is one of the largest producers of platinum in the world, his factory having a capacity of 75,000 pounds yearly. This concern takes its products directly from the ore with the aid of special machinery. The metal is run out in sheets of from one pound to any desired weight, and the platinum is made either soft or to any degree of hardness that may be desired. New machinery for wire drawing has been introduced into the factory and wire is now turned out in gauge from one-thousandth of an inch upward. Manufacturers of incandescent lamps who are desirous of purchasing platinum which will meet their requirements should communicate with this firm.

An interesting article appeared in the *Electric Spark* for May, describing the great Morman Temple nearing completion at Salt Lake City. Describing the electrical work in this costly building the article says: "The Temple is wired throughout with Habirshaw insulation, considerable of the celebrated land core being used for mains. Mr. Holding, in selecting his wire for this building, unhesitatingly sought the best; and after much consideration decided that the Habirshaw insulation only would perfectly fill the required conditions. The building will be handsomely and perfectly lighted, the sunbeam incandescent lamps being used throughout. The illumination in the large assembly room is done entirely from the ceiling, which will produce a very pleasing effect, the lamps being carried around the outer edge of the ceiling eight inches apart for the entire distance. At a space of every three feet there is a longer pendant where a higher candle power lamp is used. In the center there is an enormous electrolier, which will be one vast glowing mass of incandescent light. All of the smaller rooms and offices will be appropriately lighted, the power being obtained from a station about 100 feet from the Temple. Sufficient generating capacity will be placed in the station to also light the tabernacle and assembly hall, both of which are in the same grounds as the Temple."

ELECTRICAL STOCK MARKET.

(Quotations furnished by Perry & Noyes, Edison building, New York.)

The closing quotations of electrical stocks on Saturday, June 18th, in New York, were:

	Bid.	Asked.
Edison General Electric company, Capital $15,000,000	108½	109½
Edison Illuminating company of New York	87	88
" " " Brooklyn	85	90
" " " Boston	115	120
" " " Chicago	135	145
Edison Ore Milling company	15	20
United States Illuminating company of New York	30	40
Brush Electric company of Cleveland	30	40
Brush Illuminating company of New York	30	40
Thomson-Houston Electric company	65½	66
" " " Preferred	29½	30
North American Phonograph company	4	6
New York " "	2¼	5
Automatic Exhibition company	3	5
Westinghouse company Common	29	30
" " Preferred	46	47

ELECTRICAL PATENTS.

Issued June 14, 1892.

476,776. Electric Railway. Richard W. Barkley, Brooklyn, N. Y.

476,781. Electric Switch. Francis Broadnax, New York, N. Y.

476,792. Electric Switch. William M. Goodridge, Highland Park.

An electric switch for telephone exchanges is arranged to loop the operator's telephone into one circuit and then into another without leaving the first circuit open.

476,793. Metallic Circuit House Telephone System. William M Goodridge, Highland Park, Ill.

476,813. Porcelain Insulator. James Pass and Albert P. Seymour, Syracuse, N. Y.

476,816. Electric Converter. Gustav Pfannkuche, Exeter, N. H., and Alfred Pfannkuche, Cleveland, O.

476,818. Magnetic Inductor for Dynamo Electric Machines. Lazarus S. M. Pyke and Edward S. Harris, London, Eng.

476,819. Field Magnet for Dynamo Electric Machines. Lazarus S. M. Pyke and Edward S. Harris, London, Eng.

476 826. Telephone Exchange Apparatus. John A, Seely, Brooklyn, N. Y.

476,827. Wire-Cleat. Albert P. Seymour, Syracuse, N. Y.

476,828. Circuit Breaking Insulator. Albert P. Seymour. Syracuse, N. Y.

476,829. Electric Switch. Albert P. Seymour, Syracuse, N. Y.

476,830. Compensating Alternating Current Dynamo. Oliver B. Schallenberger, Rochester, Pa.

476,843. Current Alternator. Harry L. Tyler, Corning, N. Y.

476,845. Limiting Stop for Armatures. Richard Varley, Jr., Englewood, N. J.

476,855. Lightning Arrester. Alexander Wurts, Pittsburg, Pa.

A bare conductor, connected in series with the circuit, is embedded in a well grounded conducting medium.

476,873. Electric Train Signal. Nathaniel B. Cregier, Chicago, Ill.

476,887. Telephone System. Belizaire Marinovitch and Geza Szarvady, Paris, France.

476,889. Pole for Electric Wires Julius Meyer, New York, N. Y., and Carl Binder, Chicago, Ill.

476,914. Process of and Apparatus for the Extraction of Aluminium. Myrthil Bernard and Ernest Bernard, Paris, France.

476,933. Spark Arrester for Electric Lamps. Walter M. Spencer, Chicago, Ill.

476,935. Electric Railway. Charles P. Tatro, Spokane, Wash.

476,964. Insulating Tube for Electric Conductor. Albert P. Seymour, Syracuse, N. Y.

476,970. Junction Box. Craig R. Arnold, Sharon Hill, Pa.

476,983. Pyromagnetic Generator. Thomas A. Edison, Llewellyn Park, N. J.

In this device magnetized iron is surrounded by electrical conductors and means are provided for increasing and decreasing the heat of the iron whereby the magnetism of the same is alternately decreased and increased to induce electric currents in the conductors surrounding the iron.

476,985. Trolley for Electric Railways. Thomas A. Edison, Llewellyn Park, N. J.

476,986. Means for Propelling Electric Cars. Thomas A. Edison, Llewellyn Park, N. J.

The motor is supported directly from the car axles in such manner that the axles may move slightly relative to the motor.

476,987. Electric Locomotive. Thomas A. Edison, Llewellyn Park, N. J.

476,988. Lightning Arrester. Thomas A. Edison, Llewellyn Park, N. J.

A device in the form of a condenser is employed as a lightning arrester.

476,989 Conductor for Electric Railways. Thomas A. Edison, Llewellyn Park, N. J.

476,990. Electric Meter. Thomas A. Edison, Llewellyn Park, N. J.

476 991. Method and Apparatus for Separating Ores. Thomas A. Edison, Llewellyn Park, N. J.

An electrified plate is placed over the end of a belt carrying the pulverized ores to attract the lighter particles against the force of gravity into a receptacle.

476,992. Incandescent Electric Lamp. Thomas A. Edison, Llewellyn Park, N. J.

A central wire carries current to the end of the loop where the current divides and passes through the two halves of the filament in multiple.

476,993. Electric Arc Lamp. Thomas A. Edison, Llewellyn Park, N. J.

The invention embodies apparatus for moving the carbons gradually and a retarding device.

477,049. Electric Clock Synchronizer. James W. Du Laney and Charles F. Du Laney, Canton, Ohio.

477,068. Fire Alarm System. Lewis G. Rowand, Camden, N. J.

477,069. Fire Alarm System. Lewis G. Rowand, Camden, N. J.

477,070. Fire Alarm System. Lewis G. Rowand, Camden, N. J.

477,071. Annunciator. Lewis G. Rowand, Camden, N. J.

477,091. House Door Letter Box. Frederick H. Walker, Philadelphia, Pa.

477,100. Electric Elevator. John H. Clark, Boston, Mass.

The electric motor and the pump operated by it are rendered inoperative when the volume of fluid in the tank has reached a predetermined point and maintained so until the volume of the fluid in the tank is reduced by actual use of the elevator.

477,101. Electric Welding. Charles L. Coffin, Detroit, Mich.

The passage of the current through the material in any other path than that of the proposed weld is prevented by subjecting any shorter path to magnetic influence.

477,121. Automatic Temperature Regulating System. Warren S Johnson, Milwaukee, Wis.

477,146. Electric Lamp Socket Switch. Gwynne E. Painter, Baltimore, Md.

477,175. Detachable Commutator. Charles H. Gaylord, Cleveland, Ohio.

477,182. Secondary Battery. Henry H. Lloyd, Philadelphia, Pa.

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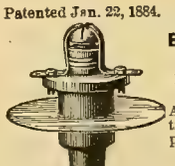

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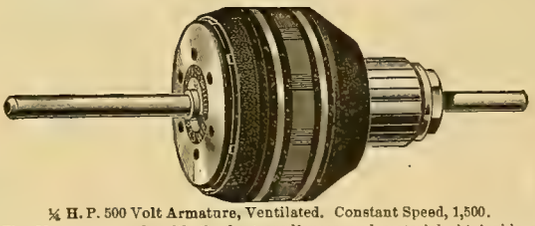

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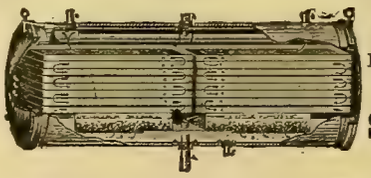

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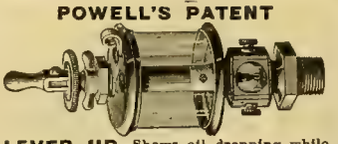

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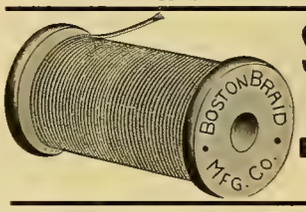

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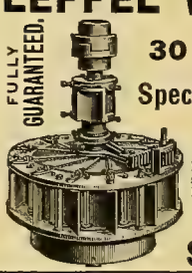

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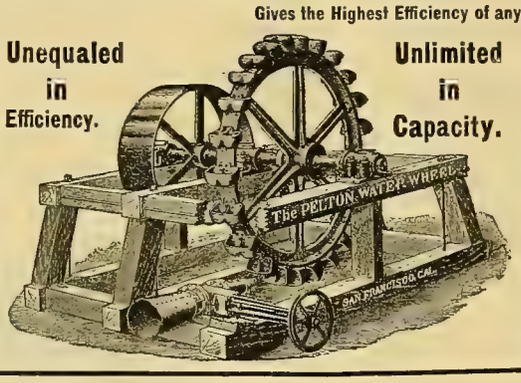

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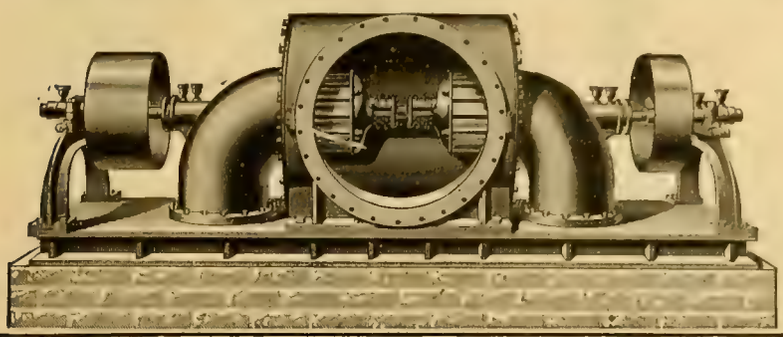

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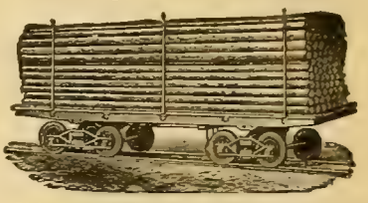

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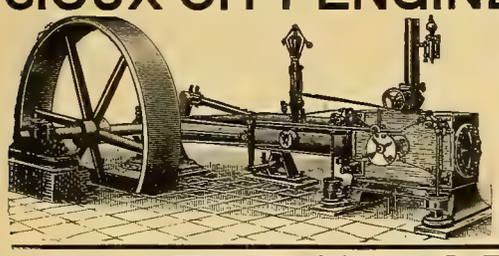

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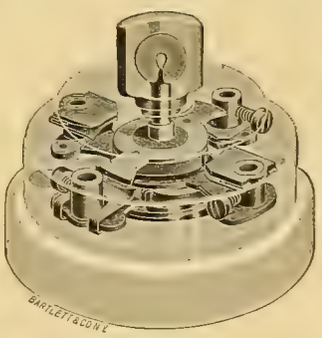

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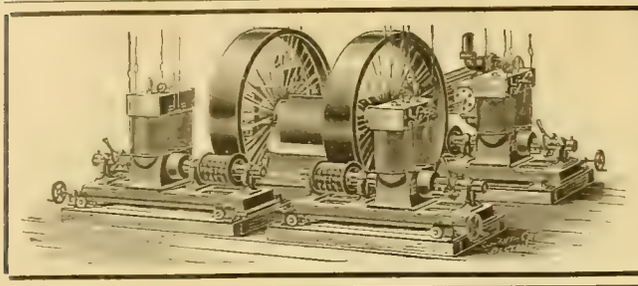

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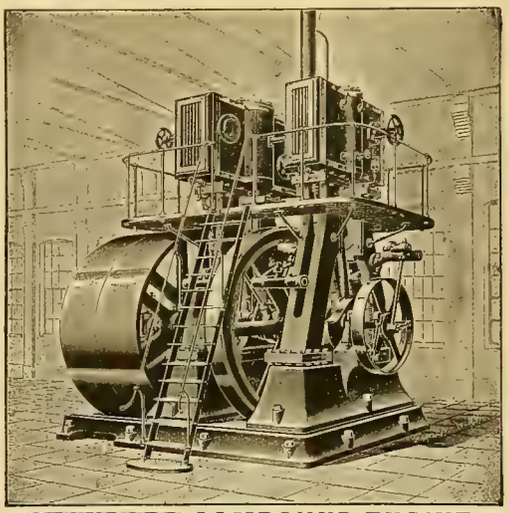

STANDARD COMPOUND ENGINE.

POWER AND ECONOMY TABLE FOR SIMPLE ENGINES—NON-CONDENSING.

Table No. 8.

Size of Engine	Diameter of Cylinder Inches	Stroke Inches	Revolutions per Minute	Horse-Power when cutting off at 1–5 Stroke			Horse-Power when cutting off at ¼ Stroke			Horse-Power when cutting off at ⅛ Stroke			Horse-Power at 1 lb. M.E.P.	Dimensions of Wheels				Steam Pipe	Exhaust Pipe	Floor Space over all				Height above floor line			
														Diam.		Face				At right angles with shaft		Lengthwise with shaft		Lower Line		Upper Line	
				70 lb.	80 lb.	90 lb.	70 lb.	80 lb.	90 lb.	70 lb.	80 lb.	90 lb.		Ft.	In.	Ft.	In.			Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
B	7½	10	370	20	25	30	26	31	36	32	37	43	.86	4	0		4	2½	3	4	0			6	4	5	3
C	8½	12	318	27	32	39	34	41	47	41	48	56	1.11	4	6		5	2¾	3½	4	6			7	7	6	3
D	10½	14	277	41	49	60	52	62	71	63	74	85	1.70	5	9		6½	3½	4	5	9			8	10	7	3
E	12	16	246	53	64	77	67	81	93	82	96	111	2.21	6	8		9	4	4½	6	8			10	2	8	4
F	13½	18	222	66	80	96	84	100	116	102	120	138	2.75	7	6		11	4	5	7	6			11	5	9	5
G	16	20	181	95	115	138	120	144	166	146	172	198	3.95	8	4	1	3	4½	6	8	4			12	8	10	4
H	18	24	158	119	144	173	151	181	208	183	215	248	4.95	10	0	1	7	5	7	10	0			15	2	12	4
I	22	28	138	179	216	261	227	272	313	276	324	373	7.45	11	8	2	4	6	8	11	8			17	9	14	6
K	24½	32	120	221	267	322	281	336	386	340	400	460	9.20	13	4	2	10	7	9	13	4			20	3	16	7
L	27	34	112	269	325	392	342	409	470	414	487	560	11.20	14	2	3	5	8	10	14	2			21	6	17	8
Mean Effective Pressure . Lbs.				24.	29.	35.	30.5	36.5	42.	37.	43.5	50.															
Ratios of Expansion				5			4			3																	
Terminal Pressure (about) . Lbs.				17.9	20.	22.3	22.4	25.	27.6	29.8	33 3	36.8															
Per Cent. Cylinder Condensation				26	26	26	24	24	24	21	21	21															
Steam per I. H. P. per hour, Lbs.				32.9	30.	27.4	31.2	29.0	27.9	32.	31.4	30.															
Lbs. Coal at 8 lb. Evaporation, Lbs.				4.11	3.74	3.42	3.9	3.62	3.49	4.00	3.92	3.75															

NOTE: The Nominal Power Ratings of the Engines is at 80 lb. Steam Cut-off at ¼ Stroke.

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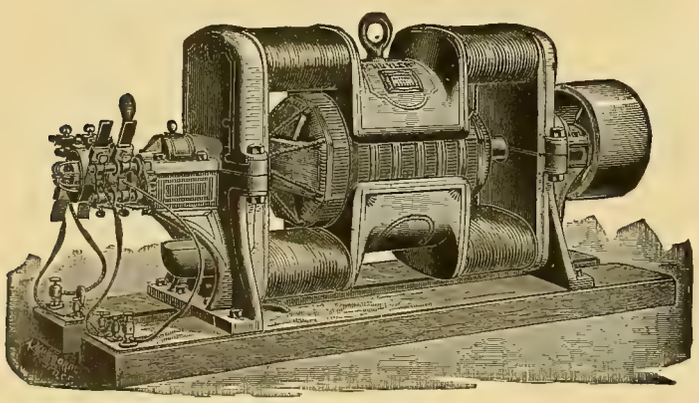

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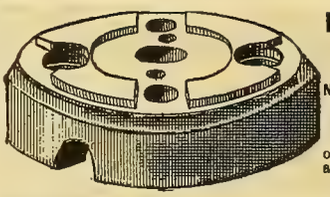

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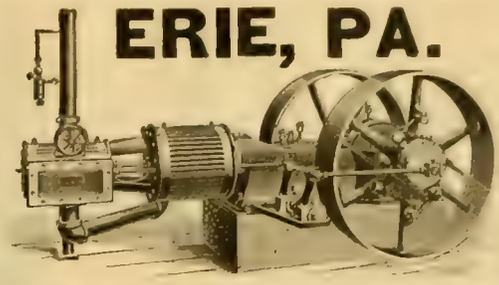

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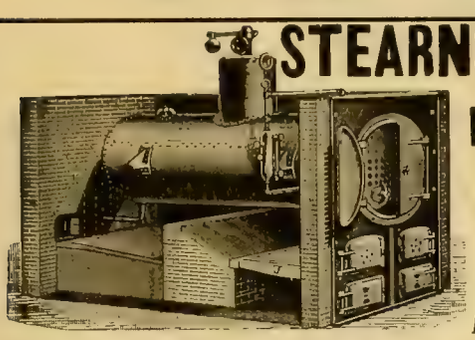

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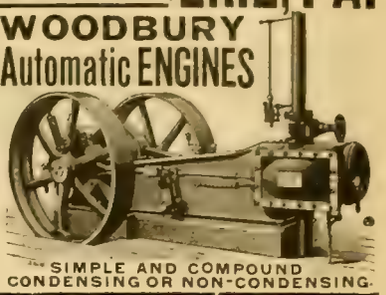

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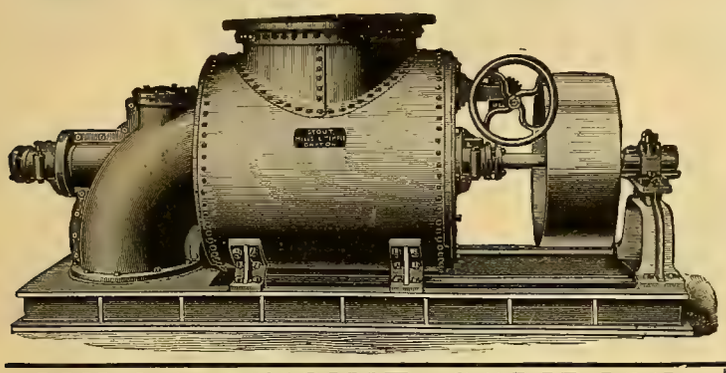

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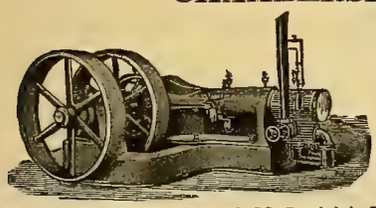

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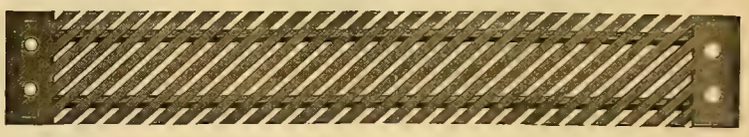

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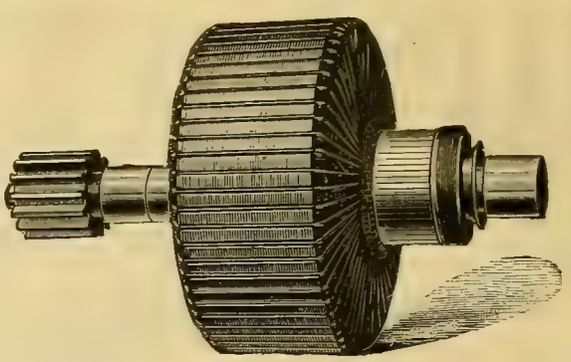

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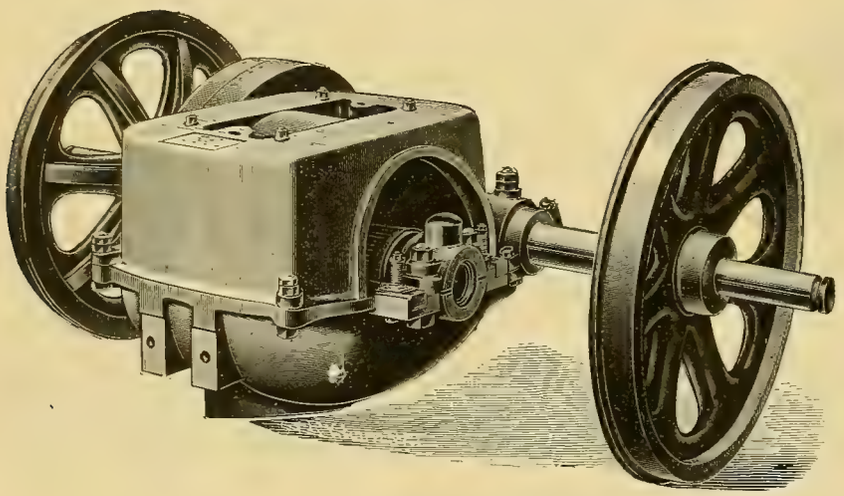

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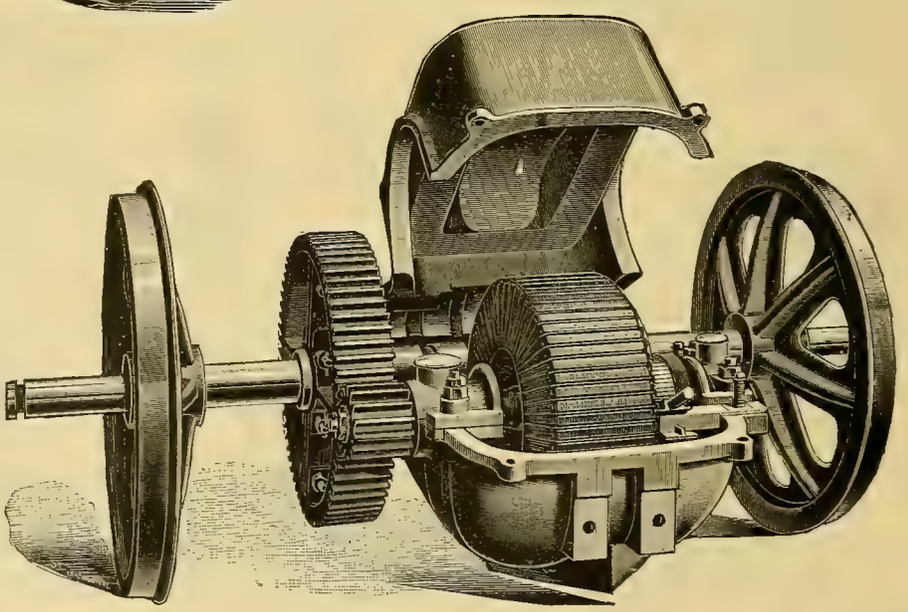

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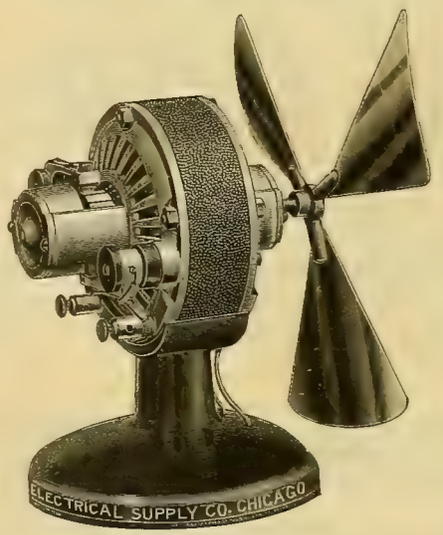

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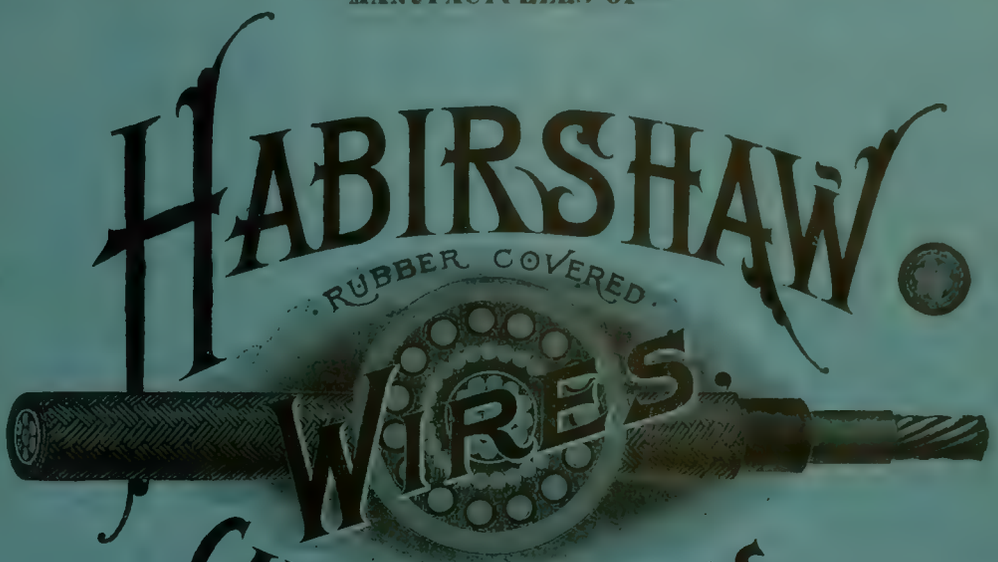

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